

THE SOCIAL CONTEXT OF FOREST FIRE MANAGEMENT ON THE ISLANDS OF LESVOS, CHIOS, AND SAMOS IN GREECE

A Report on Results of a Survey Conducted in Spring, 2004

Barbara Morehouse
University of Arizona
Tucson, Arizona, USA

Martha Henderson
Evergreen State College
Olympia, Washington, USA

Kostas Kalabokidis
University of the Aegean
Mytilene, Lesvos, Greece

Theodoros Iosifides
University of the Aegean
Mytilene, Lesvos, Greece

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This report is being published in fulfillment of a promise to those whom we interviewed. We promised we would send each of them a summary of what we learned from our interviews and field trips. We are also providing a copy of the report to the Fulbright Foundation in Greece, in appreciation for the travel support we received.

The findings and conclusions summarized in this report are entirely those of the authors.

Executive Summary

Greece has experienced devastating wildfires for the last two decades. Fighting these fires is becoming an expensive proposition for local, regional, and national governments. The loss of property, communities, ecological settings, and potential land erosion increasingly drains Greek communities and resources. The Greek Forest Service within the Ministry of Agriculture and the Greek Fire Service within the Ministry of Public Order have implemented new policies, developed fire management strategies, and integrated wildfire fighting with structural fire fighting. It is hoped that with these combined resources, along with research on Mediterranean ecosystems, land use practices, and climate conditions, wildfire management will improve and that the increasing demands of costly wildfires on each island are met. This report summarizes the results of a survey on the islands of Lesbos, Chios, and Samos to characterize fire management at regional and local levels, and perceptions of fire risk.

The research, conducted by a group of researchers associated with the Department of Geography, University of the Aegean in Mytilene – Lesbos, reveals useful insights into the ability of local fire managers to meet the demands of wildfire events. Based on interviews and background research, this report finds that “unknown” continues to be the most commonly cited cause of fires. Among the most important factors influencing changes in fire regimes on the islands are changing land use patterns and practices, and changes in climate and fuel conditions. While use of scientific information is not widespread, there are individuals on all three islands who regularly consult scientific sources. While fire policy is largely controlled at the national and European Union levels, local activity also occurs, most notably through the volunteer fire fighting organizations, interactions with local officials, and public education efforts. However, though seen as important, significant lack of financial support and resources exist to support public prevention programs.

The report concludes that prevention of fires on the islands, including the use of prescribed burning, is relatively inadequate, and that, although an intense interest in preventing the loss of communities and ecosystems is frequently encountered, public participation in fire prevention remains limited. The findings suggest that relying on local knowledge and fire managers’ decision-making abilities could improve fire prevention and reduce the cost of fighting wildfires. These people know the physical and human geographies of their specific islands, but feel hampered by the lack of equipment for both fire detection and fire fighting. In many ways, the local people are the storytellers and heroes of this intersection between humans and nature. Their voices emphasize the need limiting the destruction of wildfires on three invaluable Greek Islands of the Aegean Archipelago.

1. Introduction

Over the past two decades, Greece has repeatedly experienced devastating wildfires. These fires have taken a huge toll on the forest resources of the country and have incurred high financial, human, and ecological costs. In response to the situation, the Greek national government enacted significant changes in forest fire management policy in 1998. One of the most wide reaching changes of the new policy was a shift in responsibility for fighting forest fires from the Forest Service, located in the Ministry of Agriculture, to the national Fire Service, located within the Ministry of Public Order. The new policy also provided an increase in resources to fight fires throughout the country, yet fires continue to burn across sensitive forest and grass lands.

In Spring 2004, we conducted a survey on the islands of Lesvos, Chios, and Samos in the Aegean Archipelago (Map 1.1) to develop a better understanding of local perceptions of fire and its causes on the three islands, the policy framework within which fire is managed at local levels, the use of scientific information and technologies for managing fire and its risks, and concerns about future fire risk. This report summarizes the findings of our study and makes recommendations based on those findings.

Map 1.1
Study Areas in Northeastern Aegean, Greece, S.E. Europe



2. Brief Profile of the Study Sites: Lesvos, Chios, and Samos

The islands of Lesvos (area of 163600 hectares), Chios (84200 hectares), and Samos (47740 hectares) are among the many areas of Greece that have seen destructive forest fires in recent years. Although the specific cause of forest fire is frequently unknown, fire experts agree that almost all of the fires are set by people; many are set by accident, some are the result of arson. Most forest fires on the three islands of Lesvos, Chios, and Samos occur during the months of July and August, though the fire season extends from May through October. Burning of pasture lands for grazing and burning of pruned branches and other agricultural residues are among the most frequent sources of fires; most of these fires are small and are kept under control. However, in some instances, escaped agricultural fires have grown into major wildfires. Igniting fires is generally prohibited between May and November. During these months, fire managers enforce regulations. Penalties for breaking the law may include as much as two years in jail.

Between 1983 and 1992, the three islands experienced a total of 293 forest fires, burning a total of 17860 hectares. From 1993 through 2003, there were 971 fires and a total of 73440 hectares burned. While most of the fires were small, each of the islands experienced several large wildfires during the time period 1983 – 2003.

Patterns of population growth, economic activities, and land use practices provide an understanding of the context within which forest fires occur and are fought on the islands. Population declined in every decade between 1961 and 1991, with the largest decrease on all three islands occurring between 1961 and 1971. Population data as of 1991 illustrate trends on the islands. The 1991 population of Lesvos, 87151, was only 74.2% of the 1961 population; the Chios population of 51060 constituted 85% of the island's 1961 population. The 1991 population of Samos, 33039, was 80.3% of the island's 1961 population. By comparison, in 1991 the total population on all the Aegean islands, at 95.5% of the 1961 population, a considerably lower overall population decline. The 1981 to 1991 data for Lesvos, Chios, and Samos show some interesting variations in trends between 1981 and 1991: while Lesvos saw a continued decrease in population, virtually no change occurred on Chios, and Samos saw a small increase in population. Looking at the most recent census data of 2001, however, all three northern Aegean islands experience slight increasing trends compared to the 1991 population: Lesvos with 109118, Chios with 53408, and Samos with 43595 inhabitants.

Urban land use data provide additional background information useful for understanding fire issues on the islands. On Lesvos and Chios, urban land use decreased between 1961 and 1971 then increased over the next two decades. By 1991, Lesvos had 483 hectares in urban land uses and Chios had 445 hectares of urban use. On Samos, urban land uses increased steadily across the entire thirty years. The island added 26 hectares in urban land uses over the time period, for a total of 186 hectares of urbanized land. These changes reflect larger-scale population shifts from rural to urban areas and a related shift in patterns of rural land use and cultivation practices. It is now not at all untypical for rural land to be owned by residents of urban areas, who travel to their parcels of land at the end of the workday and on weekends to tend their olive groves and cultivated plots.

Not surprisingly, trends in the amount of land devoted to cultivation have declined or at best held steady over the thirty-year period 1961-1991 (the most recent data available to us). The number

of hectares of cultivated land on Lesbos decreased steadily over this time period, while on Chios, the amount of land devoted to cultivation declined in earlier years then leveled out between 1981 and 1991. Samos saw an increase in cultivated land between 1961 and 1971, followed by a decrease over the next two decades. Use of land for pasturage shows a slightly different pattern, especially on Lesbos where land used for grazing decreased between 1961 and 1971, then increased over the next two decades. On Chios and Samos, pasture land use decreased between 1961 and 1971, increased over the next decade, and then saw a small decrease between 1981 and 1991. Greece's accession to the European Union and migration of rural residents to urban areas – especially young women – have both played a significant role in changes in rural land use patterns throughout the country, including the islands. At the same time, development of prime rural lands, especially those near the sea, for vacation homes and tourist facilities is deeply changing the landscapes of the country, and especially of the islands. These changes have significant implications for the location, nature, and intensity of forest fires as well as with regard to the impacts of uncontrolled fires.

Forest lands increased on all three islands between 1961 and 1971 – the same decade that saw considerable declines in cultivation and grazing activities – then decreased over the following decade. Trends in forest coverage on the three islands, and for all the Aegean Islands combined are provided in Table 2.1 below, derived from the most recent data available to us.

