



**BASELINE DATA
FOR
FOREST FIRE CONTROL**

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2.1 Management Policies for Forest Fire Control

Consideration of general background facts

Before the onslaught of the industrial revolution almost 50% of the land surface of the world was covered with forest. In 1955 this area had been reduced by half, and in 1980 the original pre-industrial revolution area was estimated to be only 20% of the land surface.

Today, we can therefore say that every country must be concerned about the threat of fire to their forests.

The full comprehension regarding the negative impact of forest fires on the environment and the economy might not be clear enough.

When seeing a wildfire on communal land, grassland, savannah, and so on, many people may think that there is no reason to worry as there is nothing for the fire to damage and no losses will occur. On the contrary however, it can be proved that every wildfire causes some loss or damage to the environment and to the balance of nature.

Damage and fire loss can be summarised as, for example:

- lack of fuelwood for the people for cooking and heating purposes;
- economic losses in valuable timber plantations and forests;
- large scale soil erosion starting after a fire on steep slopes (soil erosion in turn causes other problems, such as siltation of the rivers and dams); and
- damage to the environment and natural resources.

Fire on the land or in forests can be either intentional or unintentional.

The intentional fire is usually under planned human control and has some beneficial objective.

The unintentional fire, or wildfire, is not under human control and normally causes damage to the natural resources and to the human population.

Unintentional fires are usually caused by one of the following activities:

- Grassfires for grazing purposes.
- Slashfires for cultivation.
- Prescribed burning for fire prevention in fire hazardous areas.
- Prescribed burning for silviculture (slash, litter, and debris burning for clearing, road maintenance, etc).
- All outdoor burning for farming, hunting, camping, ranchers, against animals, etc.

Long term experience of wildfires has shown that they are difficult to control without practice, and therefore that these fires may spread out of control. That is why in most countries a large number of forest fires start from some kind of controlled burning. There are also problems in not being able to differentiate exactly between arson and unintentional fires.

When a policy of forest fire management is worked out the first step should be to formulate clear directives and rules, and if needed, guidance for the people and farmers on how, where, and when to light a fire. A person may be allowed to light a fire on common land but who is then responsible for it?

When the rules and directives for forest fire control are laid down care will have to be taken of, and adaptations made to:

- the general protection needs and values of the land and forests;
- the farmers needs for fire in cultivation; and
- the use of fire in local conditions, considering religion and traditional uses by the rural people.

Often there exists a strong conflict between legislative forest fire control and the traditional ways of using fire in the rural areas. This is why all the traditional uses of fire by the rural people cannot always be taken into serious consideration.

If traditional fire methods are to be accommodated in the objectives of forest fire control it will need long-term planning and step by step education to achieve changes in the people's attitudes and ways.

2.2 The Objectives for Fire Control in Different Types of Forest

It is the responsibility of the high political authorities in government to determine the objectives and the extent of the National Forest Fire Control Programme. This is because government funds will be required to run the organisation.

Determining the full extent of national fire management will depend on the one hand on all the added costs, and on all the estimated and added benefits on the other.

Some of the products and benefits from the forest are difficult to value in economic or monetary terms, others are impossible. For example:

- hunting and camping;
- aesthetic values; and
- other recreational activities.

The objectives of fire protection on different types of land and forest will alter depending on their economic and environmental values and on the overall utilisation of the areas.

In forest fire management, land and forest areas can be divided into two main groups:

- (i) Protected forest areas (high value).
- (ii) Second growth or non protection requiring forest/land areas (non or very low value).

Maintenance of the forests and lands by the type of utilisation can be divided as follows:

- (i) Plantations.
- (ii) Forests under economic management and silvicultural forests.
- (iii) Multiple use forests and general mixed forest.

- (iv) Protected forests, natural and national parks (for wildlife, camping, tourism, etc.).
- (v) Farmers' forests (agroforestry).
- (vi) Livestock and cattle ranching and other areas of cultivation.
- (vii) Hardwood areas, such as savannah, etc.

The level of fire protection must be as high as possible in commercial plantations and silvicultural forests. Economic losses and damage are usually very high when an accidental fire occurs in these types of forests.

As opposed to the coniferous forests, in some of the broadleaf forests fire protection could be set at a very low level since these areas usually contain tree species that are very fire resistant.

