



THE FINNISH ASSOCIATION
OF FIRE OFFICERS

Arctic Fire and Rescue Network of Knowledge: Arctic operation environment and developing the services in the Arctic Region

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Fire Officers



Table of Contents

Introduction	3
ArcResc -project	4
Arctic Operation environment	6
Societies and infrastructure	8
Tourism	10
Climate change	11
Fire and Rescue Services in the Arctic Region	12
Special knowledge, skills, and equipment in the Arctic	12
Wildland Fire Management	13
Development of Arctic fire and rescue capacities	15
Arctic Fire and Rescue Network of Knowledge	16
Recommendations and further ideas	17

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Introduction

Welcome to read about the *Capacities of the Rescue Services in the Arctic: Advancement of Knowledge and Cooperation (ArcResc)* project, which explores the characteristics of the Arctic operational environment, fire and rescue services in the Arctic Region, and identified differences between the countries' services and operation models. The project has established an Arctic Fire and Rescue Network of Knowledge. In the last chapter, we discuss about the network.

This report is a summary of the information gathered from ArcResc project meetings and workshops with fire and rescue service specialists from different countries, enriched by information from public sources. Arctic countries share many similarities in their environments, but it is not homogeneous. The report describes general circumstances, but local variations exist.

The ArcResc project extends its gratitude to all stakeholders who have participated, promoted, and supported the project. You made it possible; thank you!

Abisko and Riksgränsen fire stations
 Akureyri Fire Department
 Alta Fire Department
 Arctic Council, EPPR
 Bear's Lodge
 Camp Ripan
 Canadian Association of Fire Chiefs
 CHC Rescue Helicopter
 City of Oulu
 Elovisual
 European Commission, DG ECHO
 Fire and Aviation BLM Alaska
 Government of Yukon Geological Survey
 Government of Yukon: Fire Marshal's Office
 Government of Yukon: Wildfire and Emergency Operations
 Greater Reykjavik Fire and Rescue Service
 Gällivare Rescue Service
 Haines Junction Fire Station
 Húsavík fire department
 Kesän sauna, Oulu
 Kiruna City
 Kiruna Rescue Service
 La Société des Immeubles Franco-yukonnais (SIFY)
 LKAB
 Luleå Rescue Service
 Lumel Studios
 Mack Brewery
 Norwegian Coast Guard
 Oulu Emergency Response Centre

Outokumpu
 Parks Canada, Kluane National Park
 Rescue Services of Kainuu
 Rescue Services of Lapland
 Rescue Services of North Ostrobothnia
 Rescue Services of South Karelia
 Rescue Services of South Savo
 Science Centre Arktikum
 Skagway Fire Department
 Skógarböð
 The Department of Civil Protection and Emergency Management of Iceland, Icelandic Police, Lögreglan
 The Finnish Border Guard
 The Finnish National Rescue Association, (SPEK)
 The Ministry for Foreign Affairs of Finland
 The Ministry of Interior of Finland
 The Norwegian Directorate for Civil Protection (DSB)
 The Norwegian Public Roads Administration
 The Swedish Civil Contingencies Agency (MSB)
 þeistareykjavirkjun geothermal station
 Troms Police District
 Tromsø Fire Department
 University of Helsinki
 Viking Rafting
 Whitehorse Fire Department
 YLE, Finnish Broadcasting Company
 Yukon First Nations Wildfire (YFNW)



ArcResc -project

The Finnish Association of Fire Officers has managed the *Capacities of the Rescue Services in the Arctic: Advancement of Knowledge and Cooperation (ArcResc)* project. The project has facilitated international cooperation and knowledge exchange in the field of fire and rescue services within the Arctic Region, covering Finland, Sweden, Norway, Iceland, Greenland, Canada, and Alaska. This two-year project has successfully established a network among operational-level Arctic fire and rescue service actors. Funding for the project has been provided by the Ministry for Foreign Affairs of Finland and supervised by the Ministry of the Interior of Finland.



Picture 1. ArcResc -logo.

It is anticipated that various forms of human activity will increase, and the impacts of climate change are challenging the Arctic Region at an accelerating pace, leading to more severe accidents in the area. During the project's planning, it was assumed that the fire and rescue services of Arctic countries face similar challenges in their duties due to similarities in operational environments. Typically, each country's services have developed their own models and working methods according to national standards. This provides a fruitful foundation for mutual learning and improving the performance of their services.

The project aimed to **promote international cooperation** in the field of rescue services in the Arctic Region, **enhance knowledge and the performance** of rescue operations, and **establish a continuous network** among Arctic rescue service actors.

