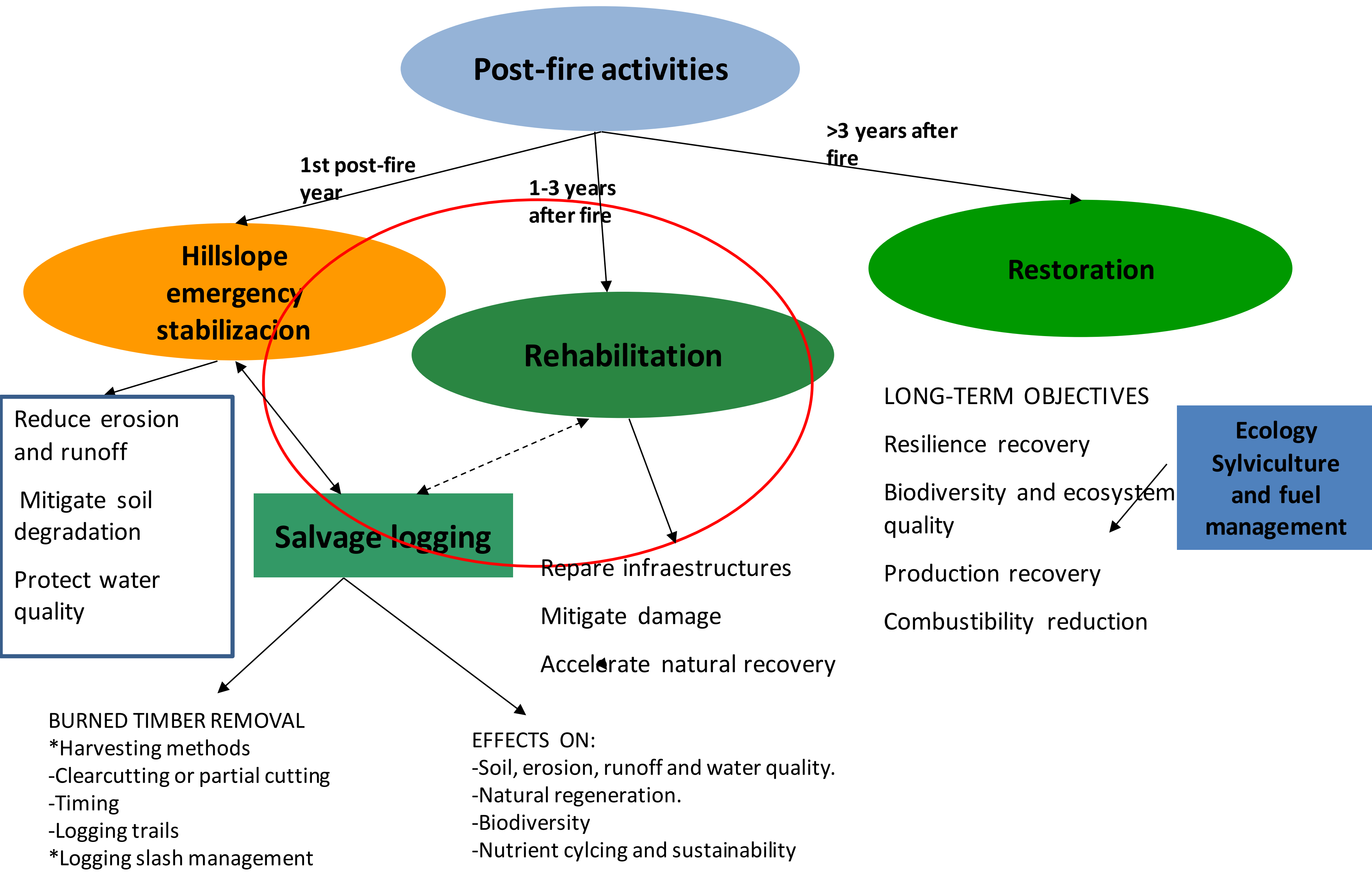