Table 2.1
Trends in Forest Coverage 1961-1991 (hectares)

Islands	1961	% of Island	1971	% of Island	1981	% of Island	1991	% of Island
Lesvos	28780	17.5	32470	19.9	31460	19.3	30900	18.9
Chios	9550	11.5	10310	12.2	9710	11.5	9700	11.5
Samos	9000	18.8	10190	21.3	10120	21.2	10320	21.6
Aegean Islands	123810	13.8	129970	14.3	127620	14.0	126930	13.9

Sources: National Statistical Service & Forest Service, Greece

Fires over the past two decades, especially on Chios and Samos, have substantially reduced the amount of land covered by forest. Lesbos has fared much better, but remains at risk of the kind of denudation that the other two islands have experienced. Both Chios and Samos have experienced repeated burning, over short time intervals, of formerly forested areas. Such repeated burning virtually eliminates any possibility of natural forest regeneration on these lands. Indeed, most reforestation efforts have failed, resulting in a transition of many burned areas to shrublands and in increased soil erosion.

Of the various types of vegetation that make up the forests and woodlands on the islands (see Table 2.2), fire data indicate that most of the blazes occur in the brutia pine (*Pinus brutia*) forests and, to a somewhat lesser extent, in shrublands. On Chios and Samos, sclerophyllous evergreen woodlands may also experience significant fire events.

Table 2.2
Forest and Woodland Structure, by Species (hectares)

Island / Species	Forested Land	Percentage of Forest & Woodland Coverage
Lesvos		
Brutia pine	36878	39.0
Black pine	1041	1.0
Chestnut	416	0.5
Oak	9375	10.0
Plane	1458	1.5
Sclerophyllous evergreen woodland	45629	48.0
Total	94797	100.0
Chios		
Brutia pine	10001	20.0
Oak	834	2.0
Plane	416	1.0
Sclerophyllous evergreen woodland	37295	77.0
Total	48546	100.0
Samos		
Brutia pine	14376	27.0
Black pine	1250	2.0
Oak	2084	4.0
Sclerophyllous evergreen woodland	35420	67.0
Total	53130	100.0

Sources: National Statistical Service & Forest Service, Greece

Changes such as the above in both societal and biophysical conditions imply shifts in the nature of the risks posed by wildland fire, the sources of wildland fire ignitions, and the policies and practices implemented to address the changing mix of risk factors. The research reported here provides insights into the implications of repeated large fires for Lesvos, Chios, and Samos. The authors hope that the information provided in this report will prove useful in efforts to reduce fire risk on the three islands.

3. Methods

The research carried out for this study involved (a) background reading about forest fire and its management in Greece, and review of statistical data; (b) personal interviews, based on a written questionnaire, with key individuals on each of the three islands, as well as with one individual on the Greek mainland; and (c) analysis of the information collected. The interview data were compiled into a Microsoft Excel spreadsheet for analysis.

Interviewees were carefully chosen, based on a matrix designating the type and number of individuals to be interviewed on each island. We sought to interview two representatives, the head and a second person, of the Forest Service and Fire Department on each island, as well as at least one person representing the agricultural sector, one person representing an environmentalist perspective, at least one volunteer fire fighter, and at least one elected/appointed official. Identification of the specific individuals to be interviewed involved determining the person holding the particular position (for example, head of the Forest Service on the island), personal acquaintance with individuals deemed to be important repositories of knowledge, and referrals obtained through contacts with personal acquaintances. A total of 27 interviews were carried out on the three islands, ten on Lesbos, ten on Chios, and seven on Samos. Before the interviews were held, letters were either sent by fax or handed to each interviewee explaining the project and clearly stating that the individual's confidentiality would be maintained. A copy of the questionnaire was also provided. The interviews, conducted by the authors of this report, involved the assistance of translators in most cases. In some cases, the discussions that ensued extended beyond the questions posed in the questionnaire; in all cases, an effort was made to obtain answers to as many of the questions as possible, in order to allow for sufficient statistical analysis of the results. The cover letter and the questionnaire used in the interviews are provided in Appendix A at the end of this report.

The information gathered during the interviews was entered into an Excel spreadsheet to facilitate analysis. The responses were categorized, coded, and analyzed for all individuals from the same island, and across all three islands. This allowed for comparisons in responses on the same island as well as among all three islands. Data collected during the interviews were compiled and added to existing data bases about fire on the three islands. These data provided a quantitative foundation for the qualitative information gathered in the interviews.

4. Survey Results

Survey results fall into four general categories: (1) information about fire occurrence, (2) use of scientific information and technologies, (3) reflections on fire policies, and (4) commentary associated with the series of map questions asked at the end of each interview. Note that the number of responses reported below may not add up to 27 (the number of interviewees); in some cases, individual interviewees did not answer some of the questions; in others, interviewees indicated more than one response.

A profile of the interviewees shows that the length of time each person has been in his/her position ranges from less than one year to 32 years. Average times in their position ranged from 6 years on Samos to 8-1/2 years on Chios and 13 years on Lesbos. Many of the interviewees had been living on their island for many years. The range of residence times was less than one year to the person's entire life. A total of 22 individuals indicated that they have lived on their island for more than 10 years. The geographical area of responsibility for most interviewees was their entire island; several represented municipalities and several noted areas of responsibility encompassing the entire prefecture or larger area. Almost all of the interviewees declared that they had personal experience of very many fires, with many noting that they had been involved in more than 100 fires. Only five interviewees noted experience with zero or only a few fires.

4.1 Fire Occurrence

Questions were asked regarding the number of fires on the island, changes in the frequency of fire occurrence, fire intensity, and size of fires on the three islands. The question asked about how many fires had occurred on the island produced statistical information as well as insights into the years that stood out in interviewees minds: the year 2000 was clearly important to interviewees on Samos and Chios, while 1994 and 1998 seemed to stand out in the minds of interviewees from Lesvos.

In terms of changes in fire frequency, results indicate that 12 people thought that fire frequency was now less and 11 thought fire frequency was about the same; only 3 people thought fire frequency had increased. With regard to fire intensity, results were similar: 12 interviewees believed that fire intensity had decreased and 8 thought it was about the same. Only 4 thought intensity had increased. Likewise, 19 people thought fires were smaller; 4 thought fire size was about the same and only 1 person thought that fires were now larger in size (see Table 4.1).

Table 4.1
Perceptions of Fire Trends

	Samos	%	Chios	%	Lesvos	%	Total	%
Fire frequency								
Same	6	75.0	3	33.3	2	22.2	11	42.4
Lower	2	25.0	5	55.6	5	55.6	12	46.1
Greater	0	0.0	1	11.1	2	22.2	3	11.5
Fire intensity								
Same	4	44.5	2	25.0	2	28.6	8	33.3
Lower	3	33.3	4	50.0	5	71.4	12	50.0
Greater	2	22.2	2	25.0	0	0	4	16.7
Fire size								
Same	1	12.5	3	37.5	0	0.0	4	16.7
Smaller	6	75.0	5	62.5	8	100.0	19	79.2
Larger	1	12.5	0	0.0	0	0.0	1	4.1

As shown in Table 4.2 below, among the factors that have contributed to changes in fire regimes on the islands, the most frequently cited by the interviewees were abandoned farmland and increased road access to areas of high fire risk. Also scoring highly were climate conditions, fuel conditions, land use change, increased pasture demand. Some interviewees selected “Other” factors. For example, one person noted that one of the factors relates to how waste disposal is handled; another considered implementation of an early warning system having a favorable effect on fire risk. Two individuals related improved fire risk conditions to the transfer of responsibility for forest fire management to the Fire Service, and one person observed that many of the forests had already burnt, which in itself changed the fire regime on their island. One individual associated changes in fires to reactions of olive growers to fire threat. According to this person, growers are not interested in fighting fires in their groves; they would rather wait for compensation funds from the European Union.

We also asked interviewees to rank the causes of fire, in terms of which were most important. While few respondents gave useful responses, the results from those who did provide insights indicate that they view agricultural and grazing activities as the highest ranked causes.

Table 4.2
Factors Influencing Fire Regime Changes

	Samos	Chios	Lesvos	Total
Land use change	3	4	2	9
Accession to EU	2	1	0	3
Changes in agricultural production	2	2	1	5
Increases in pasturage demand	1	4	3	8
Increases in tourism	3	1	3	7
Climate conditions	4	4	1	9
Fuel conditions	3	5	1	9
Increased forest density	4	1	0	5
Abandoned farmland	4	7	4	15
Increase in uses of fire at urban interface	0	1	0	1
Urban expansion	2	2	0	4
Increased road access to areas at risk of fire	5	4	6	15
Increased access to funds for fire management	2	0	2	4
Other	1	2	3	6

In response to a question about which decade they believed most fires occurred, 2 people selected the 1970s, 11 respondents indicated the 1980s, and 11 selected the 1990s; 3 selected the 2000s. Several individuals selected more than one decade. No one selected the 1950s or 1960s. By island, the majority of interviewees from both Samos and Lesvos saw the 1990s as the years having the most fires; for Chios the 1980s were most often selected.