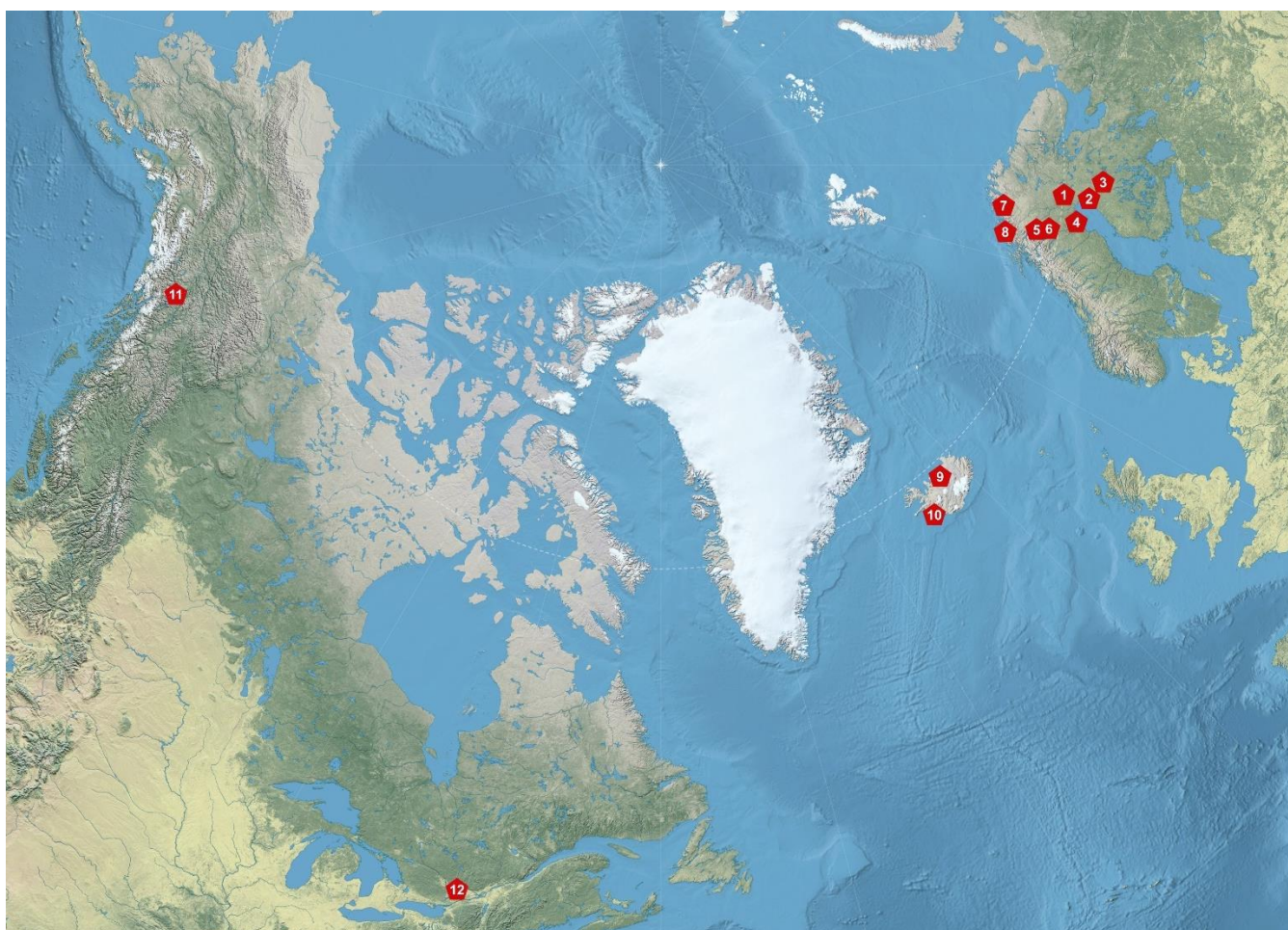
The project had seven themes that were:

- Arctic environment and disaster scenarios in the arctic
- Actors' operation models, capacities and equipment
- Climate change related issues
- Forest fires & wildfires
- Human rescue
- Indigenous people
- International and cross-border cooperation

Through active participation, an *Arctic Fire and Rescue Network of Knowledge (ArcResc Network)* was established. At present, it consists of **12 fire and rescue services from Finland, Sweden, Norway, Iceland, and Canada** (see Picture 2). The same organizations were the core actors during the project. More information about the network and its continuity is provided in the last chapter of this document.

In addition to the network, the ArcResc project collaborated with several organizations when arranging meetings, including researchers, local rescue services, police, national parks, rescue helicopters, etc. (see the full list in the Introduction).