Other broadleaf forest areas could have some special value or purpose, for the prevention of soil erosion for instance. In this case the level of protection must be high.

The use of fire on grazing lands is a common practice, but for fire control purposes it is important to ensure that the lands are burnt at the proper time of the day and year, and at the right frequency.

Any plantation or intensively managed commercial forest should not be established before sufficient funds have been allocated for fire protection and effective fire management. Also, the planning in regard to both the preparedness and fire suppression should be up to date. Plantation areas always involve important economic values and it is therefore worthwhile to allocate more than average amounts of money for fire protection to these areas. The protected forest could have different values and objectives, such as wildlife protection and the prevention of soil erosion on steep hillsides.

Often, the protected forest areas will also require intensive fire management control.

2.3 Forest Fire Management Plan

Successful forest fire management and the obtaining of good results presupposes profound and overall planning. The forest fire management plan should include:

- the objectives of fire protection;
- fire prevention;
- the procedures when a fire occurs; and
- suppression activities.

It is better to prepare separate plans for the different types of forest areas, such as plantations, protected forest areas, etc.

The fire plan should include information on the following:

- (i) a responsible personnel list;
- (ii) duties;
- (iii) activities; and
- (iv) preparedness for a fire.

It must also be planned at different levels:

- (i) government level;
- (ii) provincial and / or district level; and
- (iii) local or municipal level.

The most important, and also the most detailed plan, is the local fire plan. Before every fire season the fire plan must be re-checked. Planning and checking is the duty of the authority responsible for forest fire control.

Before starting fire management planning the following background information has to be obtained.

- (i) Description of the protection areas:
 - fire management objectives of the different areas;
 - ownership and utilisation of the land and forest areas.
- (ii) Fire history, coded by:
 - day and month;
 - time of day;
 - cause of fire;
 - size (estimated in hectares);
 - location (map co-ordinates, municipal);
 - types of fuel (forest, brush, grasslands).
- (iii) Fuel types of the main areas:
 - special fire hazard areas such as slashed areas and plantations;
 - history of the fire, rates of spread;
 - any special difficulty in fire control in the different fuel types.
- (iv) Climatic conditions and fire seasons (for each year and for each individual month of the year):
 - temperature: average, maximum, minimum;
 - humidity: average, maximum, minimum;
 - rainfall: average per month;
 - burning index: average;
 - fire season: start date, ending date (month).
- (v) Settlement conditions, wildfire regulations, and ways of the people:
 - rural and urban areas;
 - commercial forests and farming areas;
 - traditions, regulations, rules, and legislation for the control of wildfires;
 - means of transport, public roads, forest roads and tracks, etc.
- (vi) Alternative organisations who are responsible for fire control:
 - duties and responsibilities of the main governmental organisation;
 - results from other potential organisations.

A basic fire management plan will include information on the following items:

- (i) forest areas and fuel types;
- (ii) responsible organisation(s);
- (iii) fire prevention plan.
- (iv) fuel hazard reduction work;
- (v) fire danger measuring system;

- (vi) fire detection plan;
- (vii) fire reporting;
- (viii) alarm systems and communications;
- (ix) fire suppression plan;
- (x) fire suppression management plan;
- (xi) co-operating personnel;
- (xii) equipment and tools;
- (xiii) supplies;
- (xiv) safety measures; and
- (xv) maps and records.

If the fire plan and organisation is established for the average fire situation, it could then happen that there will be insufficient resources and provisions for a very serious fire situation. Figures show that statistically, most damage occurs during a severe fire situation and during the very few large fires, which account for only 10% of all fires.

2.4 Losses Caused by Forest Fires and Economic Aspects of Fire Management

The effect of economic losses and the total damage caused by forest fires will affect the people and the country as a whole. This is the basic reason for the organisation of forest fire management.

It will be possible to give a more accurate estimate of the economic losses if there is a clear view of the natural resources and if the full values placed on them are used. In addition, information of burnt areas and fires occurring during the past few years is needed.

By going through this regionally accurate analysis of loss and damage a regional fire risk record map can be created. This fire record map is needed for decision making by the fire management organisation to determine the level of its involvement and its authority.

The key questions to put forward to the authorities of government would be:

- What funds are available each year to support forest fire protection?
- How much damage (in hectares) is caused and how much money is lost per year?