Each interviewee was asked who sets large fires (more than 100 hectares in size). The results for the top-ranked causes were the same for all three islands (see Table 4.3): 22 cited agriculturalists, and 18 indicated the military. Much less often cited were waste management personnel and picnickers. Fourteen respondents also indicated others as originators of forest fires. Five of these individuals cited dump fires; (one person blamed glass in the dumps for igniting fires on hot sunny summer days). One person mentioned electrical wires (arcing of electrical wires in the forest on hot summer days), four mentioned shepherds and one indicated rural people setting fires for revenge and conflict purposes. Arson was mentioned by two individuals. Two people indicated the military, though with the caveat that the military was not a big cause of fires nowadays – for they are more careful about fire than they used to be.

Table 4.3
Who Sets the Kinds of Fire that Could Cause Large Wildfires (>100-200 ha)

	Samos	%	Chios	%	Lesvos	%	Total	%
Agriculturalists	7	36.8	8	25.8	7	31.8	22	30.6
Military	5	26.3	8	25.8	5	22.7	18	25.0
New residents in rural areas (e.g., vacation home owners)	0	0.0	1	3.2	1	4.6	2	2.8
Foreign tourists	0	0.0	1	3.2	0	0.0	1	1.4
Picnickers	0	0.0	3	9.7	2	9.0	5	6.9
Waste management personnel	1	5.3	5	16.1	1	4.6	7	9.7
Residents in the urban interface zone	1	5.3	2	6.5	0	0.0	3	4.2
Other	5	26.3	3	9.7	6	27.3	14	19.4

In earlier interviews we asked interviewees to indicate which kinds of activities involving use of fire posed risks of hazardous wildfire events. Note that we later deleted this question because we believed it asked basically the same information as the question described in the previous paragraph. Of the responses to this question that we received early in the project, the most frequently cited were waste incineration (11 responses) and clearing debris piles (10 responses). Six individuals cited clearing undergrowth; 5 noted clearing more land for grazing and 3 cited clearing more land for cultivation. One person cited cooking fires as a source.

We also asked interviewees whether or not it is always illegal to set fires. Fifteen individuals answered this question “no” and 11 indicated “yes.” This variance in responses may be due to lack of clarity about the question, however; more nuanced responses gave details about the conditions under which fires might be allowed, for example that fires could be set, with proper permits in hand and sufficient assistance to control the fire, between November and May. Illegal burning during the May to November period, by contrast, could result in the person being sent to jail.

4.2 Use of Scientific Information and Technologies

We asked a series of questions about whether or not interviewees used scientific information of different kinds, and if so, what their sources of information were. We asked if they consulted *climate* forecasts – that is, forecasts issued for a month or more in the future:

- 16 people indicated that they did not consult this type of information
- 9 people indicated that they did consult climate information

For those that did consult climate information the main sources were as follows (Table 4.4):

Table 4.4
Sources of Climate Information

Source	Number of respondents	Percentage
Web	7	41.2
Consult with a colleague	3	17.6
Television	3	17.6
Radio	2	11.8
Newspaper	2	11.8

Two people indicated additional sources: one consulted his own meteorological station; another obtained information from an unspecified source in Athens.

In terms of when these forecasts were consulted:

- 7 people indicated they consult forecasts during the fire season
- 5 individuals indicated consulting such information during the winter/spring before the fire season
- 2 people said they use climate information after fire season

We also asked interviewees whether they consulted *weather* information (that is, information pertaining to immediate conditions and up to about 1 month):

- 20 people indicated that they use weather information
- 5 respondents indicated that they do not consult this information

The primary sources of information were (Table 4.5):

Table 4.5
Sources of Weather Information

Source	Number of respondents	Percentage
Web	10	43.5
Consult with a colleague	0	0.0
Television	9	39.1
Radio	1	4.4
Newspaper	3	13.0

Of the 9 indicating “other:”

- 6 indicated Civil Protection in Athens; 1 person mentioned “fax”, which was probably from this same source
- 5 people consult with a colleague
- 3 mentioned the Meteorological Service
- 2 mentioned getting information from remote weather stations
- 1 used information from his own meteorological station

With regard to when the information is used:

- 19 use this information during fire season

- 6 use the information during the winter/spring prior to fire season
- 2 people used weather information after fire season

We believed that other kinds of scientific information might also be useful in fire management, so our questionnaire included a question about other information respondents used (Table 4.6):

**Table 4.6
Other Information Used**

Data Type	Number of respondents	Percentage
Fire danger index data	11	27.5
Vegetation conditions	11	27.5
Fire history data	7	17.5
Fuel moisture data	7	17.5
Remote sensing information	3	7.5
Fire prediction models	1	2.5

Three people indicated using other types of information. Among the other types of information used were wind, relative humidity, personal experience, and participation in informal communication networks. One person wished to have more information such as predictions from fire behavior models. Another interviewee mentioned cooperation with the University of the Aegean effort's to improve fire danger monitoring on the island. One person commented that scientific information was handled in Athens, rather than locally, and four people indicated they or their office used the information and model outputs Athens provided, such as the fire danger index and reports produced by the General Secretariat for Civil Protection. One person used various kinds of information gathered from his own meteorological station, and another gathered information from remotely sensed imagery.

We also asked interviewees specifically if they collected data locally that would be useful for forest fire management (Table 4.7):

**Table 4.7
Data Collected Locally**

Data Type	Number of respondents	Percentage
Precipitation	8	15.0
Temperature	7	13.2
Vegetation coverage	7	13.2
Vegetation conditions	7	13.2
Agricultural activity	7	13.2
Pasturage activity	5	9.5
Fuel moisture	4	7.5
Soil moisture	3	5.7
Tourist/recreation statistics	2	3.8
Land use practices	2	3.8
Relative humidity	1	1.9

Several people indicated other data collection activities. One person cited reliance on the work done at the University of the Aegean-Lesvos to generate fire danger information. One cited fire statistics, and two said they look at annual fire reports. Three respondents indicated that, although people on the island do not formally collect this kind of information, personal knowledge is an important input to decision making. Personal knowledge and experience about local trends and conditions, such as wind, vegetation, tourism numbers, etc., are all used. This information is gained from experience, from having lived on the island for a long time, and/or from engaging in activities such as hunting. Interactions with residents and maintenance of informal networks for gathering information from local residents are also seen to be important.

4.3 Fire Planning and Activities during Fires

We asked interviewees how far in advance they do their fire planning:

- 3 only plan one month in advance
- 9 said they plan 2-3 months in advance
- 6 plan 4-6 months ahead
- 2 engage in planning 1 year into the future
- 2 plan more than a year in advance

Comments made related to this question included an opinion that planning should be done all year, but that staffing was insufficient to do this; another noted that they update their plan annually, then 2-3 months before fire season information is obtained from the fire suppression people. Municipality-level planning, according to one person, is generally done 2-3 months in advance of fire season.

On the assumption that training for fire fighting and fire management is important, we asked respondents about the types of training they have had (Table 4.8):

**Table 4.8
Training Received**

Type of Training	Number of respondents	Percentage
Fire suppression	16	33.4
Disaster planning	10	20.8
Disaster relief	6	12.5
Post-fire rehabilitation	6	12.5
Fire use	5	10.4
Post-fire claims	5	10.4

Five people indicated other sorts of training, including an emergency planning workshop, damage estimation, and registration of burnt lands.

With regard to tasks carried out during forest fires, respondents indicated they undertook the following types of tasks (Table 4.9):

Table 4.9
Tasks Carried Out During Forest Fires

Type of Task	Number of Respondents	Percentage
Notify authorities	16	21.4
Warn people	14	18.7
Request fire fighters to be brought in	12	16.0
Arrange for food/water for fire fighters	11	14.7
Request equipment	8	10.6
Arrange lodging for fire fighters	8	10.6
Help evacuate people	6	8.0

Six individuals indicated other activities such as responding to requests from the Fire Department for assistance, reporting fire outbreaks, organizing volunteer network, consulting with the Fire Department, extinguishing the fire. One person noted that he organized transportation of ground forces, called for help from other volunteer troops, and provided for volunteer backup in large fire events.

