LEARNING FROM THE BEST

Dispersed Basing Operations of the Finnish and Swedish Air Forces

Robert M. Moxley, Major, USAF

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Foreword

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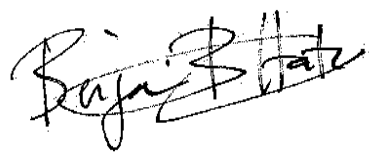

BENJAMIN B. HATCH
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Abstract

US Air Force air assets are most vulnerable when they are on the ground. An examination of the Finnish and Swedish air forces' histories shows the paths they took to defend themselves during the onset of the Cold War to present. Their development of dispersed basing operations, which were established to defend assets against Soviet and NATO threats. Understanding how these concepts were developed across all parts of the military from operations, logistics, security, and training, presents a whole picture. This, in turn, will provide insight to USAF planners using Agile Combat Employment concepts. Utilizing dispersed basing operations, specifically focusing on air base clusters and regional dispersion sites, emphasize survivability and resiliency when faced with threats of advanced anti-access/area-denial (A2/AD) weapon systems. These tactics can be employed against current threats from Russia and the People's Republic of China.

Introduction

During the Cold War, 1947–1991, the Finnish Air Force (FINAF) and Swedish Air Force (SwAF) developed robust concepts for dispersed basing operations to survive and to defend their airspace in the face of numerically superior Soviet and even North Atlantic Treaty Organization (NATO) threats.[1] The dispersed basing concepts of both the FINAF and SwAF model how air forces can survive while in their most vulnerable state—on the ground. Today, the US Air Force (USAF) faces many of the same challenges operating within the threat envelopes of advanced antiaccess/area-denial (A2/AD) weapon systems employed by Russia and the People's Republic of China. Exploring the unique attributes of the FINAF and SwAF provides valuable insight to guide contemporary USAF planners and practitioners experimenting with Agile Combat Employment (ACE). Specifically, the FINAF and SwAF dispersion concepts emphasize specially designed air base clusters and regional dispersion sites, decentralized execution, and cross-functional training. Bringing these capabilities and techniques together boosts survivability and resiliency while sustaining critical combat airpower against an oversized adversary.

Before applying FINAF and SwAF concepts to modern paradigms, this study aims to initially answer why FINAF and SwAF developed in their unique ways. Accordingly, the research is divided into three parts. The first explores the histories of the Finnish and Swedish militaries, highlighting key factors that influenced their respective air forces from the Cold War to the present. Within this section, a deeper look at the Soviet and modern Russian threats aims to properly juxtapose this with the preparations made by the FINAF and SwAF through dispersed operations. The second examines the distinct features of the FINAF and SwAF's dispersed basing concept, broken down into four subcategories: operations; maintenance, logistics, and sustainment; air base security; and training. Lastly, the third section offers recommendations for contemporary USAF planners and practitioners developing ACE within US Air Forces in Europe (USAFE) and, elsewhere within NATO and beyond.

Part 1: History

To the casual observer, the Cold War security environments of Finland and Sweden may appear nearly identical due to their shared policies of neutrality and military nonalignment. However, unlike Sweden, Finland shares over 800 miles of border with Russia, along with a long history of conflict with its powerful neighbor. The Russian Empire controlled Finland from 1809 to 1917,

and after two decades of independence following the Russian Revolution, Finland fought two brutal wars against the Soviet Union: the Winter War (1939–1940) and the Continuation War (1941–1944).[2] In the latter conflict, Finland tacitly cooperated with Nazi Germany to oust the Red Army, a factor that came to play a leading role in post–World War II Finno-Soviet relations.

Owing to Finland's cooperation with Nazi Germany, the 1947 peace treaty that followed between Finland, the Soviet Union, and the Associated Powers, along with the subsequent Finno-Soviet Treaty of Friendship, Cooperation and Mutual Assistance (FCMA) of 1948, dramatically shaped Finland's military posture and relationships with the West after World War II.[3] Specifically, the provisions of the 1947 peace treaty limited the FINAF to 60 aircraft and 3,000 personnel and explicitly prohibited the acquisition of aircraft designed for bombing purposes.[4] The treaty further restricted Finland from developing or possessing atomic weapons and guided missiles.[5] Although the treaty's language and intent were clear, the Finns later interpreted it as limiting only the number of frontline fighter aircraft, allowing for additional support aircraft to be included in the overall total. To this day, the number of Finnish fighter aircraft remains around 60, supplemented by other types for mobility, training, as well as intelligence, surveillance, and reconnaissance.[6] The extent to which this situation can be directly attributed to the 1947 treaty, Soviet/Russian appeasement, fiscal constraints, or true operational requirements remains opaque. However, former Finnish parliament member and security expert Risto Penttilä asserted in his 1991 book, *Finland's Search for Security through Defence, 1944–89,* that "the limits for the development of the defence forces were set by economic and political constraints, not by the military articles of the peace treaty."[7] Regardless of the underlying cause, the reality is that the FINAF's fighter force appears to be fixed at around 60 jets, with the pending acquisition of 64 F-35As by 2030 to replace the current fleet of F/A-18C/Ds on a one-for-one basis.[8] Similarly, the FINAF's current personnel strength remains conspicuously near the agreed 1947 limit. According to its official website, the FINAF employs approximately 2,000 uniformed and nonuniformed service members and trains around 1,300 conscripts each year.[9]

Further refinements and interpretations of the 1947 peace treaty and 1948 FCMA took place throughout the Cold War. In 1963, the contracting parties agreed to permit Finland's acquisition of defensive missiles, which it followed with the procurement of Soviet K-13A (NATO AA-2 Atoll) infrared air-to-air missiles for its MiG-21 fighter fleet.[10] Eric Solsten and Sandra Meditz's *Finland: A Country Study* helps give context to the FCMA, noting, "The Finnish government distinguished the FCMA treaty from a military alliance by pointing out that its military clauses were restricted to situations of attack against Fin-

land or against the Soviet Union through Finnish territory."[11] Despite Finnish leaders' desire to downplay the FCMA, its very existence was enough to challenge Finland's perceived neutrality.[12] Not until the fall of the Soviet Union and Finland's entry into the European Union (EU) in 1992 would Finland emerge unambiguously within the Western sphere.[13]

Throughout the Cold War, both Finland and Sweden resisted joining the NATO alliance, but for slightly different reasons. Both recognized their vulnerability as smaller states caught between two superpowers, with the Soviet nuclear arsenal and large conventional forces on the one hand and maintaining their sovereignty amidst NATO's potential encroachment on the other.[14] In this way, Finnish and Swedish threat perceptions were multipolar and linked. Finland, however, felt the Soviets' pressure along its border perhaps more acutely and characterized this in public debate as the traditional threat of Soviet invasion. Having just fought two wars against the Soviets, this seemed the most likely scenario for traditionalists. Alternatively, Cold War modernists conceived Finland and Sweden as transients for countries using their territory and airspace to attack one another.[15] The development of NATO and Soviet cruise missiles, specifically, lent credence to this argument as flight paths, for these systems were likely to overfly Nordic airspace.[16] While candid conversations revealed Finland's deeper concern with the traditionalist view, modernist perceptions, especially in light of the FCMA, also contributed to the FINAF's defense planning.[17]

To hedge between the great powers, Finland pursued détente with the Soviet Union while strengthening ties with its Nordic neighbors and, later, NATO. Accordingly, Finland acquired a mix of Soviet and Western defense technology until the fall of the Soviet Union, when greater emphasis was placed on Western equipment. For the FINAF, this meant the acquisition of 24 MiG-21F in 1963, which were subsequently upgraded by 28 MiG-21bis in 1978 and 38 Swedish J 35 Draken from 1974 to 1986.[18] The Soviet-built MiG-21bis fighter-interceptors, along with the Drakens, constituted the FINAF's fighter backbone until the mid-1990s.[19] Today, the FINAF operates 62 F/A-18 Hornet C/D, which they acquired from the US starting in 1995.[20] The acquisition of the multirole Hornet began the FINAF's transition from a purely air-to-air capable fighter force to a multimission-capable air force. What is more, the transition to Western equipment made compatibility with NATO more seamless, even if full entry into NATO was not pursued.

