

Ambulance helicopter contribution to air based search and rescue in North Norway during 2000-2010

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Abstract

Background: Search and rescue (SAR) operations constitute a small but important proportion of the Norwegian ambulance helicopter services' workload. There is no common database for all SAR helicopter operations, because several different resources contribute to the operations, and there is no common definition of SAR in use among different services.

Methods: We performed a manual search through the mission databases for the three dedicated SAR and helicopter emergency medical service (HEMS) bases in our area, and the Joint Rescue Coordination Centre (North) database, for helicopter-supported SAR operations in the potential operation area of the Tromsø HEMS base during the years 2000-2010. We defined SAR operations as all missions above sea inside 10 nM from the coast line, all missions with rescue hoist or static rope, missions with an initial search phase, and all avalanches.

Results: There were 769 requests for helicopter support in 639 different search and rescue operations, and 600 helicopter missions were completed. The number of operations increased over the study period, from 46 operations in 2000 to 77 operations in 2010. The Tromsø HEMS contributed with the highest number of missions and the service also experienced the largest increase over the years, from 10 % of the missions in 2000 to 50 % in 2010. Simple terrain operations or sea operations dominated in the different sub-regions of the study area, but avalanches accounted for as many as 12 % of the missions. Static rope or rescue hoist was used in 141 out of the 639 operations.

Conclusions: We have been able to describe all helicopter supported SAR operations in our area by combining available databases and employing common SAR definition. The local HEMS service experienced the greatest increase in SAR operations, and further studies are suggested to understand the causes for the increase. We suggest that increased availability is one potential explanation.

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Background

Search and rescue (SAR) services in Norway are organised by the police authorities, and helicopter support for the operations has been provided by the Royal Norwegian Air Force's (RNoAF) 330 Squadron (1). However, an increase in SAR missions has been seen also by The National Air Ambulance Service's helicopter emergency medical service (HEMS) bases (2,3).

Theoretically, this increase may be explained by several factors: The total SAR workload may have increased, many operations contain elements of both pre-hospital emergency medicine and SAR, and some HEMS bases fill geographic gaps in the SAR helicopter coverage (2,4).

This is the case for the Tromsø-region in North Norway. The city of Tromsø is situated more than one hour flight from both of the two nearest SAR bases (Fig. 1). The University Hospital of North Norway Tromsø (UNN) HEMS base (Tromsø HEMS) has also experienced an increase in SAR work over the last ten years (3), and both recreational activities like skiing, hiking, and other outdoor sports, as well as the coastal fisheries and industrial activities may account for the increase.

The increase in SAR requests for the HEMS is potentially in conflict with a simultaneous increasing demand for ambulance operations in the area. Air ambulance operations is the primary responsibility for the base, and it is disturbing to note that a rising number of missions are rejected because the service is busy, or even off-line because of duty time regulations (3).

In order to describe and predict the current and future SAR workload in our area we have collected data about helicopter based SAR operations from 2000 through 2010 by all relevant helicopter services in region.

Methods

Study design

The study is a retrospective cohort study of all SAR missions requested in the potential catchment area of the Tromsø HEMS base during the years 2000 to the end of 2010.

Setting

In a narrow sense, the catchment area of the Tromsø HEMS is the same as the area covered by the UNN hospital trust, covering a population of 183 500 inhabitants and an area of 30 000 sq.km (5). However, the Tromsø HEMS occasionally operates outside the UNN area in the regions Vesterålen, South West of Finnmark County, and areas of Sweden and Finland close to the Norwegian border. We included all SAR operations in this extended area, as this is the potential area for the Tromsø HEMS. All areas referred to in the paper are shown in Fig. 1. Table 1 shows the helicopter resources available for SAR in the region. The localization of the same helicopter bases are shown in Fig. 1.

Ambulance missions for the Tromsø HEMS are dispatched and coordinated by the Emergency Medical Communication Centre (EMCC) at the UNN Tromsø, but all SAR missions are led by either the Joint Rescue Coordination Centre (JRCC) or the local police authority.

There are local hospitals with emergency capabilities in Hammerfest, Harstad, Narvik and Bodø, in addition to the regional trauma centre in Tromsø.

Data sources and variables

To achieve a complete overview of all SAR operations where helicopters were requested within the study area, we searched the mission databases of the RNoAF 330 Sq, the Tromsø HEMS, and the database of the JRCC in Bodø for SAR requests to locations within the defined study area. We recorded data regarding time of the operation, SAR location, SAR category, and which helicopter resource requested were recorded.

We defined a SAR mission as: mission conducted above sea inside 10 nM from the Norwegian coast line, all missions where rescue hoist or static rope from the helicopter was necessary, all missions with unknown localisation of the casualty necessitating an initial search phase, and all avalanches. We excluded second searches for assumed dead persons if the initial search had been without any results, but we included a second search if it was based on new information that increased the possibility to find the casualty alive. To include all these missions, the Tromsø HEMS database had to be searched manually for the entire study period, as no uniform definition had been applied for SAR missions.

The following terms are used consistently in the text: A SAR operation is one event that calls for coordinated SAR support. One operation may lead to a request for assistance from more than one helicopter resource. A request may lead to a mission if it is not rejected, and thus one operation may consist of more than one mission. The causes for not completed missions were classified as either: weather conditions below operational minima, technical failure, duty time regulations, or crew busy with other mission.

The recorded SAR missions were further classified as defined in Table 2 from the information given in the databases. If necessary, the actual crews that performed the mission were consulted for control.

Statistical analysis

For some of the parameters a simple linear regression line was calculated to visualise the average change per year during the study period, using Microsoft Excel[®] 2008 software.

Approval

The Hospital's Data Protection Officer approved the study.

Results

During the study period the six helicopter resources were requested 769 times for 639 SAR operations that fulfilled our definition. Quite often, more than one helicopter is requested in the beginning of an operation, and 600 out of the 769 requests resulted in completed missions. Consistent with our initial assumption, we found a steady increase in initiated operations per year from 46 to 77 from 2000 to 2010 (Fig 2). The missions were quite evenly distributed over the months of March to September, but occurred in reduced numbers during the dark season from October until February (Fig. 3).

Traditionally, the SAR squadron 330 has been dedicated to sea rescue. For this reason we compared the number of sea operations with the other categories (Table 2), and found that the absolute increase in sea-operations was lower than the increase in other categories (Fig. 4). However, the per cent increase did not differ between the groups, and the distribution of sea versus non-sea operations remained unchanged during the period (22 % vs. 78 %).

When we studied the frequencies of the different SAR categories (defined in Table 2) we found that operations into simple terrain was the prevailing category, and accounted alone for more operations than the sea-operations in all years but two (Fig. 5). Since the HEMS and SAR helicopter crews train especially for mountain rescue operations, it was also interesting to note that the categories “alpine” and “demanding terrain” comprised approximately 10 operations per year in the region. Alpine rescue operations are not common with no more than 0-3 operations per year. On the other side, avalanche rescue is a surprisingly prevalent category and increasing, with 8-13 operations annually.