4.4 Reflections on Fire Policy

Although the English word “policy” does not interpret similarly into Greek, we formulated several questions designed to help us understand the extent to which respondents believed they had flexibility to interpret fire policies and make decisions that fit the realities on their island. With some clarification, useful information emerged:

- 8 individuals indicated that they had considerable freedom to interpret policies to fit local conditions
- 4 indicated ability to make some modest decisions
- 4 indicated having no opportunity for flexibility in their decision-making processes

We asked interviewees about how policies are enforced differently now than they were before the 1998 changes that shifted responsibility for fire suppression to the Fire Service (in the Ministry of Public Order) from the Forest Service (in the Ministry of Agriculture). We only received a few responses, but the information we received indicates that some of the changes include a local policy on Samos that banned hunting for 3 years after the 2000 fires. Also mentioned were a modest shift from focusing on built areas to also protecting forest resources, ability to call in help from other areas, and support for volunteers.

A question about whether there were important local policies indicated that interviewees saw little in the way of local policy being implemented. As noted above, the three-year ban on hunting on Samos Island was particular to that island. Also unique on Samos are the commitment to a massive offensive against fire, and the structure for volunteers, especially with regard to the establishment of an office and volunteer coordinator who reports to the mayor of Pythagorio. On Chios, the cooperation between the volunteers and agencies was cited as a model for other localities in Greece to follow. Also mentioned was the island’s master planning process. On

Lesvos, factors such as the ability to shift resources to where they are needed, practices that involve combining local and official information and networks in decision making, spreading fire resources across the island, interactions between the volunteers and Fire Service, and local fire attack techniques were all mentioned.

In response to a question about what the most important policy items were, interviewees indicated the following:

- Support for and recognition of volunteers and volunteer organizations
- The national laws, especially policy stressing fire prevention and public awareness
- The shift in responsibility for fire suppression from the Forest Service to the Fire Service
- Provision of jail time for people who break the law in setting fires
- Support for forest infrastructure such as fire breaks and water stations
- Separation of civilian and military structures/responsibilities
- Enabling of assistance from the military
- The requirement for planning boards at the municipality level

Interviewees noted, however, that insufficient funding for infrastructure, support for volunteer groups, and public education activities are a problem. Also, some individuals would prefer a policy change that devolved more responsibility for fire management to the island prefecture level.

Knowing that, in some areas of the world, controlled fires are either set or allowed to burn in order to prevent widespread damage from wildfire, we asked interviewees if controlled fires were an effective way to reduce risk. The responses split fairly evenly, with 13 people saying yes, such fires were effective for reducing risk, and 12 people saying that this was not an effective strategy. For those responding in the negative, concerns about the potential damage that might occur if such fires escaped seemed to far outweigh any benefit they might offer.

Opinions were more strongly coherent with regard to whether fire is a legitimate tool to protect the environment. In response to this question, 17 people answered no, and only 7 answered yes. Of those answering yes, several were hesitant in their response: one noted that this was only viable under controlled conditions.

We asked interviewees to reflect on what sorts of policy changes and actions to decrease fire risk were needed. Among the recommendations provided were:

- The need to pay attention to construction activities
- Creation of fire buffer zones and fire breaks, as well as water supply structures
- Increase in local-level authority for fire management/decentralization
- Higher funding levels for infrastructure, equipment, etc.
- Sensitization of the public to fire danger and increased cooperation in fire prevention efforts
- Flood control and forest rehabilitation
- Hiring more rangers to monitor/patrol for fire
- Introduction of new technologies for fire management
- More recognition of and emphasis on knowledge and local experience of conditions
- More protection for high fire danger areas

- More emphasis on cooperation with local people
- Better waste disposal practices and facilities
- Allow Forest Service to carry out public works on non-public lands (European Union rules apparently ban this type of activity, which the Forest Service used to be able to do)
- More volunteer groups, organized within municipalities and given their own facility for meeting, sharing experiences, etc.

Interaction with others is an important factor in managing forest fire risk. We asked interviewees to indicate the types of entities with whom they interacted about fire policies (Table 4.10):

Table 4.10
Interactions about Fire Policies

Type of entity	Number of respondents	Percentage
Local elected officials	16	23.9
Public administrators	14	20.9
Agriculturalists	10	14.9
Shepherds	9	13.4
Local land managers	7	10.4
Church representatives	5	7.5
Educators	5	7.5
Tourism industry	1	1.5
Local planners	0	0.0

Seven people indicated other interactions, including communicating with ministries, cooperating with volunteer organizations, interacting with large land owners, and communicating with and building a personal network of friends and acquaintances – many of whom help fight fires.

When asked what kinds of actions should be taken to decrease fire risk, respondents noted the following:

- Change people’s mentality and sensitize the public to fire risk
- Increase public interactions with regard to fire prevention
- Increase the amount of infrastructure, fire fighters, and equipment
- More fire brigades located in the villages
- Improving waste disposal facilities
- Provision of more information to local people
- Shift to year-round planning
- Move toward holistic, integrated land management

Attitudes of the public toward fire are important. In response to a question about perceptions of community attitudes, respondents commented on an array of factors. While some saw positive progress in the growth in the number of volunteers and volunteer organizations, as well as knowledge about the damage that fires can do, other respondents perceived continued indifference, criticism of fire management efforts, and a predilection to only get involved when fire is close to home, or if specifically asked. Most respondents noted that there is a higher level

of awareness among people about fire and fire risk, including environmental risk. However, one interviewee noted a lack of pressure to change old ways.

In a related question, we asked interviewees whether the public on their island would be willing to pay for better fire protection: 17 respondents said no – the public would not pay, while only 5 said yes. However, even those saying yes tended to stress that people would pay only if they believed that the money would really be spent on fire protection, rather than being diverted to other uses.

4.5 Map Questions

We provided each interviewee with a color map of their island and asked them to respond, by marking on the map, to a short series of questions. The questions we asked included:

- Where fire is most likely to occur in the next five years
- Where the individual believed the risk of fire to natural resources is greatest
- Where risk to human values (e.g., property, structures, agricultural resources, etc.) is greatest
- Where fires have occurred in the past (this question turned out to be somewhat problematical; in a number of cases, this information was provided in other ways, or the respondent had not been on the island long enough to know its fire history in spatial detail)
- Where the individual would be most sad to see a forest fire burn

Before initiating this part of the survey, we also asked interviewees where most fires occur on their island. On Samos, responses highlighted the western section of the island, agricultural areas, the military firing range, and the areas around the towns of Mytilinioi and Marathokambos. For Chios, the northern and central portions of the island were mentioned, as was the whole island. One person noted that, in the past, the south had been a focus of fire activity. On Lesbos, the agricultural and pasture areas were cited, as were the north and northwest, and the central and southern areas around Polichnitos, the Geras Gulf, and Vatera. The Amali Peninsula and the Plomari areas were also mentioned.

Composite maps of responses to the map-drawing questions are depicted in Figures (Figure 4.1, Figure 4.2, Figure 4.3, and Appendix B). In many cases, individuals provided additional information during this part of the interview.

Figure 4.1



Figure 4.2

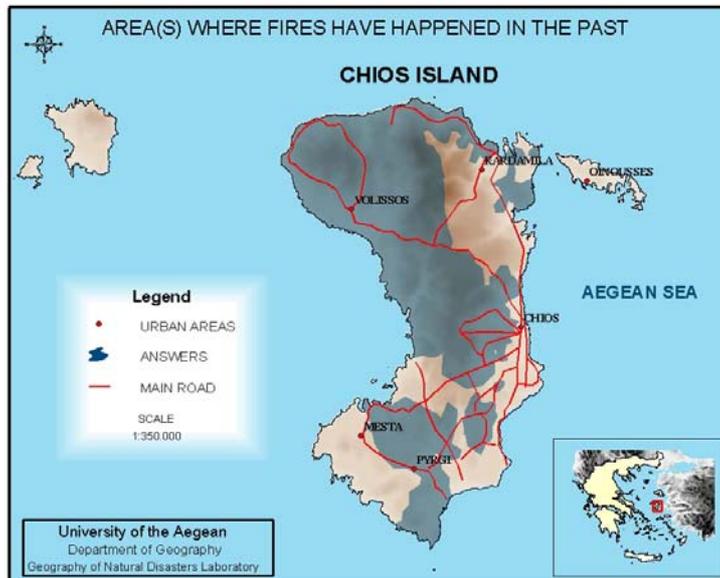
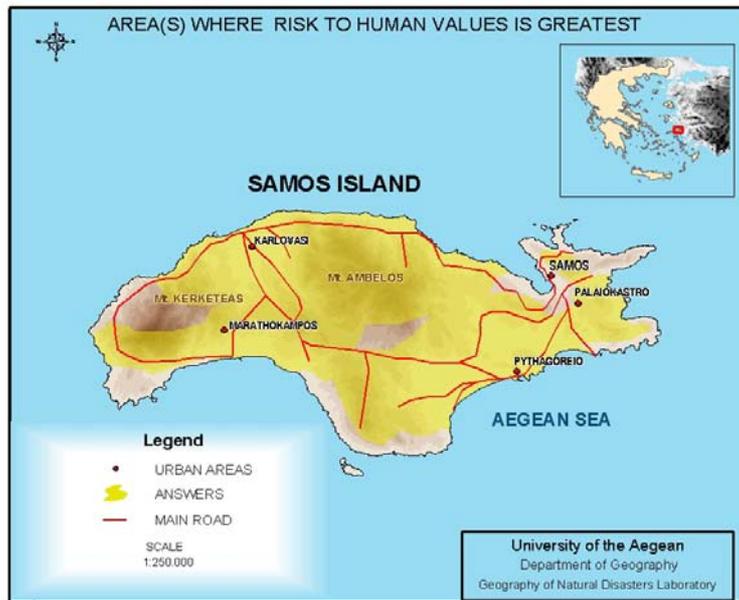


Figure 4.3



A few individuals declined to delineate answers to the questions on the map, but still provided insights into their knowledge and thoughts about fire risk. The comments below, made by some of the interviewees, provide additional insight into perceptions of fire risk on the islands.