Sweden, by contrast, maintained its armed neutrality throughout World War II and, without postwar military constraints, developed a technologically advanced and well-funded defense force. Indeed, to paraphrase John Logue in his essay "The Legacy of Swedish Neutrality," nonalignment rested on the

military credibility of the Swedish defense forces and depended as much on civil and economic defenses as self-sufficiency in military materiel.[21] The term armed neutrality is thus a direct reflection of this Swedish ideology.

Unlike any other Nordic nation, the Swedish defense industrial base afforded relative autonomy from the great powers during the Cold War, though it leaned decisively westward for assistance. Swedish automobile and aircraft manufacturer Saab, founded in 1937, forms the cornerstone of Swedish aviation manufacturing. By the end of 1945, the SwAF order of battle included approximately 800 aircraft, which made it the second-largest air force in Europe after the United Kingdom.[22] By the end of the 1950s, the SwAF boasted nearly a thousand modern jet fighters and fighter-bombers, most of which were of Swedish design and manufactured by Saab, a remarkable achievement that made the SwAF the fifth largest air force in the world at the time.[23] In 1952, Sweden became part of the Mutual Defense Assistance Act (MDAA) with the US, which allowed it to purchase armaments from the US, particularly advanced aeronautics, avionics, and jet propulsion.[24] With some US technological assistance, Saab subsequently produced the legendary Cold War fighter-interceptors the J 35 Draken and J 37 Viggen, as well as the modern multirole fourth generation JAS 39 Gripen.[25]

While Saab is perhaps the most well known, it is are joined today by other defense industry giants like British Aerospace's (BAE) Swedish subsidiary BAE Systems Hägglunds, which specializes in military vehicles, and BAE Systems Bofors, the maker of the Archer self-propelled howitzer, munitions, and other armaments.[26] Globalization continues to challenge Sweden's quest for self-sufficiency, but it fares better than most as one of the world's top 20 largest defense exporters overall and consistently within the top three defense suppliers per capita.[27]

Mandatory national service through conscription plays an important role in both Finnish and Swedish national defense plans and modern contributions to NATO. In Finland, this system has remained little changed since the Cold War. All males turning 18 take part in an annual national call-up. Conscription periods last 165, 255, or 347 days depending on specialty and rank and are divided into four 6-week phases: Basic training, Training branch, Specialty, and Unit training. The Finnish Defence Force (FDF) trains approximately 21,000 conscripts annually, with about 6 percent (1,300) of those assigned to the FINAF.[28] In case of crisis, the FDF boasts a wartime strength of 280,000 personnel, pulling from a reserve force of 900,000 trained Finnish civilians.[29]

While traditionally a mainstay of Swedish defense, conscription was suspended in 2010 and only recently revived in 2018 in the wake of Russia's increasingly aggressive behavior and Sweden's failure to establish a sufficiently

sized all-volunteer force.[30] Unlike the prior system, Swedish conscription is now both selective and gender neutral. The Swedish Defence Conscription and Assessment Agency screens 100,000 18-year-olds for service annually, accepting only about 5 percent of this cohort for military service.[31] Conscripts serve from 4 to 11 months, depending on their branch, and will remain eligible for mobilization 10 years after recruitment.[32] According to the 2025 International Institute for Strategic Studies' (IISS) *Military Balance* report, Sweden's armed forces total 14,850 active personnel (though some sources cite nearly double this at 24,000 active), with 2,700 of those in the SwAF.[33] The SwAF entered 800 conscripts for training in 2024 and intends to grow this figure to 1,000 in 2025.[34] The active force is further supported by 21,500 reservists, of which perhaps 15 percent are members of the SwAF reserve force.[35]

Understanding the Threat

In 1979, Marion Leighton published *The Soviet Threat to NATO's Northern Flank*, which quantified the specific tactical threats from the Soviet Kola Peninsula adjacent to Finland's Lapland. At the time, 300 fighters and long-range bombers were based at 40 airfields, along with several hundred naval aircraft in operation with the Soviet Northern Fleet in Murmansk.[36] These air forces were complimented by surface-to-surface missiles, air defenses, and some 70,000 total troops, which Norwegian officials assessed then to be the largest concentration of military force in the world.[37] A decade later, Solsten and Meditz's country study cited a 1988 US Department of Defense assessment of Soviet conventional forces assigned to the Northwestern Theater of Military Operations, an area that included Finland and consisted of 12 divisions, 1,350 tanks, and 160 tactical aircraft.[38] The proximity of these conventional forces to the Finnish border and the Swedish border just beyond it, compounded by the development of long-range surface-to-surface ballistic missiles and cruise missiles that may or may not be nuclear armed, helped convince both Finnish and Swedish defense planners that dispersion was the only way to survive.

In 2024, as a result of Finland and Sweden's entry into NATO, Russia reorganized its forces previously in the Northern and Western Military Districts under the new Leningrad and Moscow Military Districts.[39] Katarzyna Zysk, a professor with the Norwegian Institute for Defence Studies (IFS), explains this move: "Seen with Russian eyes, it is necessary to improve the ability to fight full-scale land operations along the Finnish border and in the Baltic theatre of military operations."[40] The Kola Peninsula, now in the Leningrad Military District, remains a strategic bastion as the only ice-free direct access to the North Atlantic and home to Russia's Northern Fleet, with its seven opera-

tional ballistic missile submarines.[41] Finland also sits astride Russia's 6th Combined Arms Army (6th CAA) and 6th Air and Air Defense Army (6th AADA) in Saint Petersburg. While the 6th CAA may be the least developed within the previous Western Military District, according to a 2021 Center for Naval Analysis (CNA) report, and despite its traditional orientation toward the Baltic states, its proximity to the Finnish border means it also cannot be ignored.[42] Specifically, the 138th Motor Rifle Brigade at Kamenka and the Northern Fleet's 80th Arctic Motorized Rifle Brigade at Alkurtii are just 30 miles from the Finnish border.[43] The 6th AADA's 159th Fighter Aviation Regiment (IAP, *Istrebitelnyi Aviatsionnyi Polk*) at Besovets, Karelia, is responsible for the provision of air attack capability along the Finnish border with a total of 36 combat aircraft, including two squadrons of Su-35S and one squadron of Su-27SMs.[44] While the total conventional combat power of the Northern Fleet, 6th CAA, and 6th AADA may be underwhelming compared to Soviet times, Russia can, of course, mobilize resources from other districts and project power or deny access (A2/AD) through long-range stand-off strikes with cruise missiles from its arsenal of strategic bombers, theater ballistic missiles, long-range surface-to-air missiles (SAMs) and now one-way attack unmanned aerial vehicles.

In addition to its conventional military, Russia employs a well-documented special forces, Spetsnaz, and military intelligence apparatus, the Main Intelligence Directorate (GRU, *Glavnoye razvedyvatel'noye upravleniye*), for clandestine and covert operations outside its borders. According to the US Defense Intelligence Agency's (DIA) 2017 *Russia Military Power* report, there are between 20,000 and 30,000 of these operatives, of which two were linked to the 2018 nerve agent attack against Sergei Skripal and his daughter, Yulia, in Salisbury, England.[45] The implication for the FINAF and SwAF is that they can expect to face such operatives in their rear areas conducting reconnaissance, sabotage, and targeted killings, both in crisis and potentially before hostilities commence.

Finnish and Swedish armed neutrality and nonalignment gave way to open partnership with NATO in the 2000s, culminating in their acceptance into the NATO alliance in 2023 and 2024, respectively, as a direct result of Russia's further invasion of Ukraine in 2022.[46] Their entry into NATO not only solidifies their security posture but also underscores the enduring relevance of their dispersed basing strategies—principles that the USAF's ACE framework can adapt to counter modern threats from Russia and China.