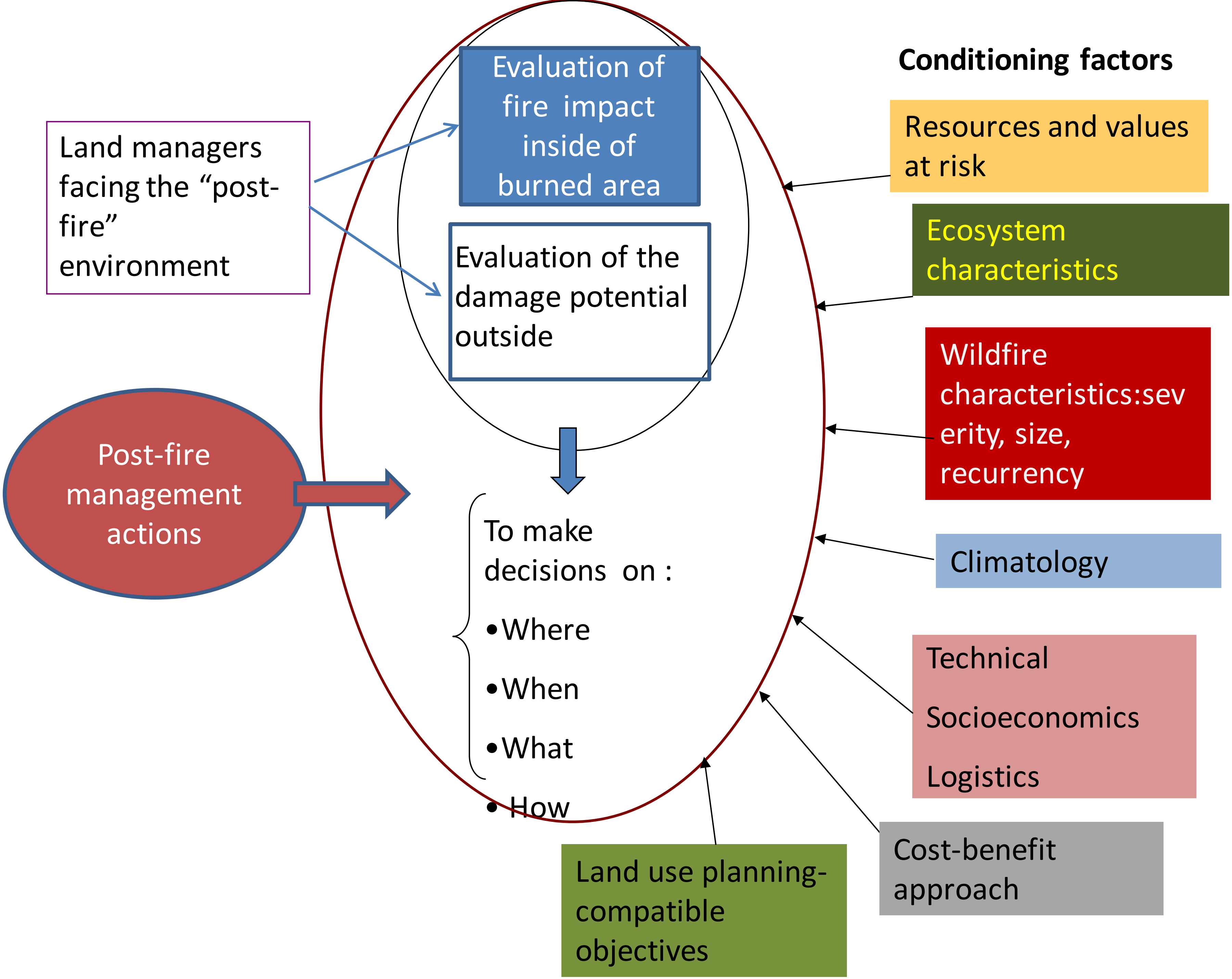
