8TH INTERNATIONAL WILDLAND FIRE CONFERENCE | GOVERNANCE PRINCIPLES: Towards an International Framework

Firebreak effectiveness prediction models developed from real wildfires in Southern Spain

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LABIF Laboratorio de Incendios Forestales

1. INTRODUCTION

Global Change → Fire regime alteration → Complex suppression scenarios

- more wildfires outside control capability
- higher suppression difficulties
- higher firefighting costs

More suppression resources
Higher preparedness budgets

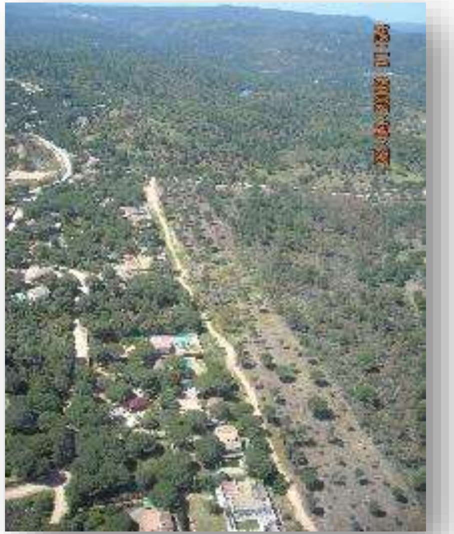
Redefine fuel break networks (science-based criteria)

1. INTRODUCTION

Fuel breaks

Areas where the structure of the vegetation has been modified by reducing fuel load

Areas where the species composition has been manipulated to reduce flammability



Firebreaks

All vegetation is removed down to mineral soil

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1. INTRODUCTION

Fuel breaks/Firebreaks

Provide multifunctionality

- Reduce wildfire hazard
- Reduce uncertainty during suppression (better decision)
- Serve as anchor points
- Increase fireline production rates
- Increase firefighter safety
- Reduce suppression difficulty and suppression costs

Reduce the energetic progression of wildfires, facilitating safe and efficient suppression

1. INTRODUCTION

WHY are firebreaks sometimes effective and sometimes not?

WHEN are firebreaks effective?

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1. INTRODUCTION

Firebreak effectiveness

Probability of controlling a wildfire (likelihood of control)

It is assessed by different methodologies

OPEN DEBATE

- Inappropriately designs
- Change in firebreaks over time
- Extreme weather conditions

Promote failures

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Research goals

- Quantitatively analyze the effectiveness of firebreaks during wildfires in Southern Spain
- Develop models to predict potential firebreak effectiveness in fire containment capabilities

2. MATERIALS AND METHODS

Database creation

Dirección General de Gestión del Medio Natural Plan INFOCA		
Incendio 2014040052	Ficha de seguimiento 2014112201	Documento 1904.03

0.2 Nombre del TOP	Javier Rubio Marín (CEDEFO Serón)
0.3 Fecha y hora de llegada	26/03/2014 7:50
0.5 Municipio	ALHAMA DE ALMERÍA
1.0 DATOS GENERALES	No escribir aquí.
1.1 Superficie aproximada a la llegada	>100 ha
1.2 Vector principal de propagación	Viento
1.3 Tipo de columna a la llegada	Columna dispersa (no consolidada). Columna oscura consolidada tumbada
1.4 Foto de la columna a la llegada	
1.5 Combustible: estratos presentes	Pasto. Matorral. Arbolado
2.0 ANÁLISIS COMPORTAMIENTO	C.- Se describe solo la zona de trabajo o sector asignado, pero de forma genérica (valores medios a lo largo de la intervención)
2.1 Hora toma de datos	
2.2 Localización de la zona descrita	6. Flanco derecho

A non-geospatial database
563 intersections between fires and fuel breaks (from 2011 to 2018)