Part 2: FINAF and SwAF Dispersed Basing Concepts

FINAF Dispersed Basing Operations

The traditional threat posed by Russia and what was once the modern threat posed by NATO, paired with past and present economic and political realities, convolved to influence Cold War and contemporary Finnish defense planning. For the FINAF, this meant a force primed to defend its airspace while ensuring survival on the ground. Major General (ret.) Lauri Tapio Puranen, former FINAF Commander from 2012 to 2014, neatly summarizes the FINAF's operating concept: "The Finnish concept of dispersed fighter operations calls for a large number of air bases to which the fighter force will be dispersed in small units. This prevents its destruction on ground by surprise attack and guarantees that at least some runways will survive enemy strikes, thereby enabling interceptor takeoffs."[47] Major General Juha-Pekka Keränen, the current FINAF commander, describes this doctrine as the "dispersed, mobile battle concept."[48] Though developed out of Cold War necessity, the FINAF continues to train for dispersed operations to meet the evolving threat from Russia's A2/AD weapons as well as its conventional force posture along Finland's border.

To give context to the extent of this network, Bert Kondruss, an aviation enthusiast who collated and mapped Cold War operating locations for many air forces across Europe, cited 47 FINAF operating locations, breaking them down into highway strips (24), airfields (16), air bases (5), and airports (2).[49] Historical and modern accounts are vague on the exact number of bases the FINAF could operate, either in parallel or in series. Dr. Tomas Ries, a senior lecturer at the Swedish National Defence College and author of *Cold Will: The Defence of Finland*, asserted in 1988 that at the height of the Cold War, FINAF's main air bases were kept on a one-hour standby to activate key road bases (presumably, highway strips and airfields) in their assigned operational area.[50] He went on to say that "In an alert, the fighters rapidly deploy to the reserve bases, after which they are constantly shifted, operating from one base to another."[51] Like a street peddler's shell game, this combination of dispersion and rotation between hot and cold bases presented the Soviets and continues to present the Russians with a complex targeting problem.

If survival is the primary reason for dispersion, Dr. Ries points to a second advantage of dispersion, FINAF's ability to deploy fighters between different parts of the country depending on the threat.[52] Solsten and Meditz's *Country Study* explains, "The country was divided into three air defense regions [Lapland, Satakunta, and Karelia]. Each air defense region was the operational

zone of an air wing, functioning in coordination with the corresponding military areas. Each of the three command centers was individually responsible for its regional air defense, based on directives issued by the air staff. One fighter squadron was assigned to each wing, but the necessary basing and support infrastructure was in place to enable the air force commander to concentrate all air force resources in a single region if necessary."[53]

Today, the FINAF operates four main operating bases (MOB) at Rissala, Rovaniemi, Pirkkala, and Tikkakoski under two fighter wings, a transport and research wing, and the Air Force Command Finland.[54] Finland's operational F/A-18s are divided between the Karelia Air Wing at Rissala, which covers the eastern and southern parts of Finland, and the Lapland Air Wing at Rovaniemi, which is responsible for the north.[55] The Satakunta Air Wing at Pirkkala serves in a largely support role through air mobility, communications, logistics, security, research, and maintenance.[56] The fourth main operating base at Tikkakoski serves as the command headquarters for the Air Force Command Finland (AFCOMFIN), which is responsible for the direction of Finland's peacetime and contingency air defense based on centralized command and dispersed operations.[57]

FINAF Maintenance, Logistics, and Sustainment

Operating primarily from within its own borders, the FINAF enjoys interior lines that somewhat simplify logistics and sustainment. The FINAF's need to constantly move not just aircraft but also their logistics support relies on mobility, pre-staged equipment, and training. FINAF's distributed basing concept is centered on a hub-and-spoke model with more than 30 such bases today that may be used as main, remote, or forward operating bases, as required.[58] In their article "A Flexible and Resilient Nordic Air Base Concept" for the Norwegian Air Power Journal *LUFTLED*, Colonel (R) Per Erik Solli, Senior Defense Analyst at The Norwegian Institute of International Affairs, et al., highlight that "to be able to support these deployments, road convoys with dedicated trucks bring the ground equipment needed, including fuel, munitions, spares, and, in the case of road bases, mobile control towers."[59] This captures a central feature of FINAF's dispersed basing concept, the utilization of mobile ground crews with specialized Aerospace-Ground Equipment (AGE) that fan out from MOBs to service remote sites.

Previously, whether to face the traditional or modernist threat, the FINAF trained and equipped exclusively for air-to-air combat. Indeed, only under exceptional circumstances would the FINAF provide direct ground or naval support.[60] The primacy of air defense is reflected in the FINAF's current mis-

sion statement. According to its official website, "The FINAF is responsible for Finland's air defence and air operations. As its secondary mission, the service supports other authorities and participates in crisis management."[61] Thus, as a primarily interceptor force it previously required only those munitions for air-to-air combat. This further simplified the ground equipment required for munitions handling, focusing on air-to-air missiles and ammunition for the 30 mm cannons on both the MiG-21bis and J 35.[62] Not until a reform in the late 1990s was an air-to-ground mission added to the FINAF's list of requirements, enabled by the procurement of US F/A-18s.

The addition of this new mission complicated not only logistics but also command and control. Whereas previously, pilots and ground crews could focus on flying and arming for an air-to-air defensive combat air patrol, the addition of strike and even close air support necessitates mixed combat loads of air-to-air and air-to-ground munitions. The supply, maintenance, and even mission taskings must, therefore, be orchestrated in advance, especially if target coordinates for stand-off weapons are required. In this area, the FINAF and USAF are likely to learn in parallel with one another as similar challenges are at the forefront of contemporary ACE planning.

Despite the complexity inherent in adopting a new air-to-ground mission, the acquisition of the F/A-18 offered a degree of operational simplification for the FINAF. By transitioning to a single fighter platform, ground crews could concentrate their efforts on maintaining one aircraft type, an improvement over the logistical and technical challenges posed by the concurrent operation of both MiG-21bis and J 35 Draken fighters.

Today, the Lapland Air Wing oversees the six-week specialty training phase for FINAF conscripted ground crews, offering specialized programs for roles such as crew chief assistants and military vehicle operators both serving 347-day conscriptions as well as aviation ordnancemen serving a 165-day conscription.[63] Notably, upon completion of their specialty training, aviation ordnancemen will be with their assigned operational unit just 42 days to complete their final six-week unit training phase before their obligation terminates. For crew chief assistants and vehicle operators, after the conclusion of their unit training, they will go on to serve an additional 179 days with their operational unit. The constant ebb and flow of personnel, though well rehearsed, surely challenges the acquisition of additional weapons hardware, given already breakneck training timelines.

As if the FINAF conscription pipeline and dispersed hub-and-spoke operations were not challenging enough, sustainment may yet be its Achilles' heel. Reliant, as it is, on foreign military hardware and munitions, it is easy to conceive in a major conflict pre-positioned supplies quickly dwindling due to ex-

penditure. What is more, in such a scenario, the FINAF would be unable to replace aircraft combat losses even if they are relatively safe while on the ground receiving maintenance. In 1988, Finland produced about 40 percent of its own equipment, mostly light arms, munitions, and vehicles.[64] Then as now, Finland remains reliant on external, namely Western, suppliers for advanced weapons and equipment, such as missiles, radars, and aircraft. For instance, according to the SIPRI (Stockholm International Peace Research Institute) database, Finland likely has around 2,000 air-to-air missiles, including 745 AIM-120 A/C advanced medium-range air-to-air missiles (AMRAAM) with an unknown number of AIM-120Ds on order for the F-35A and less than 1,000 AIM-9 E/M/X short-range air-to-air missiles.[65] Stocks of stand-off air-to-ground weapons are even more depressed, according to the same database. In total, Finland has fewer than 800 stand-off air-to-ground munitions: 11 AGM-154 Joint Standoff Weapon (JSOW), 50 AGM-158A Joint Air-to-Surface Standoff Missile (JASSM), 200 AGM-158B JASSM–Extended Range (ER), and 500 GBU-53B StormBreaker glide bombs. While this may be sufficient for a short conflict, prolonged high-intensity combat operations with the Russian Federation would almost certainly deplete these stocks within days, if not several weeks.

FINAF Air Base Security

FINAF air base security constitutes a mixture of active and passive defenses to guard against a host of possible threats, namely conventional or nuclear armed theater ballistic and cruise missiles, cluster munitions, and special forces and saboteurs. Due to its proximity to Russia, the FINAF also cannot rule out a ground attack or an invasion force using shorter-range munitions like artillery or even direct fire. Therefore, ground-based air defenses and light infantry security forces constitute the bulk of active defenses, while dispersion and hardening makes up the passive defense. Together, the FINAF's base-level and dispersed site security provides for a resilient, albeit limited, combat force.