No.	Service	Country	Location, (headquarter)
1	Rescue Services of Lapland	Finland	Lapland region, (Rovaniemi)
2	Rescue Services of North Ostrobothnia	Finland	North Ostrobothnia region, (Oulu)
3	Rescue Services of Kainuu	Finland	Kainuu region, (Kajaani)
4	Luleå Rescue Service	Sweden	Luleå
5	Kiruna Rescue Service	Sweden	Kiruna
6	Gällivare Rescue Service	Sweden	Gällivare
7	Alta Fire Department	Norway	Alta
8	Tromsø Fire Department	Norway	Tromsø
9	Akureyri Fire Department	Iceland	Akureyri
10	Greater Reykjavik Fire and Rescue Service	Iceland	Reykjavik capital district
11	Yukon Wildfire Management	Canada	Yukon territory, (Whitehorse)
12	Canadian Association of Fire Chiefs	Canada	Canada, (Ottawa)



Picture 2. The active participating organizations that form the network at present.



Arctic Operation environment

The Arctic Region is renowned for its nature, often characterized by cold temperatures, long and snowy winters, permafrost, and challenging geographical features. The **Arctic Region is not homogeneous**; conditions vary from coastal to continental and from subarctic to arctic climates. The Northern Hemisphere experiences distinct seasons due to the axial tilt of the Earth. The general characteristics of these seasons are as follows:

Spring

Months: March, April, May

Characteristics:

- Spring marks the transition from winter to summer.
- Daylight hours gradually increase.
- Temperatures begin to rise, and dormant plants start to bloom.
- Rainfall is common, contributing to the growth of new vegetation.
- Animals may go through reproductive cycles.

Summer

Months: June, July, August

Characteristics:

- Summer is characterized by longer days and shorter nights.
- It is the warmest season, with high temperatures and often clear skies.
- In some regions, summer can bring the risk of heatwaves and drought.
- Plant life is in full bloom, and many animals are active.

Autumn (Fall)

Months: September, October, November

Characteristics:

- Days become shorter, and temperatures gradually cool.
- Deciduous trees shed their leaves, creating vibrant autumn colours.
- Harvest season for many crops.
- Rainfall may continue, and storms are possible.
- Animals may prepare for hibernation or migration.

Winter

Months: December, January, February

Characteristics:

- Winter is the coldest season, with shorter days and longer nights.
- Temperatures drop, and many regions experience snowfall.
- In some areas, winter storms can bring heavy snowfall and icy conditions.
- Deciduous trees are bare, and many plants enter a dormant state.
- Some animals hibernate, while others adapt to the cold.

The **seasons can vary** based on geographic location, elevation, and local weather patterns. Changing seasons alter the operational environment, introducing conditions that may pose risks requiring preparation by people and fire and rescue services (see Chart 1).



Chart 1. Typical seasonal risks in the Arctic Region

Summer	Autumn	Winter	Spring
Wildfires	Storms	Slippery roads	Floods
Tasks on waters	Black ice on roads	Avalanches	Landslides
Landslides	Weak ice on waters	Snowstorms	House heating
Permafrost thaw	Darkness	Darkness	Avalanches
	Heating season starts	House heating	Ground frost thaw, collapsing infrastructure
		Low temperatures	
		Heavy snow load on infrastructures	

The Gulf Stream plays a significant role in shaping the climate of Scandinavian countries, creating a notable contrast in climate between Scandinavia and North American Arctic. In Scandinavia, the climate is milder, and winters are warmer compared to other regions at similar latitudes.

Additional climate phenomena that are periodic and have known impact to the Arctic climate conditions:

El Niño

- Warmer Temperatures in the Arctic: El Niño tends to influence the position and strength of the polar vortex, leading to a weakening of the wintertime polar jet stream. This can result in warmer-than-average temperatures in the Arctic during the winter.
- Reduced Sea Ice Formation: Warmer temperatures associated with El Niño can contribute to reduced sea ice formation in the Arctic, particularly during the winter months.
- Changes in Atmospheric Circulation: El Niño can alter atmospheric circulation patterns, potentially influencing weather systems and precipitation patterns in the Arctic.

La Niña

- Colder Temperatures in the Arctic: La Niña tends to strengthen the polar vortex and the wintertime polar jet stream. This can lead to colder-than-average temperatures in the Arctic during the winter.
- Enhanced Sea Ice Formation: The colder temperatures associated with La Niña may contribute to enhanced sea ice formation in the Arctic, particularly during the winter months.
- Changes in Atmospheric Circulation: La Niña can also influence atmospheric circulation patterns, potentially affecting weather systems and precipitation patterns in the Arctic.

North Atlantic Oscillation (NAO)

- Positive NAO: strengthening of the westerly winds, resulting in milder and wetter conditions in parts of the northern hemisphere. Above-average temperatures and increased precipitation in some regions.
- Positive NAO can influence the position of the jet stream and storm tracks, leading to an increased likelihood of storms and heavy rainfall in certain regions.
- Negative NAO: weakened westerly winds, contributing to colder and drier conditions in certain areas. This phase may lead to below-average temperatures and decreased precipitation, impacting winter weather patterns, snow cover, and water availability.
- Negative NAO may alter the path of storms and result in more persistent and amplified weather patterns. This can lead to prolonged periods of cold and dry conditions or increased chances of winter storms, impacting transportation, energy consumption, and emergency response systems.