Lesvos

- **Indicate where fires are most likely to occur.** It was noted that fires are most likely to occur in the olive groves, along the road into forest from Agiassos and in the Agiassos area (this is where the largest forest on island is located; it is difficult to suppress fires in this area), and in rural areas due to human activities.
- **Indicate where the risk to natural resources is greatest.** Some comments indicated that risk is greatest in the wildlife area around Parakila; the Geras Bay wetland habitat is also at high risk, as are the Agiassos area and Molyvos areas.
- **Indicate where the risk to human values and material goods is greatest.** It was observed that the greatest human risk is in the Agiassos area – villages exist within the forest.
- **Indicate where fires have occurred in the past:** It was noted that the Vatera area has been the site of several fires.
- **Indicate the area you would be most sad to see burned:** One person singled out the only black pine forest on the island, noting that it would be very difficult to regenerate this forest if it were to burn. Two people indicated the entire island, one of whom commented that every area that burns is sad and that every forest on the island has its own particular cultural and aesthetic value.

Chios

- **Indicate where fire is most likely to occur.** It was noted that fire is most likely on the northern part of the island. Other comments indicated that the whole island is likely to burn, except for the large central mountain where there are no trees to burn.
- **Indicate where the risk to natural resources is greatest.** The natural resource area seen to be at greatest risk is the northwestern area that is protected under EU Natura 2000 program.
- **Indicate where the risk to human values and structures is greatest.** Comments indicated that the risk to human values and structures is greatest in the northeastern area.
- **Indicate where fires have occurred in the past.** It was noted that the 1981 fire burned across the center of Chios, burning about a third of the island; another large fire occurred in 1991. Almost all the island has burned at least once and much of the island has burned two to three times over the past decade.
- **Indicate the area you would be most sad to see burned.** Areas singled out included the northern part of the island; the central portion, especially around Anavatos (a UNESCO protected traditional settlement); and two wetland areas in the northern part of the island.

Samos

- **Indicate where fire is most likely to occur.** It was observed that fire is most likely to occur on the northern part of island where the national park is located; also likely are fires in the northwestern area (which is mountainous and roadless). The area around the town of Mytilinioi is at risk, as are areas where dumps are located. The area around Kerkis Mountain (which has no roads) is at risk of fire as are the northern, eastern, and western regions – these areas are where the last of the big forests are located.
- **Indicate where risk to natural resources is greatest.** Comments indicate that risk to natural resources is greatest in the Manolates area and in the northern, eastern and western portions of the island where the last of the high forests are located. Also seen to be at risk are the resources in the EU Natura 2000 area in north-central part of island.
- **Indicate where risk to human values and structures is greatest.** The risk to human values and structures is seen to be greatest in the area around Vathy (where there are many hotels) and in the EU Natura 2000 area where they are building hiking trails, park facilities, and roads.
- **Indicate where fires have occurred in the past.** It was noted that the 2000 fire, which began near Mytilinioi, burned about half the island. The Mytilinioi area is where most big fires start. Fires in 1990, 1993, and 2000 burned some of the same areas. The 1983 fire burned 2000 hectares of forest, and of olive, citrus, and grapevines (these latter food crops did not burn in the 2000 fires, however).
- **Indicate the area you would be most sad to see burned.** Some comments indicated that it would be most sad if the southern area burned; replanting is underway in this area and the area needs to be protected to sustain forest regeneration.

5. Other Interviewee Comments

In addition to the responses to the questions asked, numerous interviewees provided additional information and insights about fire and fire management in the study areas. This information is organized below by topic.

5.1 Implications of European Union Membership

One person observed that Greece's accession to the European Union generated some of the recent changes, notably the advancement of Civil Protection to be the main fire-fighting arm of the national government, superseding the Forest Service in this role. This person noted that the EU has furnished funds to Greece for use in building up its civil services. One person observed that, before the EU regulations went into effect, managers would work to decrease fire risk on all lands, regardless of ownership status. National legislation was in place that allowed the Forest Service to go into private lands (e.g., municipality-owned land) to carry out fire reduction activities if the owners were unable to do the work; further, the Forest Service could make decisions about whether or not to charge for the work they did. After Greek accession to the European Union, Forest Service workers are not allowed to do work on non-public lands.

Until 2000, the Forest Service could maintain road networks in areas not in the public domain. Since 2000, EU regulations have forbidden carrying out such work on private lands. Today, because of this rule, roads are not well maintained. This may have big consequences for fire fighting capability in the years ahead. In addition, funds that were to be made available to owners (such as municipalities) to do the work have not been received. Concern exists that the funds would not be spent for the intended purpose. Adding to the problems is a lack of clarity among the municipalities about who should be responsible for such work and how the funds should be spent. This is particularly problematic on Lesbos, where municipalities own the largest share of the island's forested lands.

5.2 Illegal Setting of Fires

Illegal burning of land to facilitate development is still practiced. According to one interviewee, efforts to obtain approval for construction of a road to a parcel of land the owner wanted to develop and sell resulted in a catastrophic fire that burned highly prized forest lands on the island. While this was the only citation of a specific incident, other interviewees indicated that arson remains a considerable factor in fire activity on the islands, as elsewhere in Greece.

Our interviews revealed that burning of lands for grazing remains a serious concern. The practice of using fire to generate forage for grazing animals dates back to antiquity, and remains the most efficient way to clear large areas of land with a minimal workforce. However, fire use by shepherds also reflects a larger cultural structure, one in which independence from authority is highly prized. Today, initiatives to protect forests and other rural lands from denudation, degradation, and soil erosion are generating new forms of competition over land use. In this type of context, pastureland burning becomes a form of social deviation that has significant implications for achieving and maintaining cooperation between authorities and pastoralists regarding appropriate fire use and fire management practices.

5.3 Fire Planning Activities

Planning processes, according to a few interviewees, should occur all year. This is particularly the case with regard to prevention activities. Related to planning is a need to encourage more holistic land management practices, rather than trying to manage for fire based on the existing patchwork patterns of ownership categories. Also needed is more education, including activities that would prompt individuals to recognize environmental values and behave in a more environmentally friendly manner.

5.4 Fire Management

With regard to issuing permits to set fires, individuals from all three islands observed that for the most part no fires were allowed between April 1 and October 31 each year. However, this rule is rather unclear, since one person noted that the no-burn rule applies only to agriculturalists. One person noted that, in rare situations, a permit might be issued if the Fire Service considers the fire to be necessary and safe. For example, the Fire Service may allow stubble to be burned from grain fields during the summer. Fires are never, however, permitted in forests. Conditions that might allow some relaxation of this rule could include wetter than normal conditions, or a farmer's desire to burn in order to replant a field with a different kind of crop. Similarly, the no-burn season can be made longer if unusually dry conditions prevail. Individuals are supposed to obtain a fire permit before conducting any burning. The permit states the date, place, and number of hours of the planned burn. One interviewee also noted that the permittee was required to demonstrate that sufficient people would be on hand to control the fire. This seems to be especially important with regard to the burning of pasture lands in the fall season. The common practice is for shepherds to set fires on days/ times when winds can carry the fire across the large areas they wish to use for grazing. In addition to assessing weather and moisture conditions, the permitting process involves a visit to the proposed burn area by a Fire Department staff member to assess the likelihood that the proposed fire will remain under control. One related issue, noted by several interviewees, is the advanced age of many of the farmers and shepherds. As the shepherds become older, it becomes increasingly difficult for them to control the fires that they set, unless they are able to recruit sufficient help.