Ground-based air defenses are a nascent part of Finnish air base and dispersed site active defense, as coverage throughout the country has historically been, and continues to be, sparse. Over the years, Finland acquired a mixture of Soviet, Western, and even South African SAMs, including Man-Portable Air Defense Systems (MANPADS), the latter of which are comparatively easy to operate by individuals with modest training. As with the US, ground-based air defenses are the responsibility of the Finnish army, with close coordination with the FINAF.[66] Though precise employment details are limited in the public domain, it can be expected that one or multiple Air Defence Batteries

from one of the Finnish Army's Air Defence Battalions would be deployed for point defense of select MOBs and dispersion sites.

Finland obtained its first Soviet SAM system, the S-125 (SA-3 Goa), in 1980, which gave it a modest low- to medium-altitude capability against maneuvering targets. According to the SIPRI database, the agreement included 100 V-601 missiles and three associated radars, hardly enough to cover the entire country.[67] Subsequent procurements of the Soviet Strela-2/3 (SA-7/14) and Igla-1 (SA-24) and the French Mistral MANPADS throughout the 1980s emphasized Finland's prioritization of point versus area defense.[68] In 1996, Finland made its final investment in former Soviet SAMs with the receipt of three Buk-M1 (SA-11 Gadfly) systems and 300 associated 9M38 missiles.

In the 2000s, Finland continued to modernize its SAM inventory with a mixture of Swedish, Norwegian, US, and now Israeli SAMs. Finland's new MANPADS included the Swedish RBS-70 Mk-3 Bolide and US Stinger with initial procurements of 650 and 371, respectively. Their most capable modern SAM, the Norwegian (or National) Advanced Surface-to-Air Missile System (NASAMS-2), based on the US AMRAAM, adds to their point defense, with 12 systems—albeit with a relatively limited range of just 25 miles.[69] In 2023, Finland concluded a deal with Israel for the purchase of an unknown quantity of David's Sling that will give Finland its first antiballistic missile (ABM) capability.[70] As Finland continues to grow its SAM force both in quality and quantity, it will need to integrate these systems into their national air picture and work closely between the Finnish Army and FINAF to deconflict airborne threats.

The FINAF trains and equips a light infantry force to provide security at their MOBs and dispersed sites. Solli et al. explain the role of conscripts in the FINAF's dispersion concept: "To ensure enough personnel to maintain this spread-out organization and to protect these numerous smaller bases, the Finnish Air Force relies heavily on conscripts to beef up both the ground crews as well as to set up wartime base protection units which can deploy with the road convoys to protect the satellite bases."[71] The Karelia Air Wing is responsible for training these conscripts for air base defense, training between 220 and 240 conscripts annually.[72] Recognizing the need to maximize the utility of each individual, the Wing provides cross-functional training to force protection conscripts for various support and maintenance tasks, such as assistant mechanics, drivers, and medics.[73] While receiving cross-functional training, the primary responsibility of these security forces personnel is to confront adversary special forces that might be operating in Finland's rear areas during a national crisis in partnership with army units providing ground-based air defense.

As previously mentioned, aircraft dispersion is like a shell game, which refers to the deceptive trick of swiftly passing a small ball from under one cup to another. In fact, M. B. Berman and C. L. Batten arrived at this very same analogy in their 1983 RAND report for the USAF, *Increasing Future Fighter Weapon System Performance by Integrating Basing, Support, and Air Vehicle Requirements*. In their report, they recommended increasing the number of runways in Europe three- to sixfold to complicate Soviet targeting using the shell game analogy.[74]

Embracing the shell game, FINAF security through dispersion benefits from having multiple runways and parking aprons on which to land and conceal aircraft. Assuming all 60 of the FINAF's fighters are operational and using Bert Kondruss's 47 air bases and airfields, this equates to 1.28 aircraft to 1 runway (1.28:1). Eric Solsten and Sandra Meditz's country study arrived at a more favorable number, asserting in 1988 that the FINAF's "basing and logistical facilities were sufficient for about three times as many combat aircraft as were in the peacetime inventory."[75] Since Kondruss's research does not identify dispersed parking ramps or maintenance areas that may be associated with a given runway or airfield, Solsten and Meditz's figure may be closer to the Cold War reality. Present-day figures on the number of available remote sites the FINAF intends to operate are hard to come by, but as Solli notes, the FINAF did not abandon the dispersion concept after the end of the Cold War, so the ratio of 1:3 may hold true today.[76]

Hardened shelters as a means of passive defense buttress the FINAF's dispersion concept, though the scale is difficult to determine. Solsten and Meditz, almost as an afterthought, identified hardening efforts at the Satakunta Wing at Pirkkala, noting that "all of the wing's command facilities, workshops, and aircraft shelters were hardened, having been blasted out of granite cliffs."[77] The FINAF's official website further elaborates that "the Air Force Command was transferred from Helsinki to underground facilities at Luonetjärvi in Tikkakoski in 1972."[78] Widespread hardening through the use of mountain bunkers is hardly surprising given their proliferation for civil defense throughout the country. According to a 2023 Reuters article, Finland has over 50,500 bomb shelters throughout the country.[79] However, the extent to which hardened shelters are integrated into flight line positions at dispersed sites for aircraft parking, maintenance, and the like remains a gap for further research.

FINAF Training

Twice annually, the FINAF rehearses its dispersed operations through exercise Baana (Finnish for "road" or "highway") and Ruska. Major General Keränen

summarizes these exercises by noting, "The annual Finnish Air Force road base exercise Baana allows us to test the capability of various road bases, train airmen, pilots, technicians, air traffic controllers and force protection. Additionally, the annual Air Defence Exercise Ruska provides the FINAF an excellent opportunity to test quick dispersal across the country and train the whole Air Force to survive, fight, and maintain an operational tempo against a challenging air adversary."[80]

A third exercise, Hanki, appears to have supplanted Ruska in 2024, but it is not known from the resources publicly available whether this is a temporary or permanent change.

The most recent iteration of the Baana series, Baana 24, took place over the course of seven days, 31 August to 6 September 2024. During this time, the FINAF's Lapland Air Wing rehearsed dispersed operations from its MOB at Rovaniemi to the Norvatie highway strip (also referred to as Rovaniemi highway strip) roughly adjacent to Rovaniemi Air Base and Hosio highway strip.[81] The latter, Hosio highway strip, possibly refers to a conspicuous section of Road 924, four nautical miles from the small Finnish village of Hosio. If this analysis is accurate, the Hosio highway strip is approximately 40 nautical miles away or one-and-a-half to two hours driving distance from the MOB at Rovaniemi. Provided these details are correct, Baana 24 rehearsed both local and regional dispersion by generating sorties from these two locations.

According to a FINAF press release, the last iteration of Ruska, Ruska 23, ran from 25 to 30 September 2023 and was potentially supplanted in 2024 by Hanki 24, from 26 February to 2 March 2024.[82] Ruska 23 involved the entire FINAF, totaling some 60 aircraft and 4,500 personnel, including 2,600 FINAF reservists.[83] Additionally, the FINAF trained with Swedish JAS 39 Gripens and F-35s from the UK's *Queen Elizabeth* aircraft carrier. Throughout the six training days, participants primarily operated from three of the four FINAF MOBs at Rissala, Pirkkala, and Rovaniemi, two road bases at Tervo and Vieremä, and further spread out to the Tikkakoski, Oulu, Kokkola, Vaasa, Jämijärvi, Pori, Varkaus, and Joroinen areas. Where Baana focused on proficiency, Ruska stressed the command and control of the FINAF as might be expected in actual combat operations, given the utilization of multiple dispersed sites in operation over multiple days.