Iceland is situated on the Mid-Atlantic Ridge, a divergent tectonic plate boundary where the North American and Eurasian tectonic plates are drifting apart. **Its position as a hotspot of volcanic and tectonic activity makes it a unique and dynamic environment.** Iceland experiences frequent volcanic activity, and its environment differs from that of other participating countries. The landscape is characterized by glaciers, geysers, hot springs, waterfalls, and lava fields. The presence of active volcanoes can pose challenges for societies, infrastructure, aviation, and emergency management. Additionally, being an island nation, Iceland faces challenges related to coastal erosion, storm surges, and rapidly changing weather conditions.

Societies and infrastructure

The Arctic environment significantly influences people's daily lives and fire and rescue services. Generally, the **Arctic Region is sparsely populated**, with long distances and no metropolitan cities. The largest cities in the project area have populations ranging from 17 000 to 200 000 (see Chart 2). The region features large rural and wilderness areas, small villages, and towns. Particularly in Canada and Alaska, some societies are isolated from the road network and depend on aerial connections. Economically, some towns heavily rely on one or two industry sectors, such as mining, logging, fishing, or tourism, and changes in these sectors may have a significant impact on the entire society. Depending on the location, societies in the northern hemisphere may be dependent on importing food and other goods.

While some cities, towns, and villages are growing in the northern part of the Arctic countries, most places are shrinking, services are disappearing, and the population is aging. The departure of young people weakens the social networks of older individuals who may need assistance. It is challenging to attract younger people to settle in these locations after schools close, and no other facilities or opportunities are available for families.

Most of the Arctic Region is the **land of indigenous peoples**. Indigenous people are the original inhabitants of the areas. These populations have distinct cultural, historical, and social identities that are often closely tied to the unique Arctic environment, along with specialized knowledge and skills related to this environment. In Northern Canada, the indigenous peoples' culture and presence are more noticeable than in Scandinavia. Additionally, the authorities are often recognizing the indigenous people when for example, giving a presentation.

In Arctic communities, **people adapt to harsh conditions**, and infrastructure is built to withstand these challenges. Many individuals work in terrain, sometimes in remote locations, equipped with appropriate clothing and knowledge of how to navigate Arctic conditions throughout changing seasons. Machinery and expertise are employed to keep roads and other services open in various conditions, and people are skilled at commuting on rough and icy roads using vehicles, bicycles, foot and skis. Houses are well-insulated with effective heating systems.

The **experience and knowledge of living in the north contribute to societal resilience** against emergencies and other exceptional situations. For example, many houses have fireplaces as secondary heat sources that work even if no electricity or gas is available. Rural inhabitants are accustomed to living without immediate access to city services and can endure days without shopping if necessary.

Societies and individuals are becoming increasingly dependent on technology, information, and energy. Technology permeates daily life through the development of ordinary goods. This dependence makes individuals and societies more vulnerable on many levels. For instance, relying on a smartphone as a

wallet can lead to trouble when the phone runs out of battery in cold conditions. Similarly, societies are dependent on energy transportation, information, and personnel flows. Disruptions in critical infrastructure not only compromise essential services but also pose significant challenges to critical lifesaving interventions. The Arctic conditions challenge technology that is often planned for milder conditions.

Chart 2. the biggest cities in the project area

City	Country	Population
Oulu	Finland	210 000
Reykjavik	Iceland	139 000
Luleå	Sweden	79 000
Tromsø	Norway	78 000
Rovaniemi	Finland	63 000
Kajaani	Finland	36 000
Fairbanks	Alaska	33 000
Whitehorse	Canada	28 000
Kiruna	Sweden	23 000
Alta	Norway	20 000
Yellowknife	Canada	20 000
Akureyri	Iceland	19 000
Gällivare	Sweden	17 000

Case: rental car

New rental cars may be operated through a mobile app, where the car doors unlock by swiping the phone's screen. For this, both the car and the phone require a mobile data network. If the car is driven out of the network coverage area, the user may encounter issues with the car.

Recently, a group of students found themselves locked outside the car in -20 Celsius conditions late in the evening, in a remote location beyond data coverage. Fortunately, they were able to call for help, but the waiting time was several hours.

In remote places, towns, and small cities, infrastructure is often less developed than in places with more people and economic activities. The **investment level is often low**, existing infrastructure may deteriorate, and new larger investments are rare. Building infrastructure is frequently dependent on state or commercial support, often driven by natural resource extraction requiring transport connections to markets or tourism requiring attractive surroundings and services.