Table 3 shows the six helicopter resources annual contribution to SAR operations. The most striking finding is that the Tromsø HEMS has increased its contribution from 10 % to 50 % of the SAR missions during the study period. Thus the Tromsø HEMS accounts for the most of the total increase. Even the 330 Banak, and to some extent, the 337 sq seen a small increase in mission numbers, but other resources have not contributed to the trend at all. Also seen in Table 3 is the fact that approximately 25 % of the requested missions were not completed, for

various reasons, like weather conditions, service busy with other missions, coordination of the helicopter resources, etc.

Because the crew composition and mission profiles are different between the dedicated SAR resources, the HEMS and the other helicopters, we set out to analyse the relative distribution of mission categories among the different resources (Fig. 6). Not surprisingly, we found that the dominating category for the coast guard's helicopter resource (the 337 sq) was sea rescue, and the dedicated SAR squadron also did between 25 and 30 % sea rescue. However, simple terrain rescue was the dominating category for all helicopters except the 337 sq. Missions into demanding or alpine terrain were slightly more frequent in the 330 helicopters, but comprised 14 % of the SAR workload for the HEMS.

Interestingly, avalanche rescue was not uncommon, and represented 12 % of all SAR missions in our study, and as much as 17 % of the Tromsø HEMS SAR missions. The absolute figures are lower for the 337 and 339 squadrons than the 330 and HEMS bases, and the Hammerfest helicopter was omitted from the Fig. 5, as it participated in three sea-operations only during the entire study period.

Rescue without landing the aircraft is important for all categories of SAR missions, probably with the exception for simple terrain missions. Most SAR helicopters operate rescue hoists to meet this demand, whereas the Norwegian HEMS helicopters use a fixed length static rope under the aircraft to place the Rescueman/ Paramedic close to the target and to evacuate victims. We found that 237 persons were rescued from the scene by hoist or static rope, in 141 out of the 639 operations, and there was an increase in hoist and static rope operations over the 11 years. An exception to this trend was caused by one single operation in 2000 where 26 persons were hoisted from a wrecked ship, an occasion that was extraordinary and accounted for almost 10 % of all persons evacuated by hoist or static rope during the period. It was therefore omitted from the graphic presentation in Fig. 7, only to emphasise the general trend.

The other helicopter resources' contribution to hoist and static rope operations during the study period is shown in Fig. 8. As expected, the two dedicated SAR helicopter resources have contributed in the majority of these operations, with annual workload varying between 1 and 20 persons per year. The other trend that

may be seen over the years is that the Tromsø HEMS performed static rope missions from 2007, with the exception for one single mission in 2003, and the number of rope missions seems to be increasing.

Prior to this study we had seen a gradual increase in SAR workload for the Tromsø HEMS, particularly in favour of land missions, and we suspected a relationship between this increase and leisure activities like alpine skiing and with avalanches. For this reason we analysed the SAR data by region (defined in Fig. 1), and we found that the Tromsø region accounts for more than 200 of the 639 SAR operations (Table 4). This was not unexpected, as it is the most densely populated area in the region, with the Tromsø HEMS base, and with mountains around the city that are popular for skiing and alpine sports. Also the alpine Lyngen area and central regions of Troms County showed a slight increase during the study period.

To explore this assumption further, we studied the distribution of SAR categories in each of the regions we had defined (Fig 9). Operations in demanding terrain showed the highest relative frequency in the Lyngen and Tromsø areas and the Ofoten region (19-25 %). Alpine operations were far less prevalent (0-3 %), but relatively common in Lyngen (6 %). Avalanches constituted a significant part of the SAR operations in Lyngen (24 %) and Tromsø (17 %), but only 2-9 % in the other areas.

Simple terrain was the most common SAR category in most sub-regions. The exceptions were sea rescue (18-53 %) that was found to be the most prevalent category in Northern and Central Troms and in the Vesterålen area. In the continental areas of the Eastern Troms simple terrain accounted for as much as 81 % of all operations. The regional differences in helicopter resource usage showed that the nearest resource was preferred, followed by the other resources according to their distance from the region (Figure 10). Interestingly, the armed forces' 339 sq was the primary resource in the continental part of Central Troms, the area with 81 % simple terrain missions, and vast mountainous areas often used for hiking activities.

Discussion

The distinction between HEMS operations and SAR operations may not be distinctly clear. Many SAR operations rescue traumatised or acutely ill patients, and also in some of the ambulance missions the patients may be evacuated from locations not readily accessible to ground ambulance resources. To overcome this challenge, we defined a SAR mission as described earlier, excluding many of the ambulance requests to located patients outside areas accessible by ground resources. As the SAR definition may differ between different services, earlier attempts to compare data from the regions helicopter resources have not been feasible. For this reason, we conceived the present study, to be able to understand the recent changes in SAR operations supported by helicopters in our region.

One interesting finding in the present study is the magnitude of helicopter-based SAR in Northern Norway. As the local police authorities and the JRCC may scramble more than one helicopter resource during one and same operation, no less than 769 requests came to the helicopter resources during the 639 SAR operations that were started within the geographic area of the Tromsø HEMS. This figure excludes operations farther out than 10 nM from the coastline, and comprises an area with no more than approximately 250 000 inhabitants. However, we believe the vast geographic area and the low population density in the northernmost counties of Norway (2-7 inhabitants per sq km² (5)) at least in part may explain the high number of helicopter-based SAR operations.

Another striking observation is that the Tromsø region accounted for more SAR operations than other regions, and that the Tromsø HEMS participated in far more SAR missions than the other resources did, including the two dedicated SAR helicopter bases. It is important to note that this finding is based on a definition of SAR operation that excludes a significant part of the SAR operations at sea, by limiting our search to operations inside 10 nM limit from the coast line. Nevertheless, the Tromsø HEMS increased its contribution to local SAR operations from 10 % to 50 % of the missions over the study period.

One major problem with the growth in SAR operations for the Tromsø HEMS is the fact that the total number of missions lies close to the service's limits. The

Tromsø HEMS has over the last five years experienced more hours where the service is inaccessible for the health care service because of duty time limitations (3), and even more often the HEMS is forced to choose between simultaneously occurring requests. During 2008-2011, the service cancelled between 13 and 18 of the requested missions because of duty time limitations. During the same period, approximately 30 missions were cancelled annually because of a coexisting request or mission. The figures may seem small, but these figures were close to zero before 2000. Even though the SAR contribution to the total workload of the Tromsø HEMS is no more than about 5 % of all missions, we must expect that the service will not be able to increase the number of SAR operations in line with changes during the study period. In addition, the regional health trust rely on effective air ambulance services to ensure optimal patient flow between hospitals, and the HEMS will also have an important role to transport important categories of emergency patients to specialised care, e.g. intensive care units, coronary intervention laboratories, neurosurgical and trauma centres.