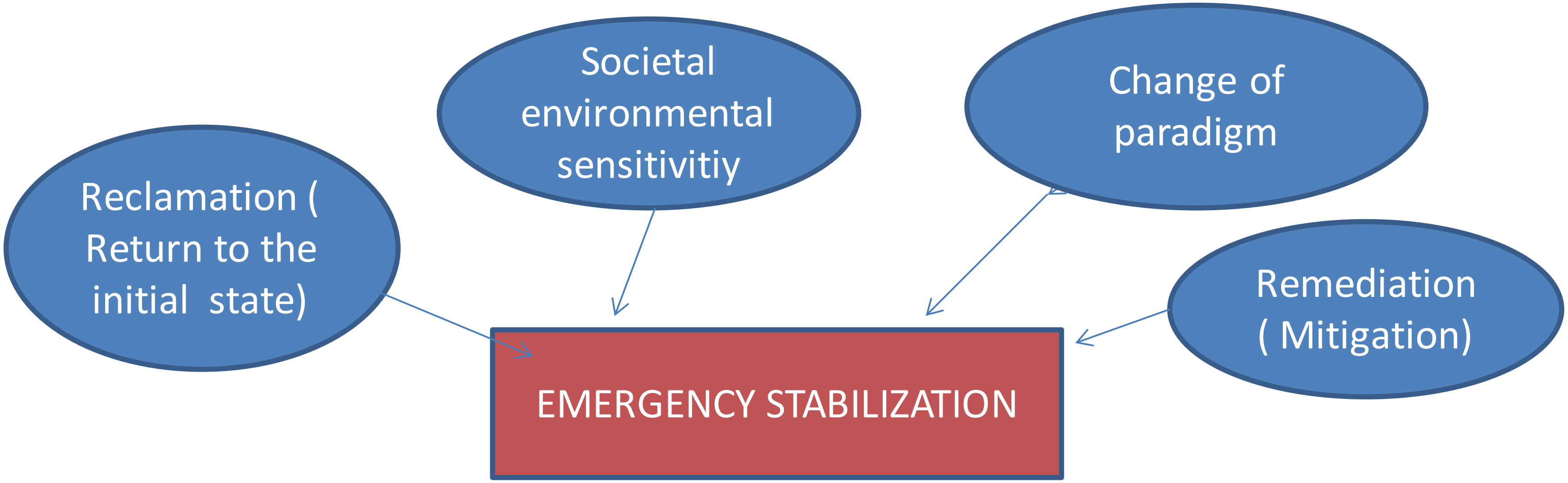
REHABILITATION TREATMENTS