Two simple rules to remember are:

- (i) If minimal funds are spent on fire protection then a weak protection force will result and the consequence could be a lot of damage.
- (ii) If maximum funds are spent on fire protection then an effective protection force will result and any consequent damage will probably be very small.

The optimum solution must be somewhere between these two.

A traditional and simple method for evaluating forest fire losses is to evaluate the loss against the amount of burnt area and to apply this to an established average price per hectare for the different types of forest. By using these basic facts the annual forest fire losses have been calculated, based on the total burnt area. In countries where timber production represents a large share of the national economy the effects of fire protection can best be calculated by showing the actual value of the timber.

Evaluating the real and total loss is not so simple and straightforward. In addition to the burnt forest, many other types of loss can occur. The total loss caused by the fires may only be known several years afterwards, for instance, in regard to soil erosion and the damage that follows soil erosion. The appraisal of fire damage in the case of recreational resources for instance is also extremely difficult.

The loss of human life caused by a forest fire is not an everyday occurrence, but is it so rare that it should be considered negligible? Also, financial resources are consumed in the fire. Both these facts must be calculated in order to achieve the total losses caused by a forest fire.

Naturally, the loss of houses, other buildings, roads, farmland, and such like must also be added to the total value lost.

Statistics based on average figures obtained from many countries show that less than 10% of all fires cause more than 90% of all the damage, and that these fires have a higher than average intensity.

Because of this, there is a need to consider at what level the forest fire organisation should be supported and from where the reserve forces may be obtained when a large fire occurs.

One principle that the fire manager must never forget is that the main purpose of the fire organisation and the fire budget is to minimise the damage caused by fires to the parent organisation.

The most important facts for an effective fire management programme and for its economic appraisal will be obtained from the accrued statistics on the number of fires, burnt areas, damage and loss, and suppression costs.

2.5 Climate and Fire Seasons

Those people who have been dealing with forest fire control will know that the weather elements have a big influence on the behaviour of fire, such as:

- the ignition of fires;
- the spreading of fires; and
- the degree of difficulty of fire suppression.

A very important condition for combustion is the moisture content of the fuel. The vegetation and the forest fuels absorb moisture during periods of precipitation and lose it during dry weather. This is why an analysis of the climate will form a sound basis for the right timing of the forest fire control activities.

The climate is related to forest fires in two ways:

- (i) it determines the length and severity of the fire season; and
- (ii) as vegetation depends largely on the weather conditions, it determines the amount and quality of the fuel available.

The climate is an expression of the weather experienced over a long time span at a certain locality.

The climate is usually expressed as the average of various weather elements and their reduced extremes. This information is very useful when a general picture of what might be expected from the weather is required.

For forest fire organisation purposes and for calculating the activity of the fire suppression units the following information about the local climate is needed month by month:

- Temperature.
- Precipitation.
- Humidity.
- The beginning and the end of the dry and rainy seasons.

With this information the local fire season, or fire seasons can be predicted quite accurately. Fire management organisations can use the climatic data to determine the local average fire occurrence over a length of time. To the climatic data the number of fires and burnt areas have to be added for use in any statistical analysis.

These facts when put together will give a sound basis for fire protection planning.

Month	Annual Average 1968 - 1977			
	Number of Fires	%	Area Burned in Hectares	%
January	13	-	30	-
February	6	-	7	-
March	43	-	541	-
April	651	7	20,895	2
May	2,012	23	166,202	14
June	1,493	17	438,563	38
July	1,906	22	370,915	32
August	1,781	21	151,172	13
September	507	6	14,517	1
October	222	3	4,420	-
November	44	1	1,714	-
December	6	-	10	-
Total	8,684	100	1,168,986	100