Like Ruska 23 before, Hanki 24 was the largest FINAF exercise of the year. It utilized a similar volume of aircraft (40) and personnel (3,800), including 2,300 reservists.[84] According to the FINAF's press release, the objective of the exercise was to "develop the readiness and capabilities of the Air Force . . . [and] train base operations and the implementation of large-force air operations from dispersed locations."[85] Although precise details are wanting, the Ruska and Hanki

exercise series demonstrate the FINAF's ability to orchestrate operations across multiple dispersed sites, either sequentially or in parallel, over roughly a week. What is not known from these exercises, or at least not disclosed, is how many of the dispersed sites were operational at any one time, for how long, or how air and ground crews adapted to changes to their assigned mission or threat and how this impacted hub-and-spoke logistics. Moreover, how long could the FINAF sustain at this increased operational tempo?

SwAF Dispersed Basing Operations

In many respects, the SwAF's dispersion concept mirrors that of the FINAF. The purpose is to generate a higher number of effective sorties than the enemy, surviving on the ground through movement and dispersion.[86] Brigadier General Anders Persson, Deputy Vice Chancellor of the Swedish Defence University, et al., summarize, "The ultimate goal in the Swedish approach is to remain as mobile as possible, temporarily open up airfields and then move on to the next base."[87] The Swedes enjoy an equally long Cold War history of perfecting their dispersion techniques. Starting with the Flygbassystem (Air Base System) Bas 60 concept in the 1950s and transitioning to the Bas 90 concept in the 1980s. Bas 60 initially aimed to protect the SwAF from a nuclear attack by dispersing aircraft and resources across the country.

The 1960s marked a noted shift in SwAF thinking about the threats it would face, first reflected in Saab's aircraft design and later in the SwAF's dispersion concept Bas 90. "No longer was a massive nuclear strike the only threat, but conventional attacks, large-scale or limited in size, had to be taken into consideration," notes Anders Annerfalk, author of *Flygvapnet: An Illustrated History of the Swedish Air Force*.[88] The planned JA 37 Viggen had to be reconfigured for a wider variety of missions, which included ground attack as well as its expected air-to-air role.[89] From the start, the Viggen design incorporated features to accommodate the SwAF's dispersed basing concept on short highway landing strips. Namely, a thrust-reverser was developed that not only shortened the distance required for landing but also allowed the aircraft to taxi in reverse and park without being towed.[90] Additionally, engineers developed a new Tactical Instrument Landing System (TILS) to assist the pilot in acquiring and landing on short, semi-hidden runways.[91] Finally, the JA 37 featured a state-of-the-art data link that connected individual aircraft to the country's Stril 60 command and control network as well as other JA 37s. This gave an economy of scale to the JA 37, allowing fewer aircraft to defend a wider swath of airspace through centralized control and decentralized execution.[92]

Bas 90 followed Bas 60 as the SwAF's dispersed basing concept in the 1980s. According to an informational film created by the SwAF's TV studio in 1986, Bas 90 was designed to counter cluster munitions or multiple conventional warheads and included expanding base infrastructure, the acquisition of new equipment, and transitioning to a new battalion organization, Base Battalion 85.[93] The Bas 90 concept emphasized a MOB with one or more auxiliary flight lines, usually a concealed highway strip, with adjacent maintenance areas. "The basic idea of Bas 90," according to the SwAF's film, "is built around the usage of multiple runways, dispersal both within and between bases, and that the base units have high mobility."[94] Bas 90 sought to expand the number of auxiliary runways near MOBs, so that each MOB's 2,200 meter (~7,200 feet) runway was augmented by up to five 800-meter (~2,600 feet) runways, dubbed V-90 strips, spread over a 10- to 15-kilometer (~6 to 9 mile) area.[95] The 1986 instructional film on Bas 90 stressed that, "Attacking aircraft on the ground is made more difficult by dispersing individual flightline positions over large areas and with long distances between each position."[96]

Multiple sources confirm the extent of the SwAF's dispersed bases. Dr. Christian Anrig, author of *The Quest for Relevant Air Power* cites, "At the end of the Cold War, the SwAF had an extensive network of as many as 30 main and reserve air bases and approximately 50 additional operating sites, including civilian airports, at its disposal."[97] Brigadier General Persson et al. put the total number of runways available to the SwAF during the Cold War at more than 100.[98]

What is not well captured are the number of hardened hangars or dispersed flight line positions available to the SwAF. Only Christopher Bowie's 2002 work *The Anti-Access Threat and Theater Air Bases* provides insight. Referencing the Air Facility Information File from 1997 compiled by the National Imagery and Mapping Agency (NIMA), the predecessor of today's National Geospatial-Intelligence Agency (NGA), information for Sweden reveals the number of airfields (18), runways (19), hardened airfields (4), and number of shelters (20).[99] It is difficult to discern from Bowie's chart compiled from NIMA's Airfield Index whether these figures simply under-report the true scale of SwAF's dispersed basing or, in fact, are a reflection of post–Cold War downsizing after the cessation of Bas 90 in the mid-1990s.

What is known today is that the SwAF consists of two operational fighter wings and one fighter training wing (total six squadrons) that operate roughly 100 JAS 39 Gripen C/D from three main bases.[100] The two operational wings, with two Gripen squadrons apiece, are geographically divided between the far north and south of Sweden, with the Norrbotten Wing (F 21) in Luleå (north) and Blekinge Wing (F 17) in Ronneby (south).[101] Two additional Gripen squad-

rons are located with the Skaraborg Wing (F 7) at Såtenäs primarily for training. There is also the Armed Forces Helicopter Wing at Malmen, which is used for helicopter operations and is also home to Gripen test and evaluation, basic flight training, and an airborne signals intelligence unit.[102] The SwAF plans to boost overall Gripen strength to 120 aircraft via its introduction of 60 E-model fighters, complemented by the continued service of 60 JAS 39 C/Ds.[103]

The JAS 39 Gripen expands on the unique capabilities initially incorporated in the JA 37 Viggen to deliver the SwAF a purpose-built multirole fighter, optimized for field maintenance and short takeoff and landing (STOL). Among the key aspects of the JAS 39 that make it uniquely well suited for dispersed operations using short runways are its aerodynamic braking via canard wings, paired with nosewheel brakes that replace the bulky reverse thrusters from its predecessor, the JA 37 Viggen.[104] Moreover, Saab advertises a high mission readiness rate, made possible by built-in-test and monitoring systems, line replaceable units (LRU), and an onboard auxiliary power unit (APU), all of which simplify ground crew maintenance and AGE.[105] Furthermore, Saab introduced "other small functional details like the master arm switch for weapon system checks, access panels that can be opened and closed with the push of button latches, bolts that can be removed to detach the engine while disconnecting the fuel, hydraulic lines, and more."[106] Details such as these were designed to save time on the ground and increase sortie generation.

Although primarily expected to serve in an air-to-air role, JAS stands for *Jakt Attack Spaning* (fighter, attack, reconnaissance), which reflects the trinity of missions the JAS 39 is expected to perform within the joint force.[107] The SwAF embraced the concept of joint warfighting much sooner than its FINAF counterparts, which is echoed in the SwAF's broader mission statement. Former Supreme Commander of the Swedish Armed Forces and SwAF officer Major General Micael Bydén defines the SwAF's mission: "To support Swedish security and foreign policy and help to maintain peace and independence in accordance with four major tasks: helping to maintain territorial integrity, participating in various crisis response operations, defending Sweden against armed aggression, and safeguarding civilians and securing vital public functions."[108] To succeed in these tasks, the SwAF recognizes its need to support multiple domains, notably its ground and naval forces. This concept of joint integration for the SwAF is present not only in the design of the JAS 39 but also through Swedish investment in air-to-surface and counter-maritime munitions and aircrew training with the joint force.

Major General Bydén describes the SwAF's centralized command with a mission command philosophy as "dynamic command."[109] From an air component perspective, this is facilitated by the JAS 39 Gripen's Tactical Informa-

tion Data Link System (TIDLS) and Link 16 NATO-standard datalink that connects not only other Gripens and NATO aircraft but also the SwAF's Saab 2000 Erieye Airborne Early Warning and Control and ground stations to a common threat picture.[110] The ability to share air tracks and other data via the TIDLS and Link 16 enables dynamic command execution as information is shared from multiple platforms to inform pilots, airborne controllers, and commanders simultaneously. Though the tools exist to facilitate centralized command and control, much in the SwAF is left to decentralized execution through their mission command philosophy.