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2. MATERIALS AND METHODS

Effectiveness dependent variable

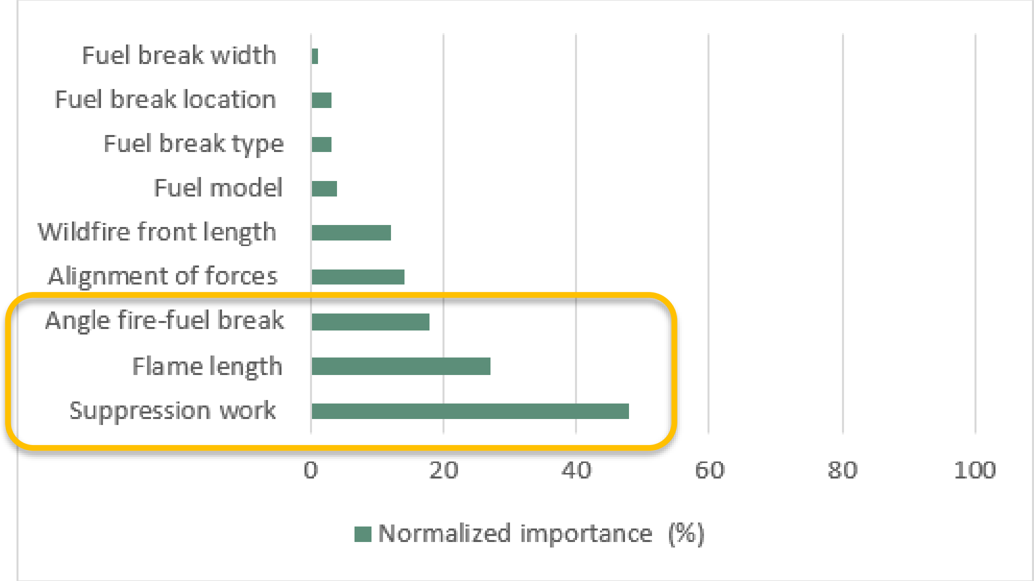
23 independent variables
topographic, meteorological, fuel, design feature, suppression and fire behavior variables

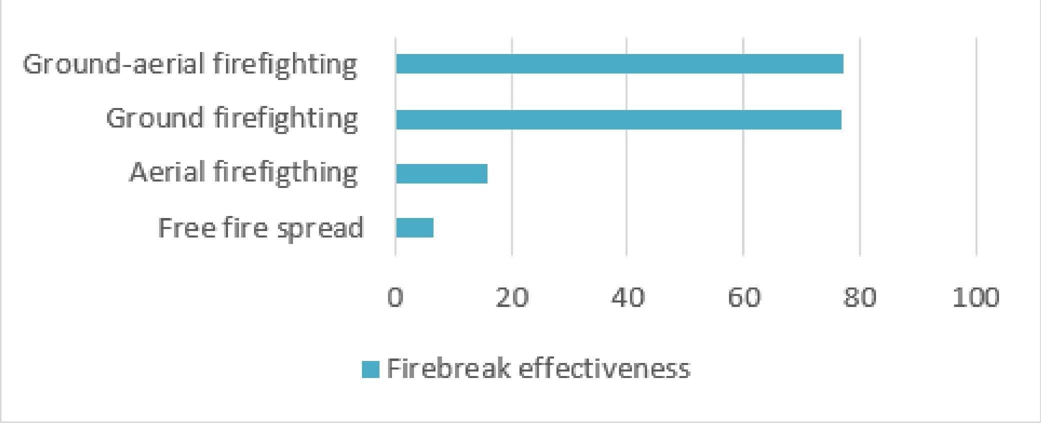
Combination of quantitative and qualitative variables

Exploratory analyses were carried out prior to the construction of the predictive models