It is customary for local people in the northern hemisphere to commute long distances between home, work, hobbies, family, and friends in all conditions. The majority of goods move on wheels, and there is a lot of heavy truck traffic on the roads. Many roads are not built for today's traffic intensity and heavy vehicles. Narrow and sometimes worn roads, along with a low level of road maintenance, increase the risk of accidents. Foreign drivers and those unaccustomed to the conditions may lack the skills to drive on icy roads, and vehicles may be equipped with inappropriate tires, leading to additional accidents.

Lower levels of infrastructure are less resistant to faults, as systems often depend on a single line, road, cable, or pipe, with no backup system. For example, if an electricity cable breaks, there is no alternative connection to deliver electricity to the village. In such cases, generators are necessary to back up electricity, and similar contingency plans are needed for roads and other means. Sometimes airway or boat access may be possible if roads are blocked.

Developing modern industry often involves complex systems, large industrial areas, and buildings with multiple hazards. High levels of automation mean fewer on-site workers. Industrial sites typically have their own preparedness against risks, but resources may be limited, and in the bigger emergency events, is usually required. Emerging green technologies bring new risks, such as H² and high-capacity batteries

in new applications. Complex industrial environments demand a high level of skills and knowledge, along with possible special equipment from fire and rescue services.

Building codes, like **fire safety regulations, are adapted for large cities** with decent fire service capacity and short fire service response times. It was discussed that in places with weaker fire service capacities, more sprinkler systems and escape routes without fire department assistance in buildings are needed. Enhancing cooperation with city authorities and fire departments when planning and granting permissions for new buildings was also mentioned as development idea.

Tourism

Tourism plays a significant role in the economy and livelihood of many Arctic locations. The booming tourist industry, new activity locations, nature-based tourism, extreme sports, adrenaline junkies, high seasonality, and fast-growing businesses cause stress for the fire and rescue services, among all other services that are not easily scalable in response to the impacts of the tourism industry. Safety planning, accident prevention, and **companies' self-preparedness play a more significant role in handling safety and rescue**. More discussion, systematic cooperation, and better information sharing between tourism stakeholders and fire and rescue services may be necessary. For example, authorities often lack information about the scale and type of the activities, companies' private trail locations, not to mention rescue routes to private activity places or other more developed preparedness.

Tourism is a labor-intensive industry, and seasonal workers often come from abroad or southern parts of the countries. Especially for newcomers, Arctic knowledge may not be on a high level, and their knowledge in preparedness, safety, and rescue is often rather limited. Employer training plays a significant role with new employees.

Guided tours are usually prepared for the needs of target groups, and companies are responsible for customer safety. In individual and self-guided tours, travellers have more responsibility on their own, and no guides are present to help in the new and sometimes challenging environment. In general, the readiness of tourists to handle emergency situations in unfamiliar environments differs greatly.

International tourists and employees may face language barriers with locals and authorities, impacting emergency situations. Additionally, multiculturalism may affect the work of authorities. For example, the threshold for calling emergency services when needed may be high, and trust in authorities may vary depending on people's backgrounds and experiences. Furthermore, knowledge about legislation, safety rules, and local norms may differ from what authorities are accustomed to. On the other hand, individuals unfamiliar with local fire and rescue resources may have **excessive expectations regarding the capacities of these services**, influencing their behaviour.

Local emergency actors have implemented several measures to reduce risks and strengthen their

Case: foreign guides

The snow conditions and avalanche problems differ in Scandinavia compared to the Alps. The same "rules of thumb" may not always apply in Scandinavian snow conditions, potentially leading to fatal planning mistakes for individuals unfamiliar with these conditions.

In the winter of 2012, a significant avalanche occurred involving a group of skiing tourists guided by a non-local guide. Unfortunately, five people lost their lives, and one sustained injuries. The mountain's name is Sorbmegaisa, with "Sorbm" being a Sami word that means accident.



capacities. For example, they have initiated customer safety projects, enhanced special rescue teams, and developed cooperation between rescue and emergency services and other stakeholders.

Climate change

The Northern Hemisphere is expected to warm more than the global average due to climate change. More unpredictable and extreme weather events are anticipated in the future, resulting in diverse and large-scale tasks for fire and rescue services. Emergency personnel already handle a wide variety of tasks, and preparing for all of them professionally with limited resources and time is challenging. Enhancing preparedness requires new training, techniques, tactics, and equipment. Many problems are hard to prevent due to the magnitude and slow development of infrastructure. Additionally, new green technology brings new risks.

Identified problems in the Arctic region are:

- More rain, rain in winter, freezing rain.
- More snow, unstable snow conditions, new avalanche locations.
- Floods, uncommon flooding times.
- Increased permafrost thaw.
- Landslides, rockslides, faster processes, new locations.
- More, longer and severe dry periods, low humidity.
- Stronger and more winds, storms.
- Sea level rise on coastal areas.