The design of our study does not allow us to answer to what extent the observed increase in HEMS contribution is a result of increased availability. Still it is a fact that HEMS static rope missions has been developed during the years of the study period, and HEMS has thus become an important supplement for alpine and demanding terrain operations in the area. The Tromsø HEMS is located close to the accident scenes in the Tromsø and Lyngen regions, compared to the dedicated SAR helicopters that are more than one hour of flight away. Thus the resource may respond quickly, and the total mission time is shorter and the costs lower than the alternatives. Furthermore, only a limited number of the operations demand the specialised competencies of the SAR helicopters, like long line operations, rescue hoisting and operations off the shore.

Another interesting observation is the relative frequency of simple terrain operations, i.e. where the helicopter often will not be the only way to evacuate the patient. This category accounts for around 40 % of all operations for all but one of the helicopters, and it is unlikely that more than a limited number of these operations are urgently needed from a medical point of view. The medical content of the operations has, however, not been part of the present study, but this should be addressed in later research to evaluate the use of a limited health care resource

for SAR operations that could have been solved without the contribution of the HEMS. It is also intriguing us to question to what extent the SAR helicopter operations actually could have been solved without air support. In particular, the simple terrain operations seem interesting in this context.

The benefit from helicopter support is evident when the victim must be evacuated by rescue hoist or, in the case of the HEMS aircraft, static rope rescue. The annual number of hoist and rope operations has increased over the study period. The Tromsø HEMS has a long tradition in landing “light on wheels” in sloping terrain with the rotor running, and the majority of terrain missions are solved by this simple operation. For this reason, we were not surprised to find that all the static rope operations performed were in demanding or alpine terrain, and that the helicopter was important and often necessary for the evacuation of the victim. The ability to work in sloping terrain without hoist or static rope in the majority of the missions does probably lower the threshold to request the Tromsø HEMS for most terrain operations. This is in contrast to other countries where such evacuations would mandate a rope or hoist rescue (6).

In some of the SAR operations the victim will need medical treatment on scene and *en route* to hospital. This aspect was not part of the present study, but it is known from the off shore operations of the SAR helicopters that a significant amount of the patients are hospitalised and some may probably not have survived without early medical treatment and short transport time to hospital (7). We believe that the land operations we describe in the present study may differ from the off shore operations, and that the medical content of the operations should be addressed separately in a later study. This is particularly important in order to elucidate whether the observed increase in SAR missions for Tromsø HEMS can be justified.

Alpine skiing has become increasingly popular in the region over the last ten years, and we believe that this accounts for some of the observed increase in demanding and alpine terrain operations, particularly in the Tromsø and Lyngen regions. Avalanches constitute as much as 17-24 % of the SAR operations in the Tromsø and Lyngen, regions that both are close to the Tromsø HEMS base. These accidents are particularly demanding with respect to access time and crew training

(8,9). The Tromsø HEMS has specialised on rapid operations to allow search, rescue and medical treatment of avalanche victims within the narrow time frame of avalanche survival. There is no doubt that this may be an important and justified use of the HEMS resource, and we believe that the demand for mountain rescue operations may continue to increase in our area.

Recommendations from a consensus report for mountain rescue emphasize the need for rapid dispatch of the resources and integration into local EMS systems to secure a smooth transition from the pre-hospital environment to advanced hospital treatment (10). This is in accordance with the Norwegian organisation, where the hospital trusts are responsible both for the EMCC dispatch and the medical staffing of the HEMS physicians. However, the recommended access to the scene within 20 minutes and a maximum service diameter for the helicopter bases of no more than 50 km is based on central European geography and infrastructure, and does not make sense in the thinly populated North. On the other hand, direct access to the hospital based EMCC via the Norwegian emergency medical telephone number 113 is well known to the people and ensures robust integration and coordination of pre-hospital resources and also prepares advanced intra-hospital health care services for immediate preparedness when indicated. This has been demonstrated several times for avalanche victims and accidental hypothermia (11), and the system also provides immediate integration with other emergency institutions, like the police, fire brigade and JRCC.

Since the medical staffing in the 330 helicopters and the Tromsø HEMS are similar, the resources may supplement each other to a considerable degree, and only most specialised rescue missions have to be restricted to the dedicated SAR helicopters. The national air ambulance service operates with Rescueman/ Paramedic that fulfil a national standard (12), and a national recommendation for training and qualifications for HEMS physicians (13) is being implemented. Still the services are not completely interchangeable, as the HEMS is part of the health care trust's services, and the dedicated SAR helicopters are controlled by the JRCC. Co-ordination of the resources is accomplished by EMCC and JRCC co-operation.

It is tempting to suggest that at least some of the increase in helicopter operations in the Tromsø area and by the Tromsø HEMS point to a lack of adequate capacity for dedicated SAR helicopter resources. In deed, the fact that a high number of SAR requests originate in the gap between the 330 helicopter bases at Banak and in Bodø, has been taken into account for this notion.

The findings of the present study may support of this notion, but there are important questions to be answered: How much of the observed increase in SAR operations is caused by the fact that the Tromsø helicopter has become more available? How many of the helicopter operations could have been solved without a helicopter? We need to know more about the medical needs of our SAR patients.

Answers to these questions are important for the future structure of health care services in the region, for the future distribution of HEMS bases, and to decide whether the Tromsø area should have a dedicated SAR helicopter service, or whether the SAR “light” operations of the HEMS should be developed further and expanded.

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Tables and Figures

Table 1 Overview of helicopter resources available for search and rescue operations

Name	Base	Owner	Helicopter	Crew	Capacity ¹	Lifting capacity (Kg) ²	Max speed (km/h)	Flight endurance (hours)	Hoist /SR	Function
Tromsø HEMS	Tromsø	LAT ANS	Agusta Westland AW 139	Pilot, Doc, R/P.	3/2	1900	306	5	SR	HEMS/ Ambulance
330 Banak	Banak	RNoAF 330sq	Westland Sea King	Pilot x2, Navigator, Mechanic, Doc, R/P.	10/6	2500	230	5,5	Hoist	SAR
330 Bodø	Bodø	RNoAF 330sq	Westland Sea King	Pilot x2, Navigator, Mechanic, Doc, R/P.	10/6	2500	230	5,5	Hoist	SAR
339 Sq	Bardufoss	RNoAF 339sq	Bell 412	Pilot, Navigator ³	3/2 ⁴	1300	259	3,5	⁵	Military transport
337 Sq	Coast guard ships	RNoAF 337sq	Westland Lynx	Pilot, Navigator, Mechanic, R/P	3/1	1200	305	4	Hoist	SAR, Fishery surveillance ⁶
Hammerfest	Hammerfest	Statoil	Eurocopter EC 225	Pilot x2, Mechanic, Doc, R/P.	6/2	3500	270	5	Hoist	SAR resource petroleum industry

¹ Stretcher / passenger capacity. Crew not included

² Total lifting capacity (including fuel, crew, patient, cargo etc) in kilograms, in role configuration (ambulance or rescue).