One interviewee noted that active forest management on Lesbos (and to a lesser extent on Chios and Samos) has been occurring over the past several decades, including cutting timber and treating fuel loads. However, other interviewees noted that the costs of maintaining optimal conditions for averting or limiting fire on the three islands is high and that there are never enough resources to do the needed clearing, roadside cleaning, and construction of buffer zones.

Comments were also made regarding priorities for protection during large fires. In one case, a decision to protect villages and farmlands that were at relatively low risk from the fire rather than to protect forest resources was blamed for 2500 hectares of wildlands being burned.

The lack of control over waste disposal and the lack of centralized and supervised disposal facilities is a source of concern with regard to fire risk. One interviewee commented that, while each municipality on his island has its own site, efforts to develop a central sanitary disposal site on the island – even though planned for many years – have been thwarted. This person believes that waste disposal site fires will continue to occur until effective enforcement mechanisms are implemented.

Also noted by many interviewees was a belief that all fires should be extinguished; only a few saw benefit in either intentionally setting fires or letting small fires that are already underway burn themselves out. Similarly, one interviewee observed that two to three fires recurring in the same area significantly reduced the likelihood that the forest would be able to regenerate. Several people observed that local experience was not being taken into account in policy making, and that new policies were needed that take account of local conditions and experience.

Differences among the islands were also noted. For example, Lesvos has dealt with virtually all land ownership issues, while this level of success has not yet been achieved on Chios and Samos. Resolution of ownership issues is important, for lack of such resolution generates conflicts over who has the right to determine how the land will be used. The considerable development pressure being exerted on many of these lands, especially those of high aesthetic appeal for summer homes and touristic enterprises, can lead to fires being set as a means of forcefully settling such conflicts in favor of those wishing to develop the lands. Another difference between the three islands is that Lesvos and Chios have more traditional agriculturalists than Samos. The difficulty of such work, and out-migration more generally were cited as reasons for this difference.

The shift in responsibility for fire fighting from the Forest Service to the Fire Service in 1998 was a major change in national policy, one that had implications from national to prefecture to local levels. Before the 1998 policy changes, the Fire Service's responsibility was only to provide staff when needed by the Forest Service to fight large fires. Otherwise, the Fire Service's responsibility had been fighting urban fires. It was noted that the 1998 change in policy that gave the Fire Service responsibility for forest fires included allocation of substantial firefighting resources. Comments made during several interviews suggested that, because this high level of resources had not been available to the Forest Service prior to 1998, many strategies and actions to manage fire risk more effectively could not be carried out. It was also noted that knowledge about how to fight forest fires was different in substantive ways from knowledge about how to fight fires in urban settings, and that fire management the first couple of years after the policy change reflected this lack of fundamental understanding. Most interviewees seemed to feel that the system is now working reasonably well, though one person noted that staff members associated with the Fire Service tend not to have the same high level of caring for the forests that many Forest Service people feel.

One person was of the opinion that recent fires on his island were related to "sabotage," and noted that fires were occurring every night after 10 pm. The interviewee saw this sequence of fires as arson and as revenge by individuals who did not get hired as seasonal fire fighters. Another source of the fires, according to this source, was indiscriminant dumping of garbage by residents of the island. The age and condition of electrical lines on the island constituted another significant factor with regard to fire risk; the ceramic connections were breaking down, and needed to be cleaned every year. A few interviewees also alluded to arson caused by Turks, especially a group widely known as the Gray Wolves. While most of the interviewees mentioning the Turkish connection expressed skepticism regarding the truth of these claims, there was a general sense that the public believed such stories, and that politicians have played on this belief. Conversations with some of the interviewees explored the role of shepherds with regard to fire. While shepherds do indeed start many fires, some interviewees observed that they tended to also be blamed for fires that they did not set, and that the majority of fires set by shepherds were kept under control. Variation in grazing land fires from year to year is also a factor; one person observed that the vast majority of fires in 2003 were on pasture lands, largely because 2002 had been so wet that fires could not be set that year. Shepherds made up for this in September and October 2003 by burning larger areas than usual. One person summarized the problem by noting that blaming shepherds for forest fire losses is, more accurately, related to

more general conflict between shepherds and others on the islands. More generally, negligence was cited as causing many of the fires on the three islands.

One person noted that aerial fire fighting with helicopters began in 1993-94, and was based on the U.S. fire management system. The first year, helicopters brought in from Canada were used; the second year military helicopters were deployed. After a few years, this strategy was discontinued. It was seen to be too expensive and could not be used when temperatures were high; also it had resulted in a crash that killed all people riding in a fire-fighting helicopter. Due to the ruggedness of the terrain, aerial firefighting, however, remains a key component of fire fighting in Greece.

5.5 Biophysical Factors Influencing Fire Regimes

A number of interviewees made reference to the role played by strong winds during fire season. During the summer months, it is not uncommon to have windspeeds of 6 to 8 on the Beaufort wind scale (when wind speeds reach 5 Beaufort – around 30 km/h, fire risk is considered to be very high). Such strong winds propel forest fires across large landscapes, and create considerable problems for fire fighting. Knowing when and where strong winds will blow is critical to fire prevention and fire suppression efforts.

Concerns related to repeated burning over the same forest areas were mentioned by several interviewees. It was specifically noted that, when forest fires burn and reburn the same area within the span of a few years to about a decade, the capacity of the forest to regenerate is lost. Concern about repeated burns is especially high in areas of high ecological and aesthetic value, such as the chestnut forest on Lesbos and officially protected areas on all three islands.

A discussion about whether the increase in fires was related to an increase in forest coverage elicited the response that this was a logical connection. In some forested areas, rock walls indicate where cultivation has occurred in the past, and where forest has taken over the land. The lack of cadastral surveys to determine land ownership on Chios and Samos was noted, as was the problem of how to deal with fires on private lands, particularly on Lesbos where land ownership has largely been resolved. The Fire Service is responsible for forest fires on public and non-public lands, and the Forest Service is responsible for reducing fire risk only on public lands. However, since the municipalities, churches and private owners do not always manage fire risk on their own lands, the Forest Service has had to direct their resources to fuel reduction efforts on private and municipal lands.

One person observed that, as the years have passed, rainfall has diminished in Greece, while another cautioned that recent trends toward smaller fires may be “accidental” and may not continue to be the pattern in the future. Biomass levels, for example, may produce large fires again in the future. Abandoned farmland was seen as a source of high fire hazard.

5.6 Public Awareness of and Sensitivity to Fire Risk

Evaluations of the degree of awareness about fire and engagement in efforts to reduce forest fire risk tends to be rather varied among the interviewees. A number of interviewees noted that public awareness about the forest fire problem had increased in recent years, and that greater coordination now existed between municipalities, the army, the prefecture, and other political

entities. This increased awareness is seen as good, though one person noted that with the increase in desire to become involved, people need more training and coaching. At the same time, people – while mobilizing to help out during fire events – still tend to complain that the decision makers are not doing things correctly. Another commented that people remained, to some extent, indifferent about the problem – especially if the fire problem is not in their immediate vicinity. One interviewee noted that fire on their island was seen to be one of the most important problems, and was highly connected with environmental problems. However, this person did not see residents taking much action to advocate policies that would address the problem, nor did he see much public involvement in fire management and mitigation. Fostering better public awareness about fire risk was seen as a significant need. One person was more specific in this regard, indicating that the first priority, should additional funding become available would be to go on television and do newspaper stories advocating the need for prevention. Another interviewee stressed the need for more public educational activities, including taking education messages into the schools and bringing groups to the local fire department to learn about forest protection.

5.7 Role of Volunteers and of Local Knowledge

A number of interviewees emphasized the value of cooperation with volunteers and others during fire season. Several also emphasized the value of local knowledge, particularly in contrast to information provided from Athens, which tends to be produced from models that are very broad. The information provided from Athens tends to cover the entire island and therefore is not necessarily at a sufficiently fine scale of resolution to address highly localized conditions such as wind conditions at specific fire sites.

The volunteer fire fighting groups were generally seen as good, that they had more information about fires and more equipment now, and that they helped considerably with fire fighting. Their tendency to take all fires on the island personally was seen by one interviewee as being a big asset. One person observed that, on his island, there is now at least one vehicle and team in every village. However, a few comments were made that, in some instances, better coordination between the volunteer units and the governmental fire fighters was needed. Also noted was the lack of sufficient support and equipment for the volunteer fire departments. Deficiencies ranged from the age of the fire trucks and equipment at their disposal to financial means to pay insurance and maintenance costs for their vehicles, as well as to pay for equipment, clothes, tools, and supplies. Donations from abroad have been a significant source of resources for several volunteer fire departments. Indeed, one person noted that, on his island, the volunteer fire departments have ongoing relations with volunteer fire departments in Italy, Germany, and Austria. One observer of volunteer activities suggested that more organization of these groups at levels from village to national would be beneficial, as would having a place for the volunteers to meet and interact with each other.