Climate change-related problems impact society and the environment at large. Addressing all impacts is challenging, and damage to infrastructure, such as roads, buildings, pipes, and cables, is expected. More severe wildfires, including far-traveling smoke with poor air quality and visibility, water shortages, and various issues for wildlife, are anticipated. The **Arctic region's infrastructure is planned for cold conditions**, and challenges arise when weather conditions become hot, especially in locations lacking air conditioning, such as hospitals and rest homes.

Climate change is altering seasons, with winter conditions becoming more unpredictable. Heavy snowstorms, unconventional precipitation, variable wind directions, and rapidly changing temperatures present challenges such as hoarfrost breaking electricity lines and avalanches in uncommon locations. Persistent high pressure can cause long periods of extremely cold and dry weather, while in summer, it leads to prolonged heatwaves.

Changing climate poses **risks for terrain users**, including rescue personnel. Traditional knowledge about ice conditions becomes uncertain, leading to potential misjudgements on lakes, rivers, and seas. Fatal accidents have occurred where authorities have gone through weak ice while on duty.

It is crucial to identify and prepare for future problems in advance to build societal resilience. The impacts are already present, and adapting is necessary. This includes **identifying vulnerabilities**, better community planning, integrating fire and rescue services into planning, new risk management plans, enhancing emergency services' knowledge, capacities, cooperation, and possibly developing special task forces against emerging large-scale threats. Efficient adaptation offers fire departments a chance to thrive in the future operational environment.



Fire and Rescue Services in the Arctic Region

The Arctic region faces **challenges in organizing fire and rescue services** due to a small population base, sparsely populated rural areas, and the large operation areas. Settlements are often spread far from services, and resources are limited, making it difficult to maintain preparedness for all types of accidents. **Preparedness is generally good for common daily accidents**, but for large and rarely occurring situations, it could be improved in some locations. Services such as water diving, urban search and rescue, and hazmat may not be available in all stations or fire departments.

In smaller communities, **services are often run by local volunteers or part-time personnel**. An aging population and urbanization result in fewer fit and skilled volunteers, especially in remote and small societies where volunteers play a crucial role. This challenge is common in the project area. In many Arctic countries, search and rescue operations are led by police and run by volunteer search and rescue non-governmental organizations. Sometimes, personnel work at both the fire department and volunteer in search and rescue services. In Finland, rescue departments lead human rescue on land, and police lead search missions on land.

Compared to southern parts of countries, **neighboring fire stations are often far**. Long distances mean that help may not be available or may take a long time to arrive in bigger and more complex emergencies. Accidents may take a relatively long time to be noticed in rural areas and small communities, leading to potentially more severe consequences. Lacking infrastructure, such as mobile phone network black spots and limited capacity, impacts services. The network's capacity may be exceeded during larger events, when many users, requiring alternative communication and data transfer methods.

While the Arctic operational environment has many similarities, services are primarily developed nationally and locally. Operational tactics, techniques, and methods show little variation, with more significant differences in study systems, fire trucks, equipment, leading and management authorities and systems, and wildfire management. Differences in culture, risk management, and risk acceptability were also noted. Alaska exhibited a more cowboy attitude, Yukon actively developed work safety away from cowboy, and Scandinavia had the smallest tolerance for risk.

Special knowledge, skills, and equipment in the Arctic

The Arctic operational environment imposes several requirements on fire and rescue personnel and equipment, particularly considering changing seasons and winter conditions. **Accidents often occur when conditions are challenging**, including low temperatures, slippery and snowy conditions, darkness, melting snowpack, ground frost thaw turning gravel roads to mud, and more. Success in harsh conditions requires understanding the current conditions' impact on equipment, tactics, and techniques, with personal experience and local and traditional knowledge playing a crucial role.

Part of the rescue personnel is newcomers or transient, lacking strong local knowledge. Deepening understanding of Arctic conditions, local terrain, and circumstances is crucial for all levels, from hands-on to management, when new people arrive. The environment is changing, and even experienced locals find **it challenging to keep track of changes in large areas**. The available information is not always up to date.

Fire and rescue personnel **need to master various skills**, including traditional technical skills and the use of technology like drones, navigation systems, and satellite phones. Navigation skills are crucial, especially when working far from cities. Weather conditions may change quickly, impacting visibility, driving conditions, clothing, etc.



Personnel must possess winter-related abilities such as winter driving skills with trucks, snowmobiles, and hydrocopters, knowledge of how to dress according to conditions and tasks, and an understanding of equipment operation in cold conditions. Other Arctic environment-related skills, depending on the location, include alpine, glacier, mountain, rope, and avalanche rescue.