³ For some periods staffed with General practitioner and a Rescueman/Paramedic. Available only daytime hours.

⁴ In transport configuration, the capacity is 9 passengers.

⁵ The helicopter is equipped with hoist when staffed with Rescueman / Paramedic.

⁶ Squadron based at Bardufoss AFB, but mainly deployed at coast guard vessels operating off the Norwegian coast

Abbreviations:

LAT = The National Air Ambulance Service, RNoAF = Royal Norwegian Air Force, HEMS = Helicopter Emergency Medical Service, Sq = Squadron, SR = Static rope, Doc = doctor, R/P = Rescueman / Paramedic.

Table 2 Definition of operation/mission categories	
Mission categories	Definition
Sea	Coastal waters inside 10 nM from Norwegian coastline
Simple terrain	Flat terrain. No belaying necessary.
Bratt lende	Sloping terrain. Evacuating an immobilised patient will require belaying. Normal movement is done without belaying.
Alpint lende	Steep alpine terrain. All movement requires belaying. Demanding rescue operations that may require use of climbers.
Snøskred	Avalanche accidents

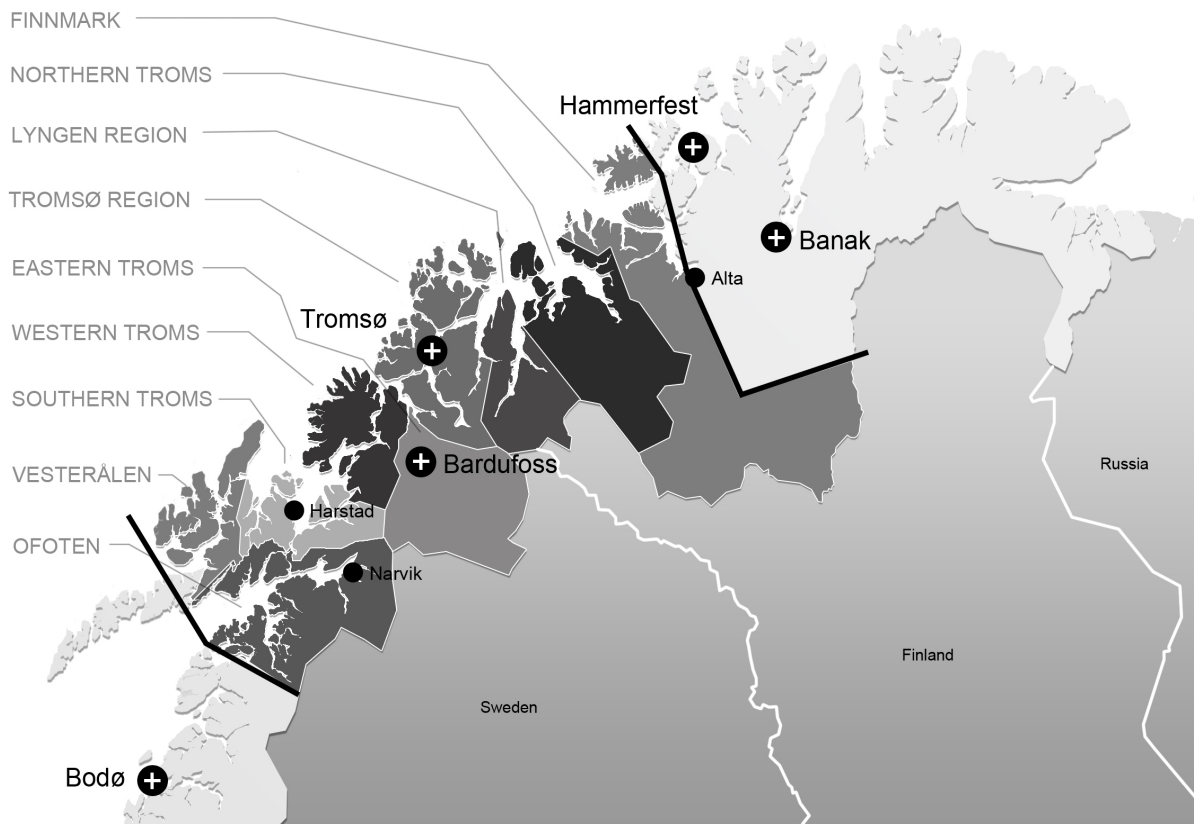
Table 3 Requests and completed missions by helicopter resource, as described in table 1.

	330 Banak		330 Bodø		Tromsø HEMS		337 Sq		339 Sq		Hammerfest		Sum	
	Req	Comp	Req	Comp	Req	Comp	Req	Comp	Req	Comp	Req	Comp	Req	Comp
2000	19	13	13	11	5	4	1	1	13	10	1	1	52	40
2001	13	8	12	12	16	12	4	2	8	8	0	0	53	46
2002	12	9	8	7	19	18	2	2	11	9	0	0	52	45
2003	14	11	17	13	25	22	3	2	14	13	0	0	73	62
2004	16	10	14	10	20	15	0	0	11	10	0	0	61	45
2005	15	11	15	12	25	18	2	1	7	7	0	0	64	49
2006	13	10	17	13	18	13	3	1	5	5	0	0	56	42
2007	20	14	17	14	35	25	5	5	12	7	0	0	89	65
2008	22	18	14	10	35	29	4	3	12	9	2	2	89	71
2009	26	22	14	10	36	29	8	8	3	3	0	0	87	72
2010	19	15	18	13	48	34	6	4	2	2	0	0	93	68
SUM	189	141	159	125	283	219	38	29	98	83	3	3	769	600

Table 4 Annual operations by geographic region, as defined in Fig.1

	Finnmark	Northern Troms	Lyngen region	Tromsø-region	Eastern Troms	Western Troms	Southern Troms	Ofoten	Vesterålen	SUM
2000	10	2	5	11	4	0	1	9	4	46
2001	4	4	6	15	3	1	2	8	1	44
2002	5	4	0	23	3	3	3	3	3	47
2003	7	3	2	22	8	5	3	8	4	62
2004	11	1	5	13	6	5	0	6	5	52
2005	11	4	3	17	3	4	4	2	8	56
2006	5	6	2	12	4	2	1	10	5	47
2007	5	5	9	25	3	7	3	8	4	69
2008	8	4	5	17	13	10	2	9	2	70
2009	12	6	8	21	6	4	2	7	3	69
2010	9	6	7	30	4	6	4	7	4	77
SUM	87	45	52	206	57	47	25	77	43	639

Figure 1: The potential catchment area for the UNN HEMS is shown within the thick black lines, and the sub-regions referred in the text are shown.