SwAF Maintenance, Logistics, and Sustainment

Although the Bas 90 concept was abandoned in the mid-1990s, many of its concepts are still in use today. Richard Bitzinger's 1991 RAND report, *Facing the Future: The Swedish Air Force, 1990–2005*, provides phenomenal insight into the logistics of the previous Bas 90 system: "Each main operating base maintains several mobile supply units, consisting of several trucks carrying fuel, armaments, etc., that can be sent to the reserve bases. These units, comprising two technical officers and 21 conscripts, can refuel, resupply, and rearm an aircraft at the turnaround area, as well as provide mobile electrical support for the aircraft. Depending on an aircraft's mission, each unit has a complete armaments load for one or two aircraft."[111]

Since the expiration of Bas 90 and the introduction of the Gripen into standard service, the central elements of this logistics orchestra remain the same, though the personnel required have decreased. According to the Saab website, the Gripen can be fully rearmed and refueled for any mission within 15 minutes, utilizing small teams of only four or five technicians and conscripts.[112] This claim appears to be validated by European Defence Editor for FlightGlobal Craig Hoyle's observations during a 2024 visit to the F7 Wing. During this time, he observed the wing conducting a dispersal exercise near its MOB at Såtenäs, utilizing an adjacent highway strip, with particular emphasis on the role of the ground crews:

> Once on the ground, each jet turns in the road and taxis back to a small layby, to be met by a support team typically with only four or five personnel . . . this comprised one full-time technician and maintainer, plus three conscripts conducting their military service.
>
> Prior to arriving at the refuelling /rearming site, the team's specialist military vehicles rendezvous nearby with a commercial truck carrying missiles. These are transferred to their vehicles' trailers via a crane arm, and—in the case of Raytheon AIM-120 AMRAAMs—then have their control fins fitted.

> Ground operations are performed without heavy machinery—notably, maintainers use a hand-cranked tool nicknamed the "fishing rod." This can be employed while loading the fighter's air-launched weapons and gun unit, replacing its engine and auxiliary power unit, and also during work on the main landing gear.[113]

Between Bitzinger and Hoyle's accounts, it becomes easier to conceptualize how the SwAF conducts field maintenance and supplies its dispersed fighter network. Nevertheless, questions persist. What is the SwAF's sortie generation rate, and how long can it support it before reconstitution? How many teams can be mobilized simultaneously? What types and how much equipment are pre-staged at deployment sites, and how are mission details precisely communicated to ground crews to know which munitions to upload and to which aircraft? These same questions might be asked also of the FINAF, and as might be expected, answers for both countries are not readily available in the public domain. However, Deputy SwAF Commander Brigadier General Tommy Petersson provides some operational-level insight: "It's not the [aircraft] take-off and landing that's our priority, it's more the coordination of everything; the fuel and ammunition, and getting the right personnel to the right spot at the right time. This kind of operation demands a mission-command culture, with trust between different professions and at different levels."[114]

Unlike the FINAF, the SwAF prides itself on being relatively self-sustaining, given Sweden's robust industrial base and ability to operate and maintain its own systems and platforms.[115] Like the FINAF, however, the SwAF depends on US and European suppliers for air-to-air and air-to-ground munitions for their Gripen fleet. The SIPRI database reveals shockingly low imports of modern short and medium-range air-to-air missiles, just 864 AIM-9L (RB-74) and 266 AIM-120 A/C (RB-99).[116] The 1,800 British Skyflash air-to-air missiles procured in the 1980s are presumed to no longer be in service. Both the AIM-9 and AIM-120 are being augmented, if not supplanted in the future, by the European short- to medium-range Infrared Imaging System Tail/Thrust Vector-Controlled (IRIS-T) (RB-98) and beyond-visual-range Meteor missiles.[117] Recent press reports reveal Sweden's procurement of a third batch of Meteor missiles to take place in 2025, although the quantity of both IRIS-T and Meteors currently in Sweden's stocks has not been disclosed.[118] Given that the number of these systems has not been made public, it is impossible to judge how apt Sweden is to sustain critical air-to-air munitions in a conflict. What can be said, however, is that whether they come from the US or Europe, they are vulnerable to interdiction and competition among other users.

Testament to Sweden's defense industry, Saab manufactures the RBS-15 family of antiship and land attack cruise missiles, which can be launched from the JAS 39, as well as surface ships and land-based platforms.[119] Of course, the total

number of these systems within the SwAF is not likely to be disclosed, but the fact they are indigenously manufactured boosts the SwAF's sustainment resiliency. To augment this system, as recently as February 2025, the Swedish Materiel Agency initiated negotiations with its German counterpart to integrate the Taurus KEPD-350 long-range attack system into the JAS 39 C and E, with initial operational capability expected in 2028.[120] The SwAF also maintains an aging inventory of less than 500 AGM-65 (RB-75) Maverick air-to-surface missiles and, more recently, 400 GBU-12 Paveway II 500-pound laser-guided bombs and 53 GBU-39 Small Diameter Bombs (SDB).[121] Assuming RBS-15 production to be relatively low-density and high demand given the rest of Sweden's modest air-to-surface munitions inventory, it is likely Sweden will be deficient in these weapons as well.

SwAF Air Base Security

Like the FINAF, SwAF air base security depends on both active security forces and ground-based air defenses and passive dispersion and fortification to enhance survivability while on the ground. The SwAF faces the same broad threats from Russia today as their Finnish counterparts.

On the ground, SwAF air bases and dispersed sites are defended by Air Base Jaeger platoons that specialize in both defense and personnel recovery, ground intelligence, and what the SwAF refers to as flight security, similar to the USAF's Ravens.[122] Jaeger platoons are operationally organized under the 25th Air Base Jaeger Company at Blekinge Air Wing (F 17), which is also responsible for their training.[123]

The core of the Jaeger Company is the patrol, and central to the patrol is the use of military working dogs to locate isolated personnel and enemy forces, avoid detection, or act as protection against mines.[124] Though variable based on the mission, typical patrols are six people and one dog, consisting of a chief, deputy, dog handler, two medics/hunters, and a sniper. Historically, according to their official website, "their role in combat reconnaissance was carried out through patrols aimed at disturbing, hindering, making contact with the enemy or gathering information. . . . The delay battle was carried out when an air base was under threat of being attacked by mechanized units."[125] It is difficult to determine how much the concept of the delay battle may still factor in Jaeger training, considering Russia's reemergence.

In addition to its Jaeger platoons and security forces augmentees from mobile ground crews, the SwAF depends on key lines of communication, supply points, and civil infrastructure to be defended by some of Sweden's 21,500 Home Guard personnel. Home Guard task force companies are designed to

be mobile and may be specifically deployed to concentrate efforts in support of a dispersed basing area.[126] These Home Guard personnel are particularly adept at identifying and engaging small saboteur teams that are a persistent threat to dispersed operations.

Swedish ground-based air defense provides a layered approach with short-, medium-, and long-range missile systems to defend critical infrastructure, civilian populations, and military units from air and ballistic missile attacks. As with Finland, they are operated by the Army's Air Defense Regiment (LV 6) but under the control of the SwAF as part of its integrated air defense system.[127] At the top end, Sweden operates four US MIM-104 Patriot batteries (known as LvS103 in Sweden) with perhaps 100 missiles, according to the SIPRI database.[128] In November 2024, Sweden joined Germany, the Netherlands, Romania, and Spain in the joint procurement of 1,000 Guidance Enhanced Missiles (GEM-T) designed for better performance against ballistic missiles.[129]

Sweden received two medium-range MIM-23B (RBS-97) I-Hawk batteries in 1983, along with 100 missiles from the US.[130] Due in no small part to the war in Ukraine and that country's receipt of I-Hawk systems from international donors, the US in February 2025 opened a modernized missile service center for the I-Hawk at the McAlester Army Ammunition Plant in Oklahoma. The upgraded facility will restore, repair, test, and re-certify Hawk missiles that have reached the end of their normal service life.[131]