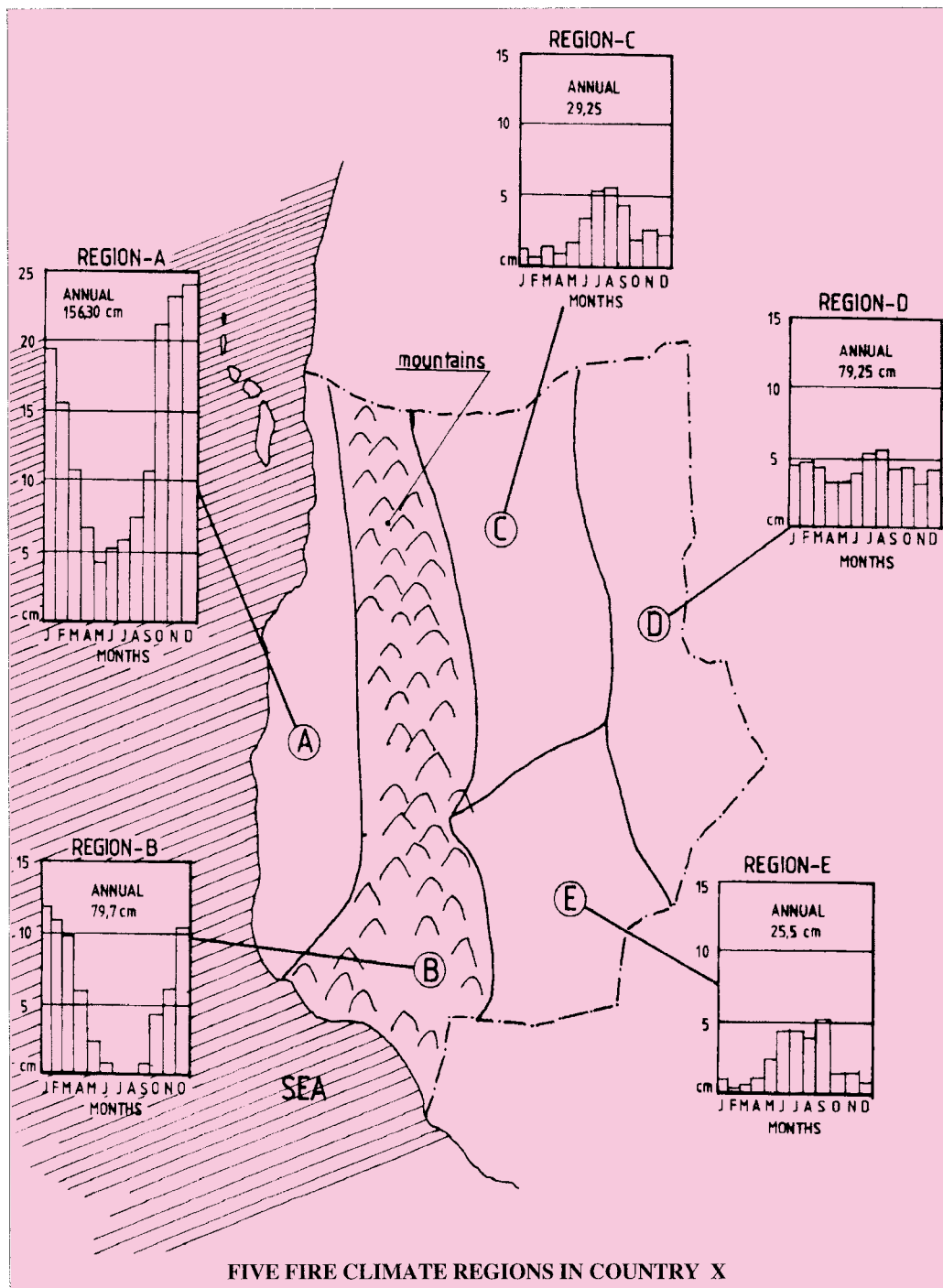
Enclosed statistical data from Canada; fire distribution by month

The fire climate of an area is dependent on its latitude, topography, and position relative to large bodies of water. In high latitudes the fire season is usually quite severe, but relatively short. The closer the area to the equator the longer, on average, the duration of the fire season will be.

If the country is very large and includes different climatic zones the differences between the zones must be considered. For planning purposes the country can be divided into the basic fire climate areas, according to the monthly precipitation, for example, and shown on a map.

This type of graphical information and pointing it out on a map will give a good review of the climatic differences between the areas, as well as indicating the approximate dates of the average fire season.

One special factor of the climate is LIGHTNING. The occurrence of lightning must be recorded as part of the fire climate, because lightning is statistically one of the biggest causes of forest fires.



FIVE FIRE CLIMATE REGIONS IN COUNTRY X

2.6 Climatic Regions and Ground Vegetation

One important basic consideration of fire management and planning is to know the main forest fuel types and the ground vegetation around the protected area. Climate also has a significant effect on the vegetation patterns.