Fire and rescue services follow the changing seasons. When the winter arrives, the basic seasonal changes and checks are:

- Boots and warm winter clothing, spare clothing.
- Heaters and windbags for victims.
- Heated catastrophe tents.
- Warm storage for sensitive gear.
- Summer tires to spike tires.
- Vehicles coolant.
- Seadoo to skidoo.
- Boat to hydrocopter.
- Flashlights and headtorches.
- Avalanche gear inspection.
- Annual trainings and lessons learned from the previous winters.
- Possibly check water hydrant signs before snow.

Winter conditions impact all tasks to some extent. In complex operations like water diving (sometimes under ice), USAR and CBRNE, the snowy season adds another level of difficulty due to slippery, cold, snowy, and dark conditions. The gear is challenging to use, preparing for operations becomes more difficult, and staying warm during tasks presents additional challenges. Equipment freezing can be a problem in some situations.

Wildland Fire Management

When comparing fire and rescue services across the Arctic Region, the most significant differences were found in wildland fire management. In Scandinavia, the primary responsibility for wildfire preparedness and suppression lies with the fire and rescue services, with actors being local or regional depending on the national system. In Alaska and Canada, the responsibility lies with state-level actors, such as Yukon Wildfire Management, dedicated and specialized in wildland fire management, preparedness, and response. North American city fire departments typically assist state services within their resources and other responsibilities.

Boreal forests dominate both North American and Scandinavian landscapes. In Alaska and Canada, forests are characterized by a mix of coniferous trees and extensive peatlands, while Scandinavian boreal forests include a mix of coniferous and deciduous trees and peatlands. Crown fires are more common in Alaska and Canada, while ground fires occur across the whole northern hemisphere, including smoldering peat fires on peatlands. **Where people are present, they are the primary source of wildfire ignition.** In wilderness areas with few people, such as vast rural areas of Alaska and northern Canada, lightning plays a more significant role as a wildfire ignition source.

In Canada and Alaska, the size, number, and intensity of wildfires are larger and higher compared to the fires Scandinavia is accustomed to. Differences in fuel and forest type, climate, wilderness area sizes,



terrain topography, and infrastructure explain most of these distinctions. A dense forest road network in Scandinavia enables easy access to most forest fires.

Wildfire research has more resources in North America compared to Scandinavia. Similarly, the experience with methods for preventing and combating wildfires is more versatile. Prescribed burning and backfires are common tools in Alaska and northern Canada. After several severe wildfire seasons, they have practical **experience in managing long-lasting large-scale operations, international assistance, and mass evacuations**. Scandinavian authorities may provide perspectives, knowledge, and skills that North American colleagues can benefit from in developing their operations.

Climate change is altering conditions for wildfires, with the forest fire season expected to lengthen, fires becoming more intensive, and control becoming more challenging. **Exceptional wildfire conditions may arise in places not prepared for severe forest fires**. Sharing knowledge among Arctic Countries' wildfire specialists can enhance all stakeholders' prevention and preparedness for future wildfire seasons.



Picture 2. Preventing the wildfires include information sharing to the people.



Development of Arctic fire and rescue capacities

In this section, we discuss the development of fire and rescue capacities in Arctic conditions from an operational level perspective, covering cooperation, personnel, and equipment. The comprehensive development is broader, including, for example, legislation and strategy-level development.

Fire and rescue services are **traditionally developed locally and nationally** to address local needs in accordance with national and state legislation. The focus has been on tackling fires and other daily tasks. Alongside societal development, new types of accidents have emerged, placing more emphasis on prevention, preparedness for various emergency situations, and overall higher planning requirements for services. This implies that fire departments need new capacities such as IT, analysis and information management, communication, specialist leadership, and project management. While developing modern services, it is crucial to retain simple and always-working "pen and paper" methods in the toolbox for times when technology fails and duties must be done.

Accident prevention provides great value to investments. Prevention not only has financial benefits but also **creates safer, more resilient communities, reduces injuries, enhances well-being, and minimizes environmental impact**. Developing a prevention culture and a robust accident prevention system to avoid large-scale and severe complicated accidents is important in the northern hemisphere, where a single actor has a relatively more significant role compared to large cities with diverse sources of livelihoods.

The labor market is highly competitive, with fire and rescue services reporting recruiting problems, especially in some smaller cities and towns. In many locations with no special attraction, it is challenging to find competent staff. Skilled professionals sometimes move to another location or leave the fire and rescue services, taking their skills and local knowledge with them. Maintaining the attractiveness of the fire and rescue service's branch, building a healthy working society and culture, developing careers and promoting equality and equity are crucial for strengthening services. Sweden plays a leading role in developing better working facilities and methods for firefighters. For example, the Healthy Fire Man Program, focusing on reducing firefighters' exposure to carcinogenic substances and other hazards has been successful. For more information, read about [Skellefteå model](#).