3. RESULTS AND DISCUSSION

Data analyses





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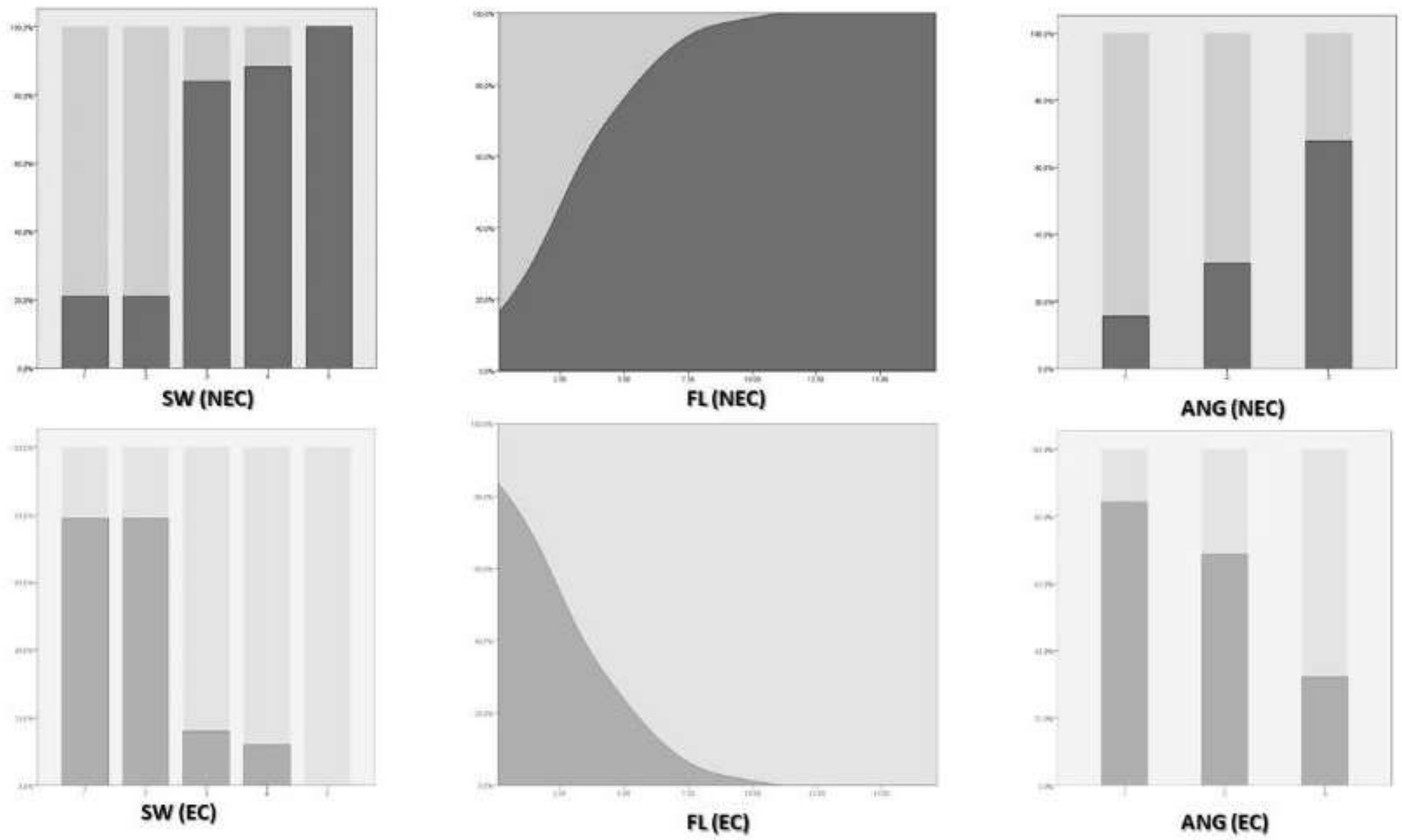
3. RESULTS AND DISCUSSION

Data analyses



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3. RESULTS AND DISCUSSION

Non-effective cluster

- Non combined ground-aerial firefighting and ground firefighting
- The average flame length was 4.41 m
- Perpendicular intersections
- Alignment of forces 3/3
- Chaparral and slash and pine litter (>90 cm)
- Mid-slope, steepest slope and canyon bottom
- Average fuel break width was 13.11 m

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3. RESULTS AND DISCUSSION

Effective cluster

- Combined ground-aerial firefighting and ground firefighting
- The average flame length was 2.42 m
- Almost parallel intersections
- Alignment of forces 0/3
- Shrubs (<0.5 m) and slash and pine litter
- Flats, watershed divides and lower slopes
- Average fuel break width was 17.30 m