For short-range air defense, Sweden relies on four systems: the IRIS-T Surface Launch Standard (SLS) (RBS-98), RBS-23 Bofors Advanced Missile System Evaluation (BAMSE), RBS-70 Next Generation (NG) MANPADS, and RBS-90. Though not accounted for in SIPRI's database, the IISS's 2025 *Military Balance* report suggests Sweden operates eight IRIS-T SLS, which shares performance characteristics with its air-to-air counterpart. An article by *Defense Express* reveals that Sweden's Saab initially built three RBS-23 BAMSE batteries in 1999, but they were subsequently put in storage due to fiscal restraints.[132] These systems reemerged in 2019 to strengthen Sweden's air defenses, though there appears to be no indication that Saab will restart production. Indeed, the backbone of Swedish point defense continues to be the RBS-70 NG laser-guided MANPADS made by Saab.[133] The RBS-90 is due to replace the RBS-70, offering greater speed and maneuverability than its predecessor.[134] As with other internally produced systems, production figures for the RBS-70 have not been disclosed, but the system has been widely proliferated to at least 21 countries, suggesting a healthy supply line.[135]

The SwAF achieves dispersion in two ways: local and regional. By utilizing alternative runways apart from main operating bases and by dispersing air-

craft at multiple individual ramps spread throughout a base cluster, it can disperse aircraft locally. When the SwAF deploys to highway strips or civil airports disassociated from base clusters, it achieves regional dispersion. Given the 100 JAS 39 Gripens in the SwAF's current inventory and assuming all 100 aircraft dispersion sites from the Cold War, the aircraft-to-runway ratio is 1:1. However, this ratio does not take into account the numerous dispersed parking areas Sweden is known to have. Moreover, in the time since the Cold War, at least some of the previously utilized highway strips are likely to have fallen into disrepair.

Determining the extent of the SwAF's underground air base facilities is similarly challenging to ascertain given publicly available information. A 1955 article in the US Naval Institute's *Proceedings* magazine by William Hessler serves as a foundation for understanding the SwAF's underground passive defenses: "The Air Force has been constructing rock hangars at various bases. These are just what the term implies—great underground hangars hewn from the solid granite, around the margins of operational landing fields, with provision for storage of ammunition and spare parts, and working spaces for repair of planes and overhaul of engines. Protected against strafing and skip bombs by armored doors and from high-level bombing by 50 or 75 feet of granite, these rock hangars represent the ultimate in security for operational aircraft on the ground."[136]

Perhaps the best historic example of a "rock hangar" exists today as the Aeroseum museum at the former Göta Air Force Base (F9) near Gothenburg along Sweden's west coast. Decommissioned in the 1990s and declassified in 2003, this 22,000 square meter (~237,000 square feet) mountain hangar provided space for an entire squadron of fighter aircraft, as well as maintenance and munitions facilities alongside an above-ground runway.[137]

Multiple sources reference the proliferation of these hangars across Sweden. Without elaborating, Bitzinger notes, "several BAS 90 sites in northern Sweden have shelters tunneled out of rock."[138] A more contemporary acknowledgment comes from Solli et al. in their 2022 article for *LUFTLED* when they confirmed "Sweden has a few mountain hangars to protect the aircraft before they disperse to the bases in wartime."[139] Again, the extent of these mountain hangars does not appear to be available in the public domain, given the declassification of the Göta Air Force Base mountain hangar as recently as 2002. What can be said with some confidence is that Sweden has such hangars integrated into its dispersion concept, and it continues to operate them.

SwAF Training

Sweden conducts significant joint, partner, and service-level exercises annually to sharpen basic proficiency and practice integration with advanced tactics and procedures. Unlike the FINAF, the SwAF does not appear to adhere to a consistent or predictable exercise schedule, making it challenging to comprehensively assess the scope of its training activities without presenting an exhaustive list. However, several notable examples underscore the SwAF's emphasis on dispersed basing as a key training objective, including Air Defence Exercise 2022 (LFÖ 22), Aurora 23, and the forthcoming Basic Function Exercise 25 (BFÖ 25).

LFÖ 22 took place over 10 days from 16 to 25 May 2022, to exercise planning, management, and execution of air defense operations at MOBs and dispersed sites in central and southern Sweden.[140] Specifically, the SwAF used a combination of five active and auxiliary bases at Såtenäs (F 7), Ronneby (F 17), Kalmar (previously F 12), Linköping/Malmen (previously F 3), and Uppsala (F 16), along with up to six additional dispersal sites involving approximately 2,500 personnel.[141] According to a press release, at least two highway strips were also used for air and ground crew proficiency training.[142] Notably, Finland participated in LFÖ 22 by deploying six F/A-18 Hornets, one PC-12NG liaison aircraft, and around 80 airmen to integrate into the functions at Såtenäs Air Base.[143]

From 17 April to 11 May 2023, 26,000 personnel from Sweden's Army, Air Force, Navy, and Home Guard, as well as 14 other partner nations, took part in Aurora 23, the largest joint exercise in Sweden in over three decades.[144] A NATO press release described the exercise's intent to conduct both offensive and defensive air operations, intelligence, surveillance, and reconnaissance operations, as well as close air support and strike missions. The same press release quoted Colonel Anna Siverstig, Commander of the Swedish Air Warfare Centre and exercise director for the Swedish Air Force and Air Defense, as saying, "Aurora 23 enhances Sweden's capacity to respond to an armed attack and the Swedish Air Force will conduct dispersed operations, using wartime air bases and civilian airports, to counter air to ground attacks." [145] Interestingly, for added realism, Swedish radio broadcast a mobilization announcement to commence Aurora 23 and rehearse their national mobilization procedures.[146] The scope and scale of Aurora 23 not only demonstrated Sweden's growing interoperability with NATO partners but also reinforced its readiness to defend national territory through realistic and strategically dispersed operations.

BFÖ 25 is projected to take place from 28 April to 9 May 2025, and intends to strengthen air base capabilities on the ground by rehearsing dispersion concepts with SwAF personnel, Home Guard soldiers, and conscripts.[147] The

scale of BFÖ 25 is significantly smaller than either LFÖ 22 or Aurora 23, utilizing just two MOBs and two dispersion sites. The intent appears to be much more part-task-training oriented, like the FINAF's Baana series, while potentially preparing some participants for the Nordic Defence Cooperation's (NORDEFCO) ARCTIC CHALLENGE 25 that follows from 26 May to 14 June 2025. The latter, exercise ARCTIC CHALLENGE 25, intends to focus more acutely on combined air combat integration between Finland, Norway, Sweden, and Denmark.[148]

Together, LFÖ 22, Aurora 23, and BFÖ 25 highlight the SwAF's deliberate emphasis on dispersed operations, force readiness, and multinational interoperability. While the SwAF may not follow a regular exercise cadence like its Finnish counterpart, the substance and objectives of its training events demonstrate a focused approach to maintaining a high degree of readiness. These exercises enhance Sweden's operational flexibility and defensive capabilities and serve to deepen integration with NATO and regional partners.

Part 3: Implications for the USAF and ACE

The USAF in Europe cannot hope to precisely mirror either the FINAF or SwAF's dispersed basing concept, given that the USAF operates as an expeditionary force along exterior lines, restricted by distance and partner nations' restraints. However, there are still aspects of the Finnish and Swedish concepts that are within the USAF's control, namely, mobile ground crews with organic transportation, specially designed air base clusters and regional dispersion sites, decentralized execution, and cross-functional training.

Key to FINAF and SwAF dispersion concepts, ground crews must be able to move on their own to auxiliary runways, ramps, and maintenance areas apart from the MOB within a local base cluster and further afield to regional sites. Though perhaps not labeled as such, the FINAF and SwAF employ local and regional dispersion within their hub-and-spoke models. Indeed, FINAF and SwAF air base clusters consist of a central main operating base surrounded by one or more auxiliary landing strips (highways) with multiple parking aprons for local dispersion. US air bases in Europe and elsewhere might consider local dispersion operations first and expand ramp space, not for efficiency, but for the specific purpose of dispersion. Correspondingly, ground crews should be equipped with organic ground transportation to travel relatively short distances away from the main base to support these auxiliary sites. Where possible, adjacent highway sections and civil airports should be co-opted for military use and outfitted with pre-staged equipment. The SwAF's previous Bas 90 and current mobile basing system emphasize the

relative proximity of auxiliary locations within the same base cluster to lean on the main base for resources while still obfuscating aircraft locations. Ground crews and aircraft on the ground must be mobile enough to achieve the deceptive effects of the shell game while still generating combat power. Moreover, maintenance and other flight operations must be augmented by mobile security forces teams to defend assets from air and ground threats. This amounts to potentially dozens of convoy operations, leveraging sustainment from both main bases and pre-positioned stocks operating in series and parallel over the course of multiple sortie days based on the threat.