Preparedness involves extensive preplanning for identified risks. It was identified that more preplanning should be done, especially for rare and complicated tasks where fire departments may lack experience and specialization. In addition to preplanning, research, gaining understanding, and executing training are essential. For efficient resource usage, special teams and shared resources with well-coordinated cooperation could be a good solution. National or international support for developing capacities for special operations plays an important role. In recent years, fire and rescue services in Sweden and Finland have developed shared capacities with EU support. Lately, the discussion of preparedness for war and other conflict times has risen in fire and rescue services, emphasizing the importance of developing cooperation for wartime situations.

Overall, the attitude towards cooperation between countries' fire departments and other authorities is positive. Different local and regional safety and security sector authorities' cooperation seems to be actively developing in many locations. The ArcResc project brought authorities together, enhancing connections and information exchange in meetings, even at the local level. It is noteworthy that basic cooperation is not always systematically organized and may depend on personal connections. High level international cooperation has long traditions. Among project participants, **there is a hope to develop**

international personnel exchange in smaller training and exercises with low-threshold participation and small costs, not only large exercises like Barents Rescue.

Suitable equipment and clothing are essential for safe and efficient rescue operations. The majority of fire and rescue equipment and clothing are not specifically planned for use in arctic conditions. For example, a firefighting suit meant to protect the user in smoky and hot situations is often worn outside in cold conditions. Some equipment may become dangerous in winter conditions, such as some fire boots being very slippery on snow and ice.

Other mentioned sectors for development needs in some fire and rescue departments include:

- Better knowledge and information on trails, routes, and especially the tourism industry's private activities and locations, with a system to follow, track, and keep information updated.
- Analyzed environmental information, weather, forest fires, avalanches, and warning systems.
- Technical support for fire and rescue operations, especially for longer and complex operations.
- Developing cooperation between authorities.
- Project leading and knowledge of project management and funds, organizations' skills for using external funding.
- Better safety for responders, with personal GPS tracking beneficial for all-terrain operations from wildfires to terrain rescue, enhancing operation management and sharpening the situational picture.
- Standardizing fire and rescue education in Scandinavia and the Arctic Region.
- Developing education and training cooperation.
- Refreshing courses for experienced employees.
- More research and funding for applied fire and rescue research regarding new technologies for reducing the gap between knowledge and performance.
- Mental health "check-up," similar to physical tests.
- Free healthcare and dental care.
- Building saunas at fire stations.
- Communication systems need to focus more on responders' needs.
- Better sleds for medical evacuations and paramedics.
- Arctic trucks (e.g., in Iceland).

Arctic Fire and Rescue Network of Knowledge

Currently, 12 fire and rescue services from Finland, Sweden, Norway, Iceland, and Canada have actively engaged in the ArcResc project's meetings, forming the *Arctic Fire and Rescue Network of Knowledge (ArcResc Network)*. As the name implies, it is primarily a network for sharing ideas, information, and knowledge and developing services in cooperation. In case of major incidents, requests for assistance will continue to be made through other existing mechanisms.

All these fire and rescue services have emphasized the importance of Arctic Region operational-level cooperation and knowledge sharing. It is essential to get to know each other, speak the same professional language to understand each other for fruitful cooperation. Participants are highly motivated to continue their work within the network. In some ways, Arctic Region fire and rescue services have more in common than with fire and rescue services in other parts of their countries.

At the end of the project, it was necessary to ensure the continuity of the established network. Currently, the Finnish Association of Fire Officers maintains the network until a suitable actor is found to host the network. The aim is to find an organization, preferably located in the Arctic regions, with relevant resources to maintain and support this network. Maintenance entails information sharing, fostering stakeholder relationships, organizing events and meetings, systematic data collection, and keeping the network active and visible. Equally vital is facilitating the entry of new participants into the network.

Recommendations and further ideas

Throughout the project, developmental prospects and proposed further actions were identified, including:

- Monitoring changes in the Arctic operational environment from the perspective of emergency services, analyzing information, and disseminating it to fire and rescue response actors.
- Collecting field information and distributing it among fire and rescue responders, such as highlighting new phenomena and sharing close call situations, along with developing new techniques, tactics, and equipment.
- Facilitating work exchanges between the fire departments of Arctic countries.
- Facilitating exchanges on training and education between the Arctic countries.
- Strengthening and expanding the involvement of indigenous peoples.
- Initiating and implementing new projects concerning Arctic fire and rescue service's development.
- Enhancing the understanding and visibility of fire and rescue services in the Arctic region at both national and international levels.
- Establishing connections and ensuring seamless information sharing between high-level international stakeholders and operational-level participants.
- Nordic rescue service actors have expressed great interest in learning about North American wildland fire management (strategy, tactical decisions, command and control, prescribed burning, aerial firefighting, etc.), presenting an opportunity for a new cooperation and training project.



Picture 3. ArcResc Network Sharing the knowledge in the ArcResc Meeting Iceland.