Flight leg	Distance (km)	Flight time ¹
Banak-Tromsø	235	66
Bodø-Tromsø	324	105
Banak-Bodø	527	160

Cities	Helicopters	Hospitals
Hammerfest	Banak	Hammerfest
Alta	Hammerfest	Tromsø
Tromsø	Tromsø	Harstad
Harstad	Bardufoss	Narvik
Narvik	Bodø	Bodø
Bodø		

¹ Flight time in minutes, at zero wind. In addition to this, all helicopters have up to 15 minutes dispatch time.

Figure 2: Requested (black line) and completed (grey) SAR missions per year with linear regression lines (thin lines) for trend.

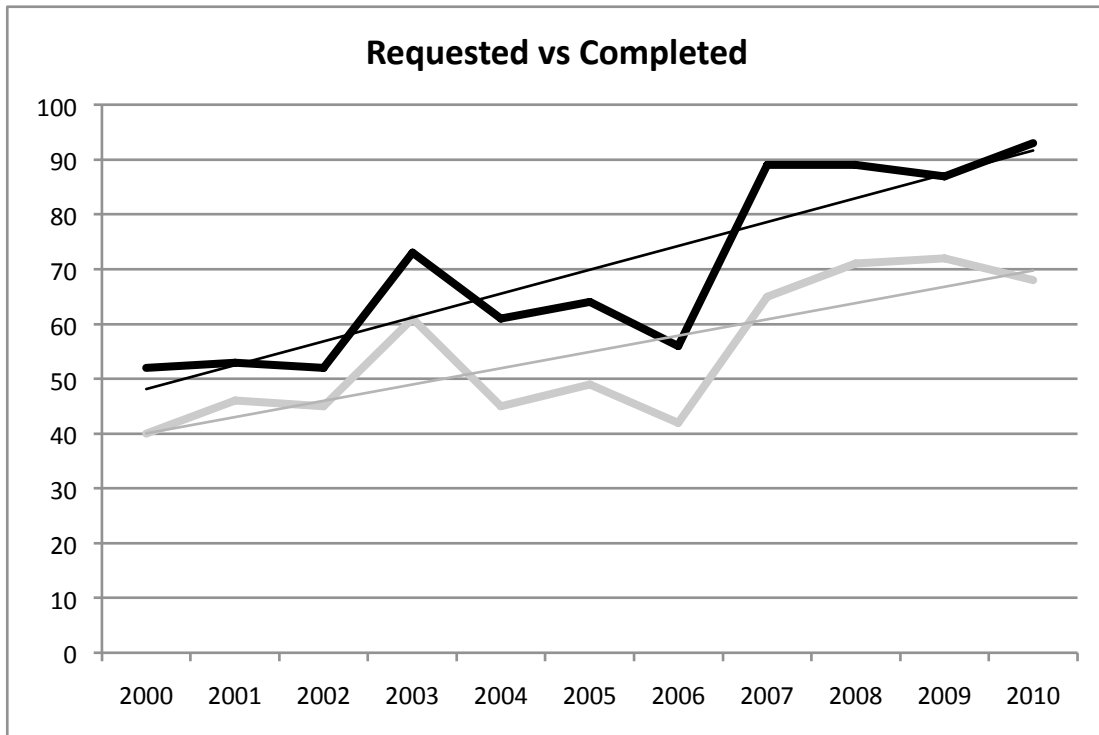


Figure 3: All operations during 2000-2010 split by month of the year.