Base clusters are further augmented by regional dispersion sites, like civil airports or remote highway strips. Having a combination of local and regional dispersion sites creates resiliency in the system, guarding against both area weapons and unitary munitions. The former, area weapons, which might affect an entire air base cluster, should be countered with a regional dispersion concept, while unitary or even cluster munitions that require precise geolocations are complicated by parking aprons and runways dispersed locally. Fortifying and applying camouflage and concealment techniques to parking aprons, hangars, and runways further enhances resiliency in both local and regional examples. Finding the right balance between local and regional dispersion should be informed by the threat and available resources.

Notably, while both the SwAF and FINAF are experimenting with regional dispersal to other NATO installations to take advantage of recently acquired strategic depth, the research was unable to discern how these air forces intended to sustain themselves outside the radius of their ground logistics. Indeed, the FINAF's two EAD CASA C-295M tactical airlifters and the SwAF's eight C-130 and two Saab 340 transport aircraft are insufficient to support sustained dispersed operations outside their respective borders.[149] It is possible, through a mutual support agreement with NATO, that some services could be provided, like fuel, maintenance, and munitions, by NATO ground crews. Indeed, both the FINAF and SwAF are already doing this between each other and their Nordic neighbors in Denmark and Norway.[150]

Aircraft homogeneity and design characteristics of the FINAF and SwAF further contribute to successful dispersed basing operations. Both the FINAF and SwAF operate a single fighter aircraft type, the F/A-18C/D and JAS 39 Gripen, respectively. This makes training, parts, and maintenance from dispersed locations relatively easy when compared to the USAF, which operates multiple fourth- and fifth-generation fighters. Finland and Sweden's utilization of Western, namely US, weapons and the FINAF's acquisition of the F-35A should enable additional interoperability within NATO to operate equivalent systems. Sweden's commitment to the JAS 39 modestly complicates displace-

ment opportunities outside of Sweden; however, the platform's compatibility with US munitions and Western standards should allay these concerns.[151] Similarly, Finland and Sweden offer NATO the opportunity to forward stage and disperse from within their borders, assuming reciprocal agreements are in place to rely on FINAF or SwAF servicing of US or NATO aircraft.

Both the FINAF and SwAF emphasize decentralized execution as a critical component of their dispersed basing strategies. For the FINAF, their "dispersed, mobile battle concept" suggests an operational approach where smaller units can operate with a degree of autonomy from their geographically separated locations. The ability to rapidly deploy and rotate between numerous operating locations, as highlighted by the comparison to a shell game, necessitates that personnel at these dispersed sites are empowered to execute their tasks effectively with potentially limited real-time guidance. This is further supported by the cross-functional training provided to FINAF conscripts, enabling them to perform various support and maintenance tasks, suggesting an environment where individuals need to be adaptable and take initiative in the absence of highly centralized direction.

The SwAF explicitly employs what it refers to as "dynamic command," which is described as a centralized command with a mission command philosophy. This approach leverages the JAS 39 Gripen's TIDLS to provide a common threat picture to pilots, airborne controllers, and commanders, enabling informed decentralized execution. While command originates centrally, the SwAF places a strong emphasis on trust and coordination between different professions and levels, which are hallmarks of a mission command culture. Like the FINAF, the successful execution of their mobile basing system, where small teams rapidly rearm and refuel aircraft at dispersed highway strips, relies heavily on the ability of these ground crews to operate efficiently and effectively based on a broader understanding of the mission objectives rather than detailed, prescriptive instructions.

Recognizing their importance in dispersed operations, the USAF is already experimenting with multicapable airmen. A 2023 study by RAND lays out two distinct labor problems the service is facing: "First, the concept hinges on a significant number of airmen operating from austere forward sites with little external support and under the near constant threat of enemy attack. . . . Second, the concept requires a small personnel footprint at dispersed locations to limit exposure to adversary attack, reduce logistical demand, and facilitate rapid movement."[152] A 1983 RAND report by M. B. Berman and C. L. Batten makes three stark recommendations that are just as salient today as they were then: "Increase the reliability of equipment, increase onboard built-in support, and decrease reliance on support personnel."[153]

The FINAF and SwAF excel in cross-functional training out of necessity, with much leaner forces than the USAF. Accordingly, the FINAF and SwAF instill cross-functional competencies early in the training of their conscript force and practice it routinely with exercises like the annual Baana and Ruska series in Finland and Sweden's Air Defense Exercise 22, Aurora 24, and the Basic Function Exercise 25. Prime examples reside in the FINAF security forces who train to accomplish ground crew tasks and SwAF ground crews who also train to augment their Air Base Jaeger platoons. While specialized equipment like the SwAF's hand-cranked "fishing rod" are of intentionally simple design, perhaps more can be gleaned by adopting less bespoke technological solutions to reduce the complexity and maintenance requirements for USAF multifunctional Airmen.

Conclusion

The dispersed basing concepts developed by the FINAF and SwAF during the Cold War provide valuable insights for contemporary air forces confronting A2/AD threats. Influenced by their unique geopolitical contexts, especially Finland's extensive border and history of conflict with Russia, alongside Sweden's commitment to armed neutrality, both nations emphasized survivability through the distribution of their air assets. Essential elements of their strategies include specially designed air base clusters and regional dispersion sites, utilizing highway strips and civilian airports as auxiliary runways, decentralized execution via mission command, and cross-functional training of personnel, which often relies heavily on conscripts. The focus on mobility for both aircraft and ground support, combined with the deceptive nature of frequently changing operating locations, continues to pose a complex targeting challenge to potential adversaries.

While the USAF, operating as an expeditionary force, faces different logistical and strategic constraints compared to the interior lines enjoyed by the FINAF and SwAF, the core tenets of their dispersed basing strategies remain highly relevant to the USAF's ACE doctrine. The Finnish and Swedish experiences underscore the importance of mobile ground crews with organic transportation, the strategic development and utilization of local and regional dispersion sites, and the fostering of a culture of decentralized execution and cross-functional expertise. By adopting these principles, the USAF can enhance its survivability and resilience in contested environments, ensuring the sustained projection of combat airpower against numerically superior adversaries, mirroring the challenges both Finland and Sweden successfully addressed during the Cold War.

Notes

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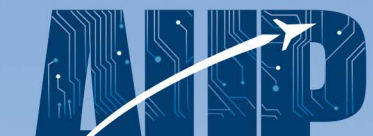
Abbreviations

AADA	Air and Air Defense Army
ABM	antiballistic missile
ACE	Agile Combat Employment
AGE	Aerospace-Ground Equipment
AMRAAM	advanced medium-range air-to-air missiles
APU	auxiliary power unit
BAE	British Aerospace
CAA	Combined Arms Army
CNA	Center for Naval Analysis
ER	Extended Range
EU	European Union
FCMA	Friendship, Cooperation and Mutual Assistance
FDF	Finnish Defence Force
FINAF	Finland Air Force
GRU	*Glavnoye razvedyvatel'noye upravleniye*
IAP	*Istrebitelnyi Aviatsionnyi Polk*
IFS	Institute for Defence Studies
JAS	Jakt Attack Spaning (fighter, attack, reconnaissance)
LRU	line replaceable units
MDAA	Mutual Defense Assistance Act
MOB	Main operating bases
NATO	North Atlantic Treaty Organization
NGA	National Geospatial-Intelligence Agency
NIMA	National Imagery and Mapping Agency
SAM	surface-to-air missiles
SDB	small diameter bombs
SIGINT	Signals Intelligence
SIPRI	Stockholm International Peace Research Institute
STOL	short take-off and landing
SwAF	Swedish Air Forces
TIDLS	Tactical Information Data Link System
TILS	Tactical Instrument Landing System
TIV	trend-indicator values
USAF	US Air Force
USAFE	US Air Forces in Europe



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