Koppen (Chandler et al 1983) has developed a mathematical system of climatic classification that ties climatic regions directly to the main vegetation types. With this system the main vegetation types in relation to the annual mean temperatures and the total annual precipitation can be seen.

One example of how the local fire climate is statistically determined with this system is shown in the following table.

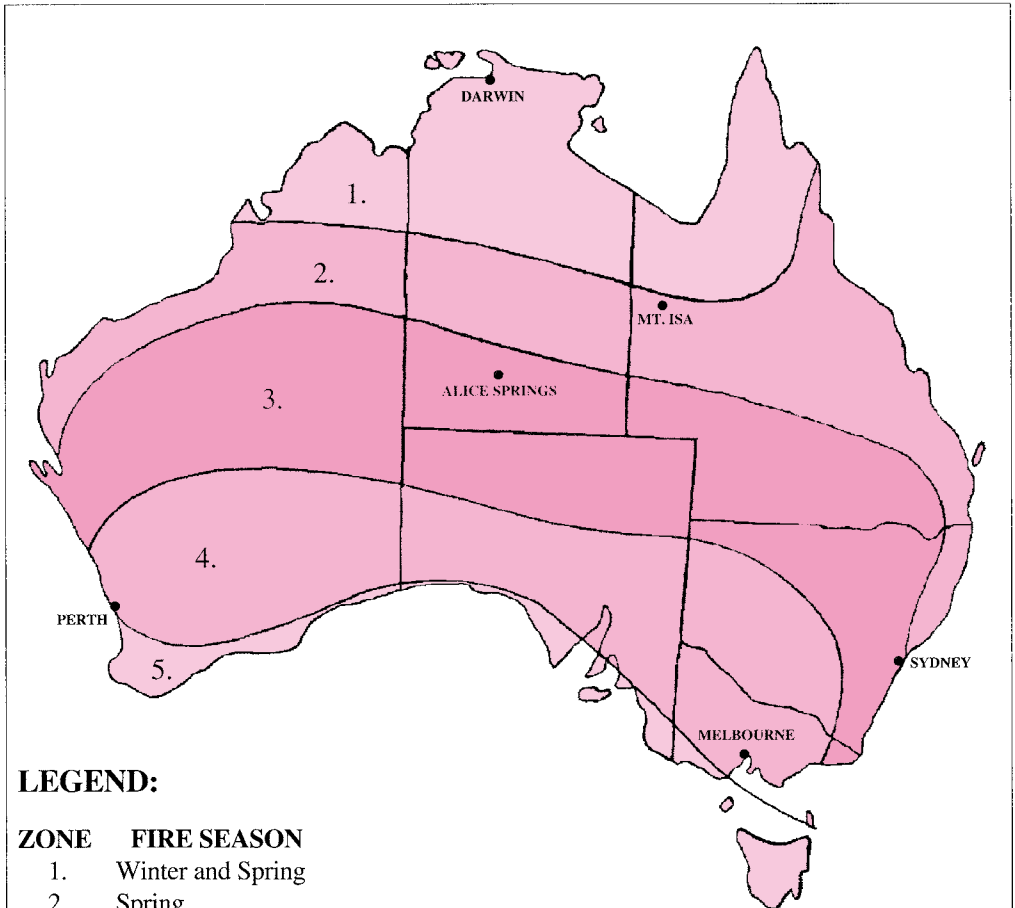
Month	Max T C	Min T C	DPT C	Precip (cm)	Snow (cm)	Days Precip	Day Length (hr)
Jan	15.6	4.4	3.3	1.3	0	1.4	9.1
Feb	17.2	5.6	3.9	2.3	0	1.4	9.1
Mar	19.4	7.2	5.6	2.3	0	3.0	12.0
Apr	22.2	9.4	7.2	3.6	0	4.6	13.4
May	26.1	12.8	9.4	2.8	0	3.7	14.9
Jun	29.4	16.1	12.8	1.3	0	1.4	16.3
Jul	32.8	18.9	15.0	0.3	0	0.1	14.9
Aug	32.8	19.4	16.7	0.5	0	0.3	13.9
Sep	29.4	16.7	15.5	3.3	0	4.2	12.0
Oct	25.0	12.8	11.7	3.3	0	4.2	10.8
Nov	20.0	8.3	5.6	5.1	0	5.7	9.1
Dec	24.4	14.4	11.7	2.0	0	1.8	14.3
Annual	23.9	11.7	-	28.6	-	-	-