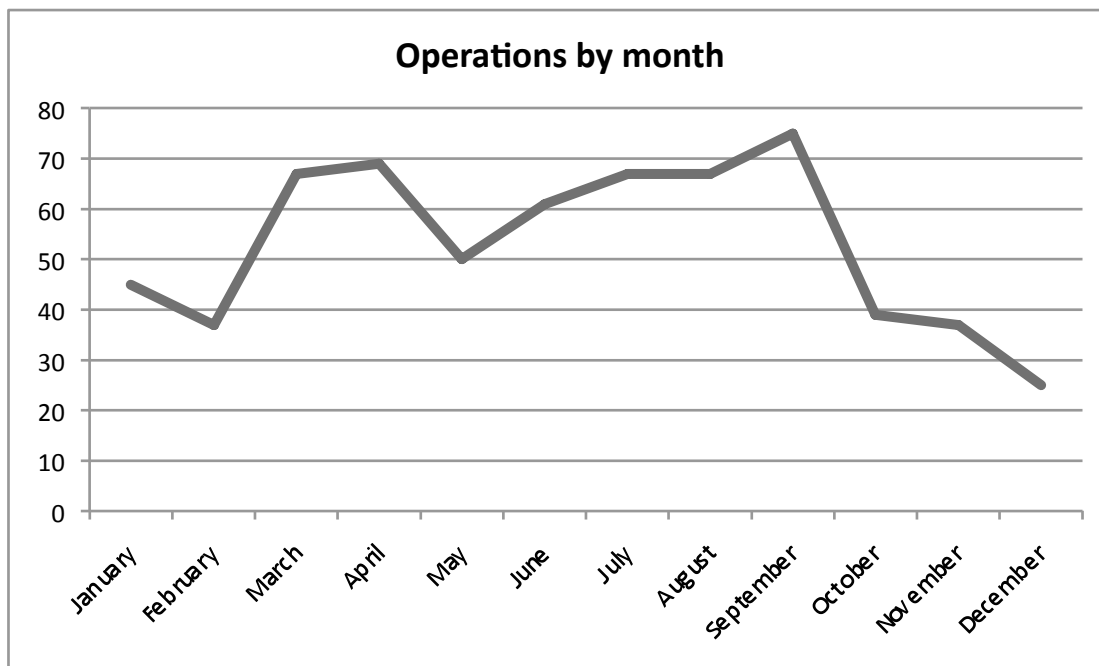


Figure 4: Land (black line) and sea (grey) missions per year

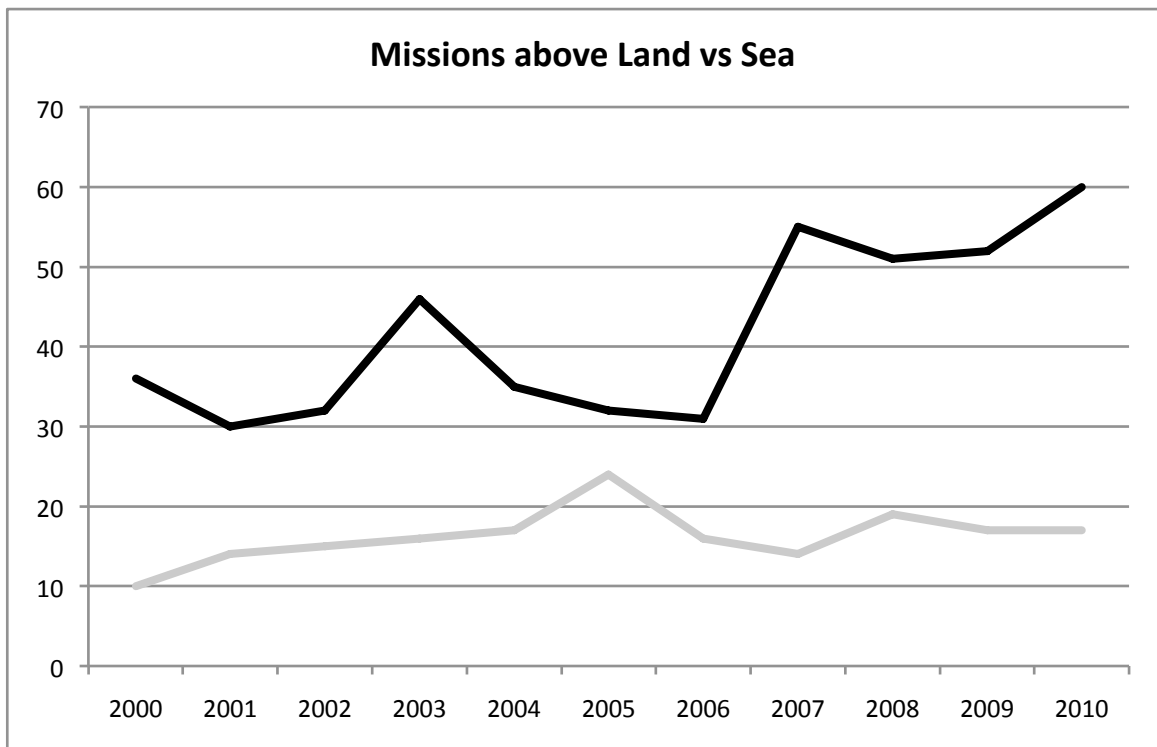


Figure 5: Annual number of missions by category, as defined in Table 2.

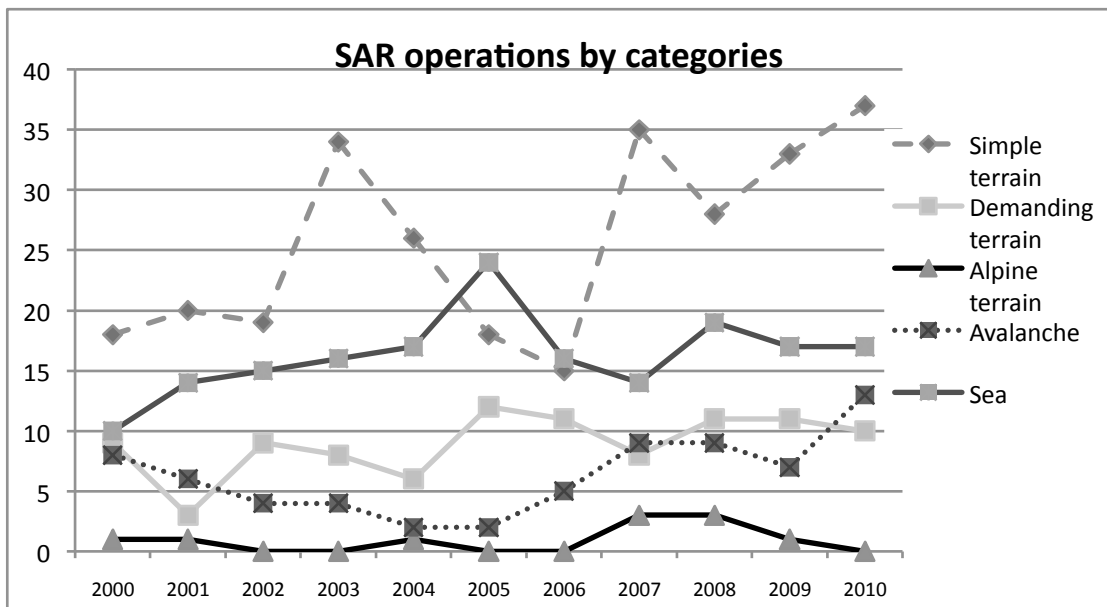


Figure 6: The relative distribution of mission categories for all helicopter resources in 2000-2010. Hammerfest helicopter omitted as it participated in 3 sea operations only.