Interviews with individuals on the three islands and with an expert on the mainland indicate that, while access to scientific information, weather and climate information, and specialized training is important, local knowledge remains an essential factor in forest fire management. The exodus of so many residents from rural areas has diminished the amount of local knowledge available for fire fighting. To the extent that some of these individuals remain in nearby towns or cities, some of this knowledge remains available. Developing ways to retain and transmit knowledge to

others about local biophysical conditions and terrain and about local trails, paths, structures, and other features is important. Volunteers can provide some of this knowledge; also needed is ongoing support for communications networks between local people and individuals involved in forest fire management.

6. Conclusions and Recommendations

The following conclusions and recommendations have emerged from our research and are based on the information we gathered from interviewees on the islands of Lesbos, Chios, and Samos, as well as from another expert whose office is on the Greek mainland.

Considerable fire threat still exists on all three of the islands we surveyed, though evaluation of the precise level of threat varies among the individuals we interviewed. It is clear that fire risk emanates from many sources, ranging from unmanaged forest growth associated with land abandonment to arson activities that seek to maximize fire intensity and area burned for any number of reasons. Confounding any quantitative analysis of causes of fire, however, is the very large number of fires categorized as being of unknown origins.

The change in responsibility for forest fire suppression from the Forest Service to the Fire Service in 1998, and the imposition of European Union rules have been very significant, particularly in terms of resources available for fire fighting and capability to manage fire risk across landscapes of mixed ownership. The shift to aerial fire fighting methods has also been significant, as has the emergence of organized volunteer fire fighter organizations on all three islands.

While traces of an environmental ethic may be discerned on all three islands, our survey suggests that environmental awareness remains relatively weak among the general population, though at least in some areas public concern about preserving island forests is discernibly heightened. To some extent, this emergence of an interest in preserving the remaining forest areas is reflected in a rise in interest and willingness among the public to go out and help *fight* local forest fires. What is unclear is the extent to which concern among local residents has been increased to the point that they will actively work to also *prevent* fires. Comments by several interviewees stressing the importance of public education, and the need to do more public educational outreach indicate that a considerable amount of effort is required to achieve the kinds of changes in attitudes and behaviors needed to reduce or eliminate destructive wildfires.

On the other hand, intense concern expressed by interviewees about the devastating effects of large forest fires on their respective islands reveals a depth of personal caring and commitment that is both striking and heartening. If this passion for Greek forests can be passed on to other island residents, there is a chance that the remaining forests may be preserved, and that, on at least some of the lands denuded by fire, forests may be restored.

The use of scientific information and technologies, such as models and forecasts tailored for fire management remains low; but with the rise of a new generation of forest and fire staff members who have received interdisciplinary training in understanding and using these kinds of tools, it is quite likely that utilization will increase. Continued investigation of ways in which new knowledge and technologies might be brought to bear on fire management should be encouraged,

as should assuring strong scientific training of the next generation of forest and fire managers and decision makers. Courses that provide insights into cultural and societal aspects of wildland fire regimes, wildland fire fighting culture, and public values and behaviors could also prove valuable.

Desire for more local control over fire management exists in tension with recognition that access to aircraft, equipment, supplies, and staff requires resources beyond those available on the islands. Developing rules and organizational structures that apportion responsibility and resources appropriately among the national, regional, and prefecture levels could improve fire management, particularly with regard to achieving an effective mix of expert and local knowledge. Material and political support of volunteer organizations, which provide a structure for identifying and using local knowledge where it is best deployed – in local areas – is one mechanism that could bridge the gap between the two forms of knowledge. Also seen as needed is commitment of resources and political support to address persistent problems such as decaying connectors on electrical lines; lack of adequate oversight of dumps and waste management practices; and use of fire for political reasons, revenge, or to gain control of lands for development.

One of the areas that would merit in-depth, island-specific research is assessment of the impacts of climate variability and change on fire regimes on the islands. Such research could be carried out at the University of the Aegean by graduate students under the direction of professors who are specialists in climate science, hazards research, and statistical analyses.

European Union rules regarding use of state resources to address fire hazard on non-public lands seems to be a considerable barrier to dealing with fire risk on the islands, especially on Chios and Samos where land ownership in many places remains unresolved and in some cases contested. Conversely, membership in the EU provides Greece with opportunities to work directly with other EU countries having similar Mediterranean ecosystems and problems with outbreaks of very large wildfires.

In-depth analysis of the effects of the 1998 policy changes, including how those changes have been implemented at the local level would be useful for developing a better understanding of what has been accomplished and what remains to be done. For example, it is likely that such analysis would reveal that there is a need (as mentioned by some interviewees) for allocation of more resources for pre-fire prevention activities. These types of activities would include formal and informal public education projects as well as more traditional projects such as forest thinning and development of fire breaks and water storage facilities. Such activities are probably necessary for any long-term change in conditions contributing to fire danger.

Likewise, research into the beneficial effects and the barriers associated with the rise of volunteer fire departments would be very helpful. Documentation of the equipment available to the different groups, the sources from which they obtain their equipment and supplies, the ways the different departments are structured, and the nature and extent of interactions between volunteer fire groups constitute important areas where additional knowledge could produce insights useful for developing strategies for reducing fire hazard on the islands.

An analysis of the formal and informal networks used for exchanging local knowledge would be very beneficial for understanding more clearly how such networks come to be established and maintained. Such networks can be useful in improving fire planning and decision making, as well as in educating the general public about what individuals need to do to reduce fire risk.

Also important is conducting ethnographic research involving ordinary citizens on the three islands to determine their perceptions of the benefits and risks of fire, their level of knowledge about fire and fire hazard, and their values with regard to both forests and forest fire. It is important that shepherds be included in this research. Questions such as how shepherds' fire use practices and value systems harmonize or conflict with efforts to prevent destructive fires need to be explored as part of this effort. The information generated through this type of ethnographic research would be very useful in devising fire education and outreach programs on the islands.

In conclusion, substantial changes have occurred over the past six to eight years in forest fire management in Greece. These changes have had a significant impact on the way fire is managed on the islands and on capability to fight fires more efficiently and effectively. Given that the human origins of the islands' fires continue to pose serious threats, whether recent successes in reducing the number and size of devastating fires can be sustained indefinitely into the future remains to be seen. The results of the survey presented in this report suggest that additional steps could be taken to further strengthen the effectiveness of fire fighting on the islands. Taking these steps, however, requires resources that are not currently available at the level where they are needed.

APPENDIX A. Samples of Cover Letter and Questionnaire

COVER LETTER

Dear Sir / Dear Madam

Under the direction of the Department of Geography, University of the Aegean, we are conducting research on cultural and policy factors related to fire risk in Greece, as well as the use of scientific information in fire management. The research focuses on three islands, which are characterized by extended forest coverage and high fire frequency: Lesvos, Chios and Samos. The results of our research will be published in three articles in scientific journals. In addition, these results will be summarized in a research report to be published when the research is completed. This research is being supported by funding provided to Drs. Barbara Morehouse and Martha Henderson by the Fulbright Foundation in Greece.

We are writing to request your assistance in this research. Attached are copies of the questionnaire we are using to gather our data. It would be helpful if you could distribute the questionnaire ahead of time to the people whom we will interview, and to review it yourself. This allows time for thinking about the questions and gathering helpful information.

The following clarifications are required by the Universities where Dr. Barbara Morehouse and Dr. Martha Henderson are employed (the University of Arizona and Evergreen State College, USA, respectively) in order to ensure the confidentiality of information being gathered during the research process:

We estimate that each interview will last 45 minutes. All answers will be kept confidential and no names will be used in the publications. The interviewees agree to publication of the information they provide with the understanding that confidentiality will be preserved. The interviewee is not obliged to answer any questions that he/she does not wish to answer and may discontinue the interview whenever he/she desires. No payment is being offered for participation in this research.

We look forward to meeting you and finding out more about fires on this island. If you have any questions, please do not hesitate to call us at the following number: 22510-36443.