Cover Type 8: Brush												
Mild Winter, Nonhumid, Long Burning Season												
Light Understory, Low Litter Weight												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Des
Fire Probabil.	0.65	0.57	0.65	0.57	0.69	0.85	0.96	0.97	0.69	0.62	0.16	0.36
Burning Index	17.0	2.10	24.0	29.0	37.0	37.0	43.0	25.0	24.0	22.0	26.0	15.0

Fire climate of Murcia, Spain, 37° 56' N, 1° 14' W, elevation 75 m

For fire management purposes more than merely the ground cover type must be known. As much as possible about fuel loading, the understory, litter, and the canopy should be known. Also when and how intensively the fires can be expected to burn. These facts are explained in chapter 5, Forest Fire Behaviour.

Finally, one example of a forest fire weather map. This map has been specially prepared in Australia. It will give a good example to the forest fire managers of how to assess the fire climate, the fire season, and the fire occurrence in their own areas.



LEGEND:

- | | |
|-------------|--------------------|
| ZONE | FIRE SEASON |
| 1. | Winter and Spring |
| 2. | Spring |
| 3. | Spring and Summer |
| 4. | Summer |
| 5. | Summer and Autumn |

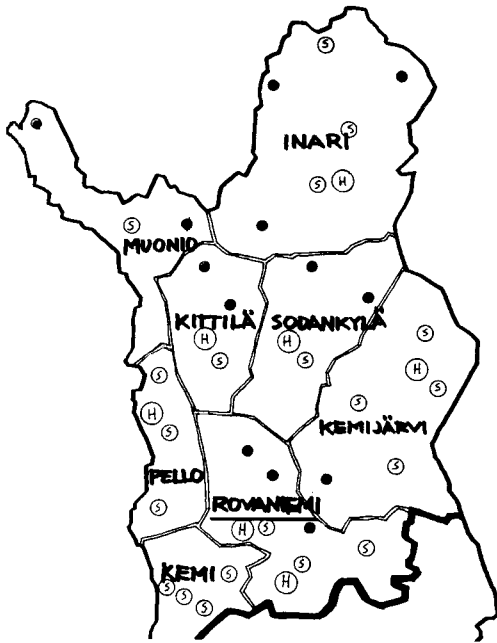
MONTHS OF THE FIRE SEASON

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1.	N	N	N	N	O	O	O	-	-	-	O	O
2.	-	O	N	N	N	N	O	O	-	-	-	-
3.	-	-	O	N	N	N	N	O	O	-	-	-
4.	-	-	-	-	O	N	N	N	O	O	-	-
5.	-	-	-	-	-	O	N	N	N	O	O	-

N = normal months when serious fires are likely to occur
 - = months where fire occurrence is unlikely
 O = occasional months when serious fires are likely to occur

Fire Weather Map of Australia

Some examples of fire management planning maps from Finland are given below.



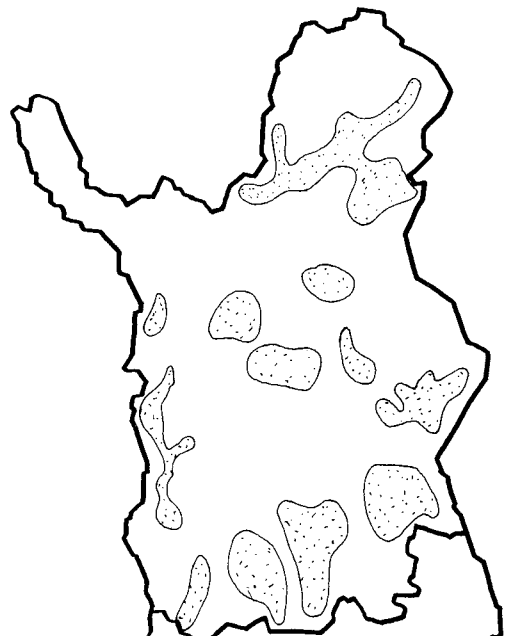
- Village fire unit
- Ⓢ Fire station, many units
- Ⓜ Forestry Headquarters
- ▬ Fire alarm region (responsible area)

Responsible areas and resources of the fire service in Lapland province



- Government
- Private

Owners of the forest areas in Lapland



Fire risk areas in Lapland