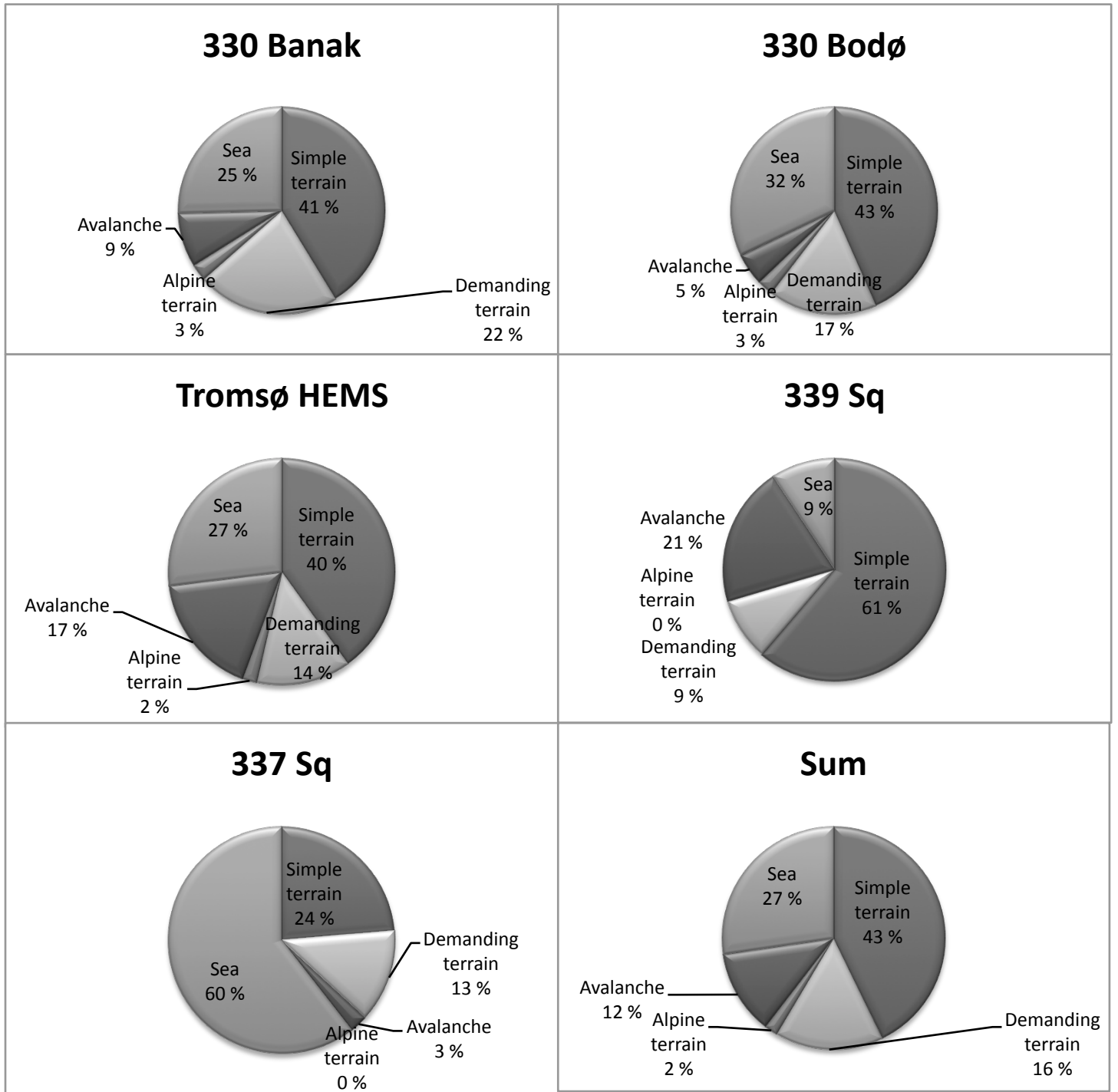


Figure 7 : Annual number of persons rescued by hoist and static rope (n=211 in 140 missions). A simple linear regression line assuming a linear trend over the study period is indicated (straight thin line). One single operation in 2000 is omitted as it contains 26 casualties in one single operation.

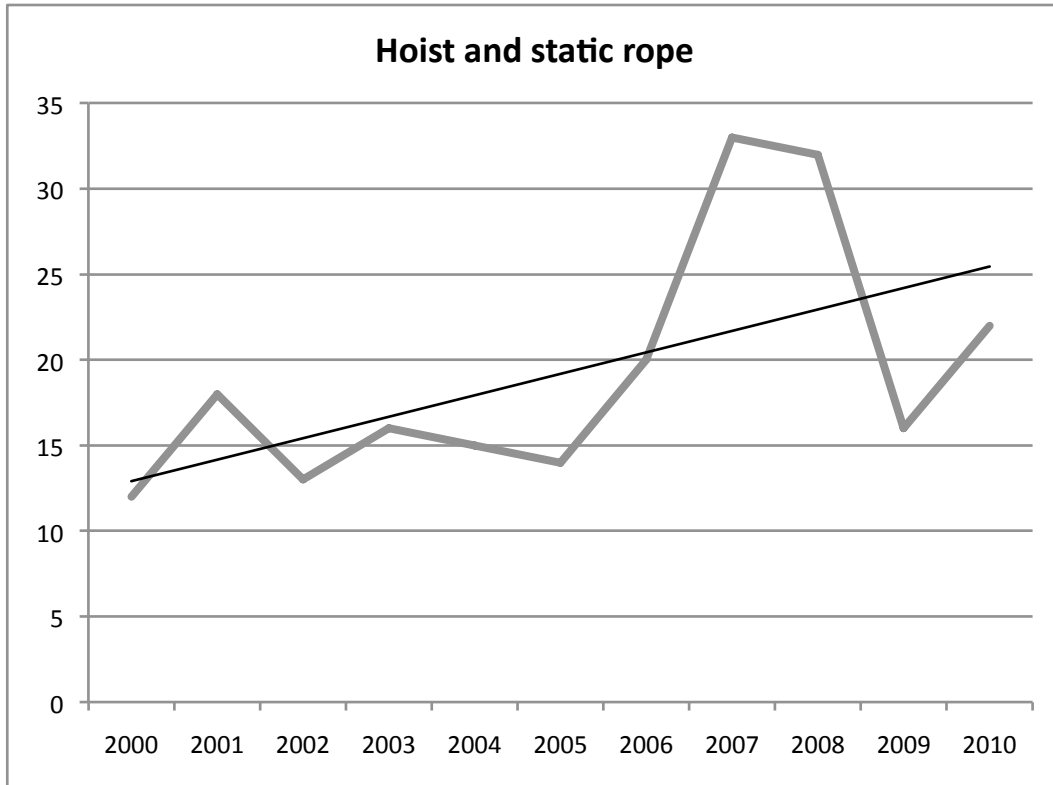


Figure 8: Persons evacuated by hoist and static rope per year, split by helicopter resource as defined in Table 1. The Hammerfest helicopter has been omitted as it has been used for hoisting on only one occasion in 2000.