Jose A. Vega Agustin Merino, Felipe garcia -Oliva

Emergency stabilization of burned soils, pose a challenge for land manageres since they need to make decisions and carry out actions in a short time to minimize the risks arisen


Post-fire activities
1st post-fire year
1-3 years after fire
>3 years after fire
Hillslope emergency stabilizacion
Rehabilitation
Restoration
Reduce erosion and runoff
Mitigate soil degradation
Protect water quality
Salvage logging
Repare infraestructures
Mitigate damage
Accelerate natural recovery
LONG-TERM OBJECTIVES
Resilience recovery
Biodiversity and ecosystem quality
Production recovery
Combustibility reduction
Ecology Sylviculture and fuel management
BURNED TIMBER REMOVAL
*Harvesting methods
-Clearcutting or partial cutting
-Timing
-Logging trails
*Logging slash management
EFFECTS ON:
-Soil, erosion, runoff and water quality.
-Natural regeneration.
-Biodiversity
-Nutrient cylcing and sustainability

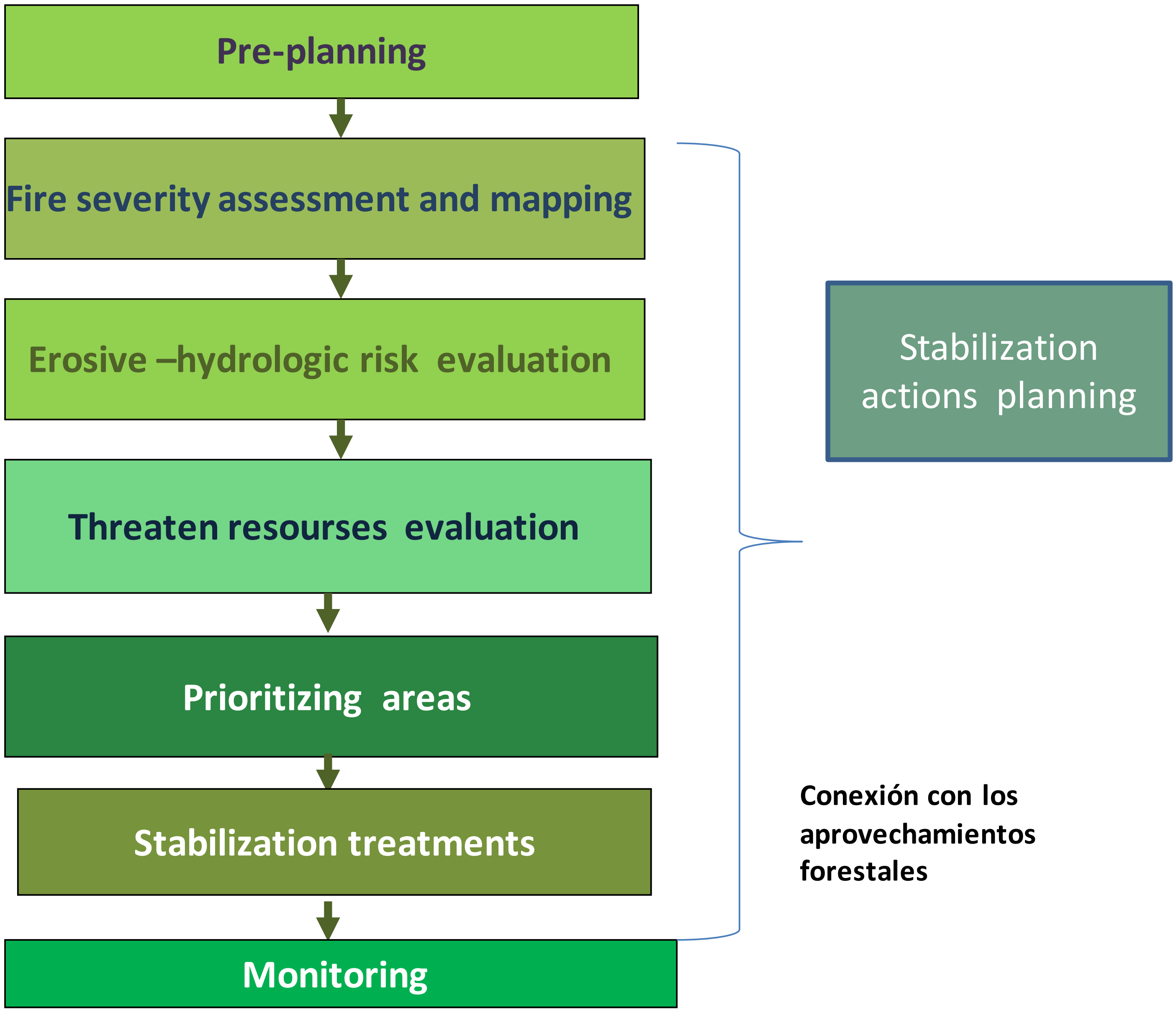

Conditioning factors
Evaluation of fire impact inside of burned area
Evaluation of the damage potential outside
Land managers facing the "post-fire" environment
Post-fire management actions
To make decisions on :
•Where
•When
•What
• How
Resources and values at risk
Ecosystem characteristics
Wildfire characteristics:severity, size, recurrency
Climatology
Technical
Socioeconomics
Logistics
Cost-benefit approach
Land use planning-compatible objectives



- " **Urgent actions carried out soon after wildfire to protect human lives and a suite of valuable resources critically threatened** "
- **They are largely aimed to decrease hydrological and erosive risk**
- **They acts limiting hillslope runoff and channels alterations, hence mitigating flood risk.**
- **Also reducing water erosion and soil degradation.**
- **Indirectly , protecting water quality and aquatic habitats.**

Planning key points

- Short response time .
- Simple and flexible planning.
- Qualified staffs. S
- .Availability of resources
- Agencies coordination
- Same terminology .
- Open communication to media and involved groups


Pre-planning
Fire severity assessment and mapping
Erosive –hydrologic risk evaluation
Threaten resourses evaluation
Prioritizing areas
Stabilization treatments
Monitoring
Stabilization actions planning
Conexión con los aprovechamientos forestales