Respectfully,

Barbara Morehouse

Martha Henderson

Kostas Kalabokidis

Theodoros Iosifides

QUESTIONNAIRE

Background Information

1. Name:
2. Job Title:
3. Agency/ Organization:
4. How long have you been working in this position?
5. How long have you lived on this island?
In this community?
6. What is your geographical area of responsibility?
7. In your job, whom do you report to?

History of fire on this island/ in this area

8. How many fires have you experienced personally?
9. How many fires have occurred on this island?
Dates:
10. What according to your knowledge are the main origins of fires? (Rank)
11. Where do most fires occur on this island?
12. How has the frequency pattern of fires changed over time on this island?
 There are more fires
 There are fewer fires
 The number of fires has remained about the same
13. How has the intensity of fires changed over time on this island?
 Fires are more intense
 Less intense
 About the same
14. How has the size of fires changed over time on this island?
 Fires are larger
 Fires are smaller
 Fires are about the same size

15. Which of the following factors have contributed to these changes? (Check all that apply)
- Land use change
 - Accession to EU
 - Changes in agricultural production
 - Increases in pasturage demand
 - Increases in tourism
 - Climate conditions
 - Fuel conditions
 - Increased forest density
 - Abandoned farmland
 - Increase in uses of fire at urban interface
 - Urban expansion
 - Increased road access to areas at risk of fire
 - Increased access to funds for fire management
 - Other (specify)
16. In your opinion, in which decade did the most fires occur? (Check only one)
- 1950s 1960s 1970s 1980s 1990s Since 2000
17. What are the attitudes of this community/ island toward fire – what do people say?
18. Would people on this island, in your opinion, be willing to pay national or local taxes to prevent/ fight forest fire? *or deal with results?*

Uses of Fire

19. Who sets the kinds of fire that could cause hazardous wildfires? (>100/ 200 ha; check all that apply)
- Agriculturalists
 - Military
 - New residents in rural areas (e.g., vacation home owners, etc.)
 - Foreign tourists
 - Picnickers
 - Waste management personnel
 - Residents in urban interface zone
 - Other (specify)
20. Is it always illegal to set fires? Yes No
21. Do you believe that controlled fires are an effective way to reduce risk from bad wildfires?
22. Should fire be a legitimate part of this island's ecology?

Use of Scientific Information and Decision Tools

23. Do you consult climate forecasts to monitor fire risk (forecasts for a month to a year in advance)?
- Yes No
- If yes, where do you get this information? (Check all that apply)

- Television
- Web
- Radio
- Newspaper
- Consult with a colleague
- Other (specify)

If yes, when do you consult this information? (Check all that apply)

- The winter/spring before fire season
- During fire season
- After fire season

24. Do you consult weather forecasts to monitor fire risk (forecasts an hour to a month in advance)

- Yes No

If yes, where do you get this information? (Check all that apply)

- Television
- Web
- Radio
- Newspaper
- Consult with a colleague
- Other (specify)

If yes, when do you consult this information? (Check all that apply)

- The winter/spring before fire season
- During fire season
- After fire season

25. Do you use scientific information to evaluate fire risk? (Check all that apply)

- Fuel moisture conditions
- Vegetation conditions
- Remote sensing information
- Fire history studies
- Fire prediction models (e.g., BEHAVE, etc. – please specify) _____
- Fire index data
- Other (specify) _____

26. How far in advance do you plan for the fire season? (Check one)

- 1 month 2-3 months 4-6 months 1 year more than 1 year

27. Do you carry out any of the following tasks if a forest fire occurs? (Check all that apply)

- Warn people
- Evacuate people
- Request fire fighters to be brought in
- Request equipment
- Provide food and water for fire fighters
- Arrange lodging for fire fighters
- Notify authorities
- Other (specify)

28. Have you received any special training? (Check all that apply)

- Fire suppression
- Fire use (e.g., controlled burns)
- Disaster planning
- Disaster relief
- Post-fire rehabilitation
- Post-fire claims management
- Other (specify) _____

29. Do you collect data locally? (Check all that apply)

- Fuel moisture
- Temperature
- Precipitation
- Soil moisture
- Vegetation condition
- Vegetation coverage
- Land use practices
- Agricultural activity
- Pasturage activity
- Tourist/ recreation statistics (e.g., number of hikers, campers, etc.)
- Other (specify)

Policies

30. What are the most important national policies for managing fire risk on this island?

31. Which best describes your ability to interpret these policies to fit realities on this island? (Check one)

- I can make some modest decisions to fit realities on this island
- I have considerable freedom to interpret these policies to fit local conditions
- I have no opportunities to do this

32. Please indicate, if you know, examples of policies that were enforced in the past
[Differently than now.]

33. Are there any specifically local policies for fire management that you enforce or administer? (Please list these policies.)

34. With regard to implementing or providing information about fire policies, with whom do you interact? (Check all that apply)

- Local land managers
- Public administrators
- Local elected officials
- Tourism industry
- Agriculturalists
- Pastoralists
- Local planners
- Church representatives
- Educators
- Other (specify)

35. Are there any policy changes you think need to be made to reduce fire risk? Explain.

36. What do you think needs to be done to decrease fire risk?

Map Questions

37. Please indicate on this map the area(s) where fire is most likely to occur in the next 5 years

38. Please indicate on this map where you think risk of fire to natural resources is greatest

39. Please indicate on this map where you think risk to human values is greatest (e.g., property, structures, agricultural resources, etc.)

40. Please indicate on this map the area(s) where fires have happened in the past. Indicate the (approximate) date(s) if possible.

41. Where would you be most sad if a fire occurred?

APPENDIX B. Composite Maps of Responses

Figure 4.4



Figure 4.5



Figure 4.6

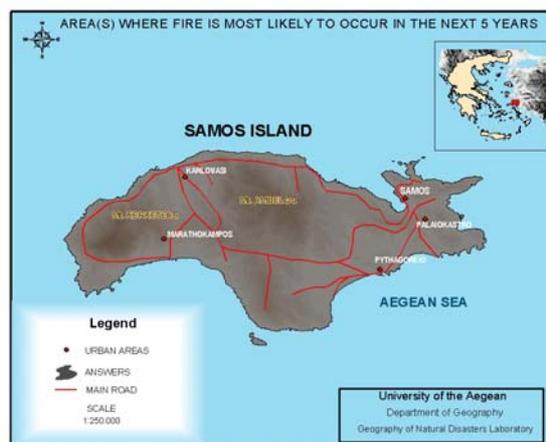


Figure 4.7



Figure 4.8



Figure 4.9

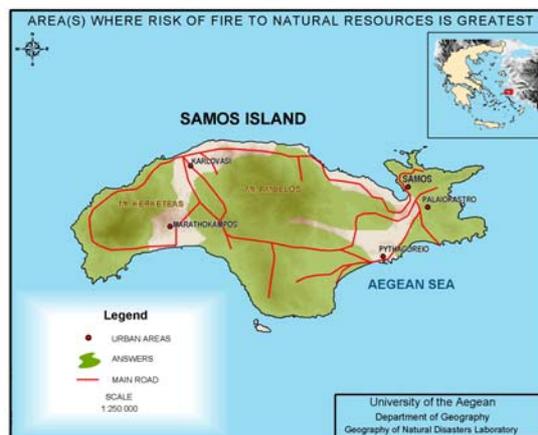


Figure 4.10

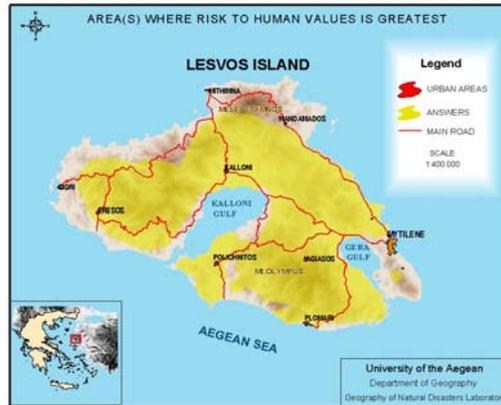


Figure 4.11

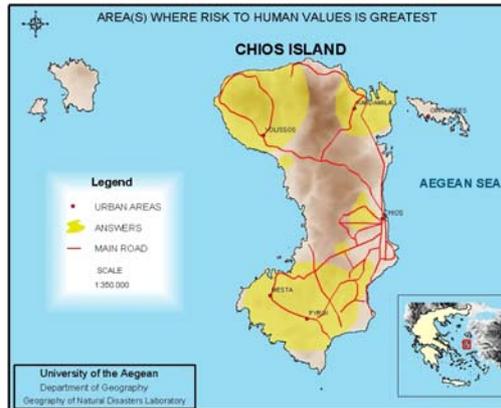


Figure 4.12