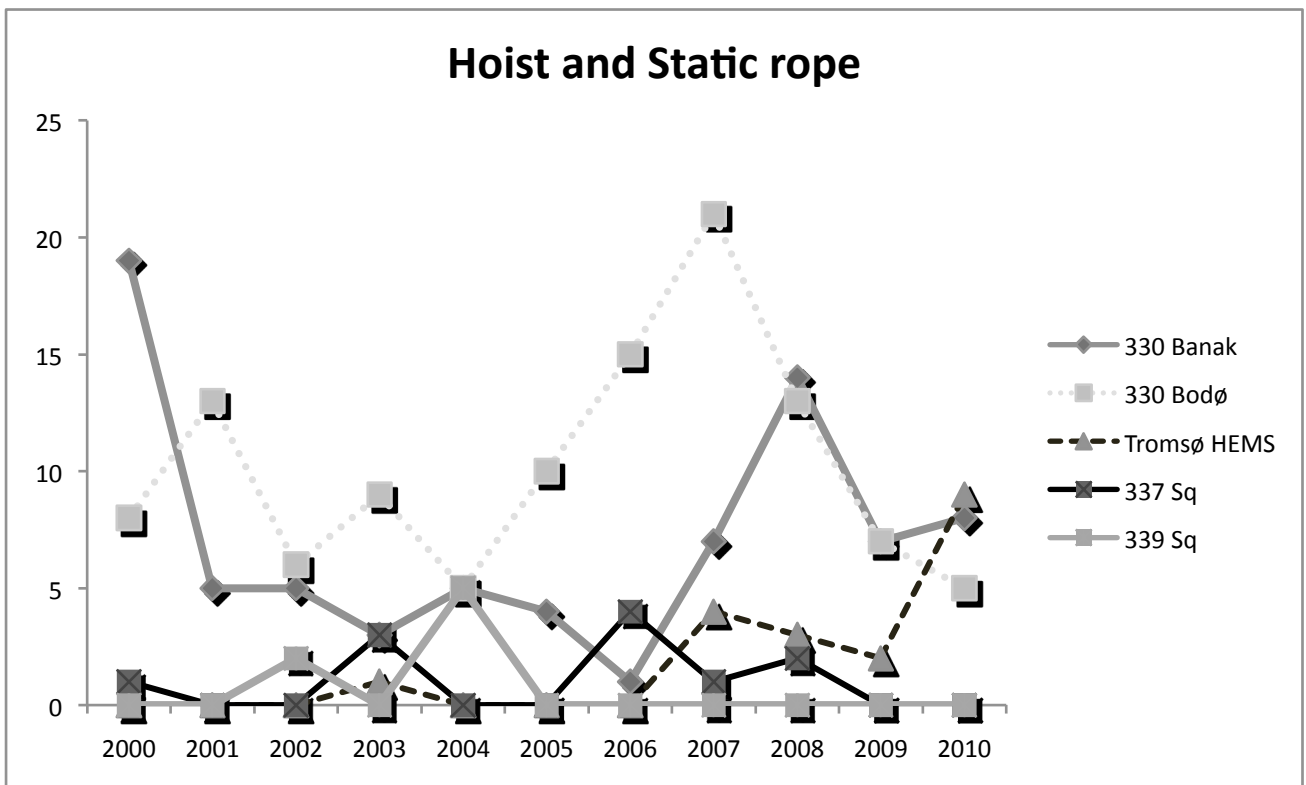
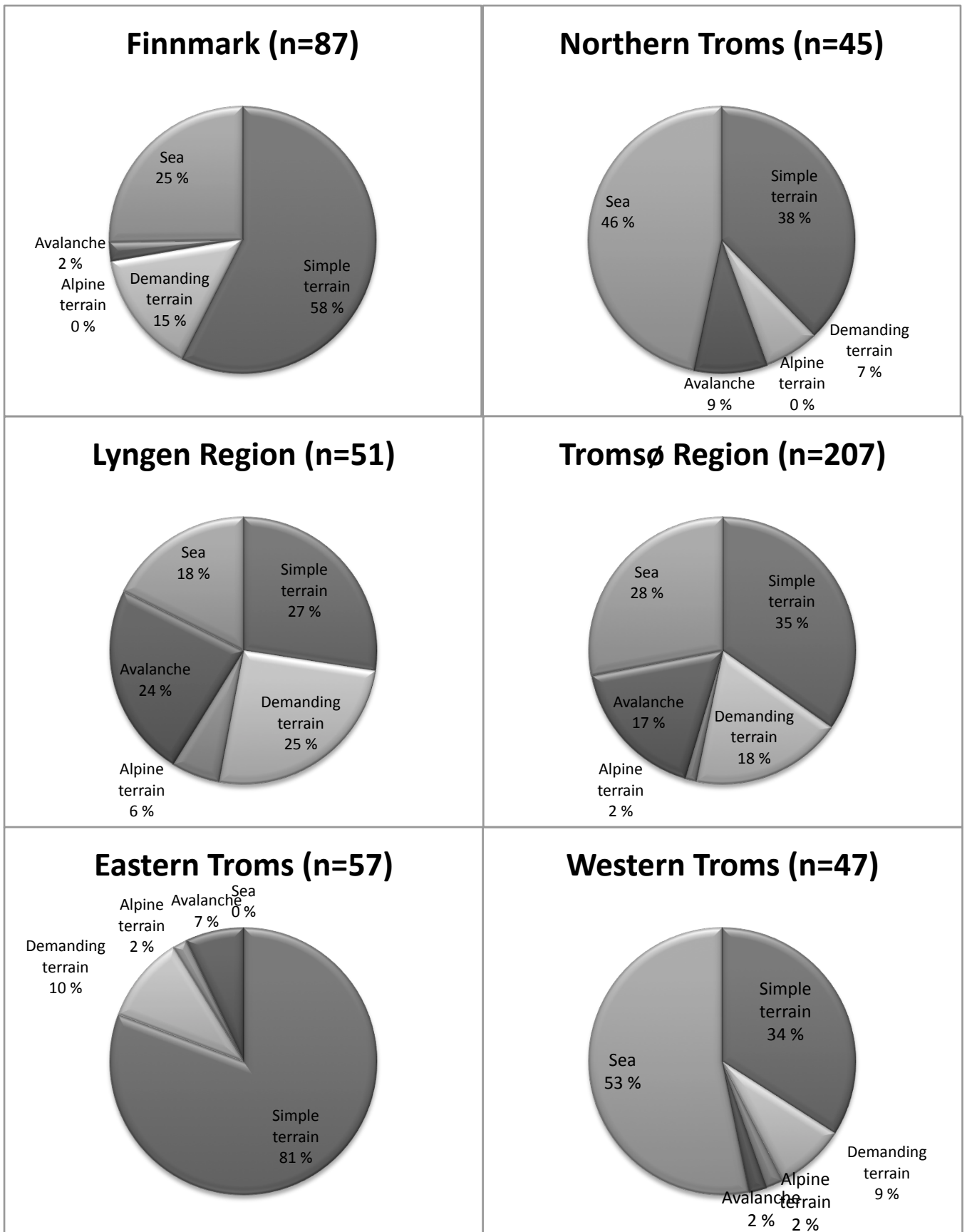
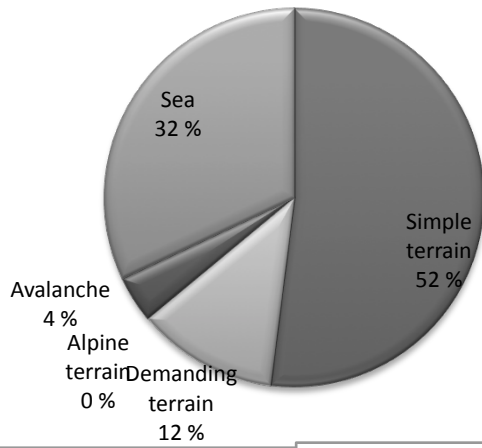


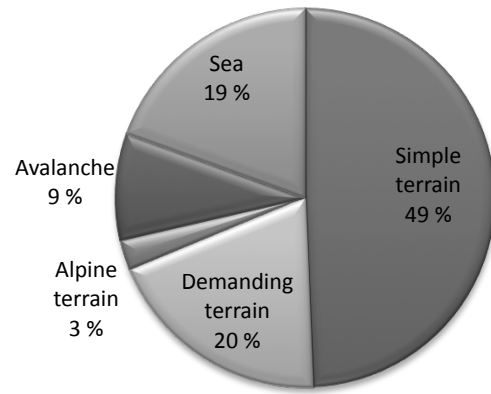
Figure 9 : Relative distribution of operation categories per region.



Southern Troms (n=25)



Ofoten (n=77)



Vesterålen (n=43)

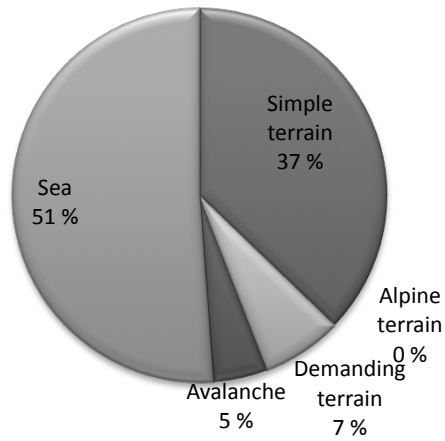


Figure 10: The relative contribution of the different helicopter resources per region for all operations in 2000-2010. The Hammerfest helicopter is not shown, as it only contributed at two operations in Finnmark and one in Troms.