3. RESULTS AND DISCUSSION

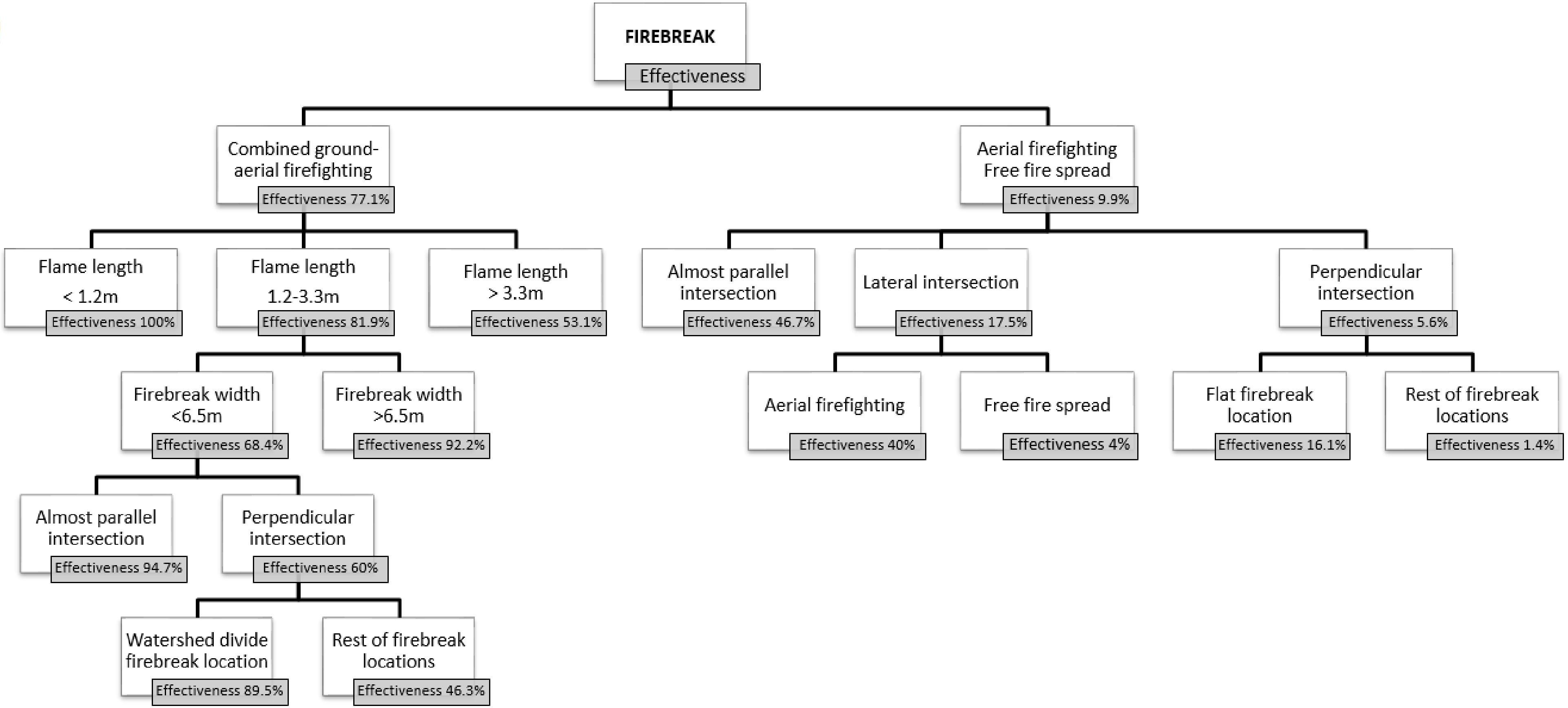
Effectiveness predictive models

- Logistic regression (LR)
- Decision tree (DT)
- Artificial neural network (ANN-MLP)

Internal validation methods: bootstrapping resampling (LR), cross-validation (DT) and split-sample validation (ANN)

	Predicted percentage correct		
Observed	LR	DT	ANN
Non-effective fuel break	86.3%	83.6%	90.9%
Effective fuel break	88.3%	83.3%	87.5%
Overall percentage	87.2%	83.5%	89.3%

3. RESULTS AND DISCUSSION



4. CONCLUSIONS

- This research entails a change in firebreak effectiveness assessment to an empirical approach in real wildfires in Spain
- It has been proven the low effectiveness of firebreaks by themselves
- Combined ground-aerial suppression work on firebreak increases meaningfully their effectiveness
- Regarding predictive models, the most accurate results were achieved with an artificial neural network, however, decision tree is easier for end users
- The applicability of predictive models has a twofold perspective:
    - Operational level (suppression). Reducing uncertainty and optimizing fire containment capability and firefighter safety
    - Planning level (preparedness). Making possible to address the design of new firebreaks or the revaluation of existing ones

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THANK YOU
FOR YOUR ATTENTION

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