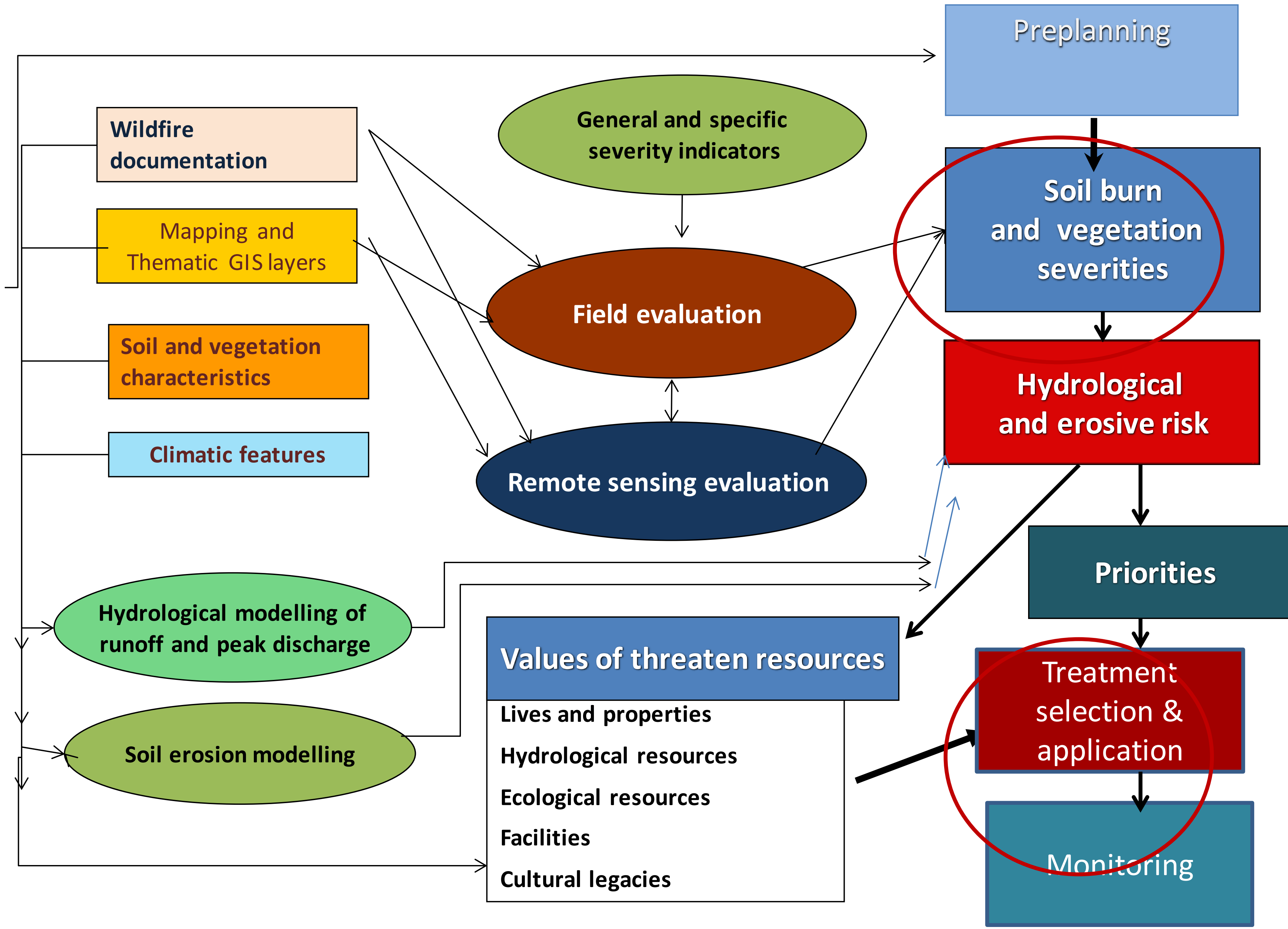
ACCIONES URGENTES CONTRA LA EROSIÓN EN ÁREAS FORESTALES QUEMADAS

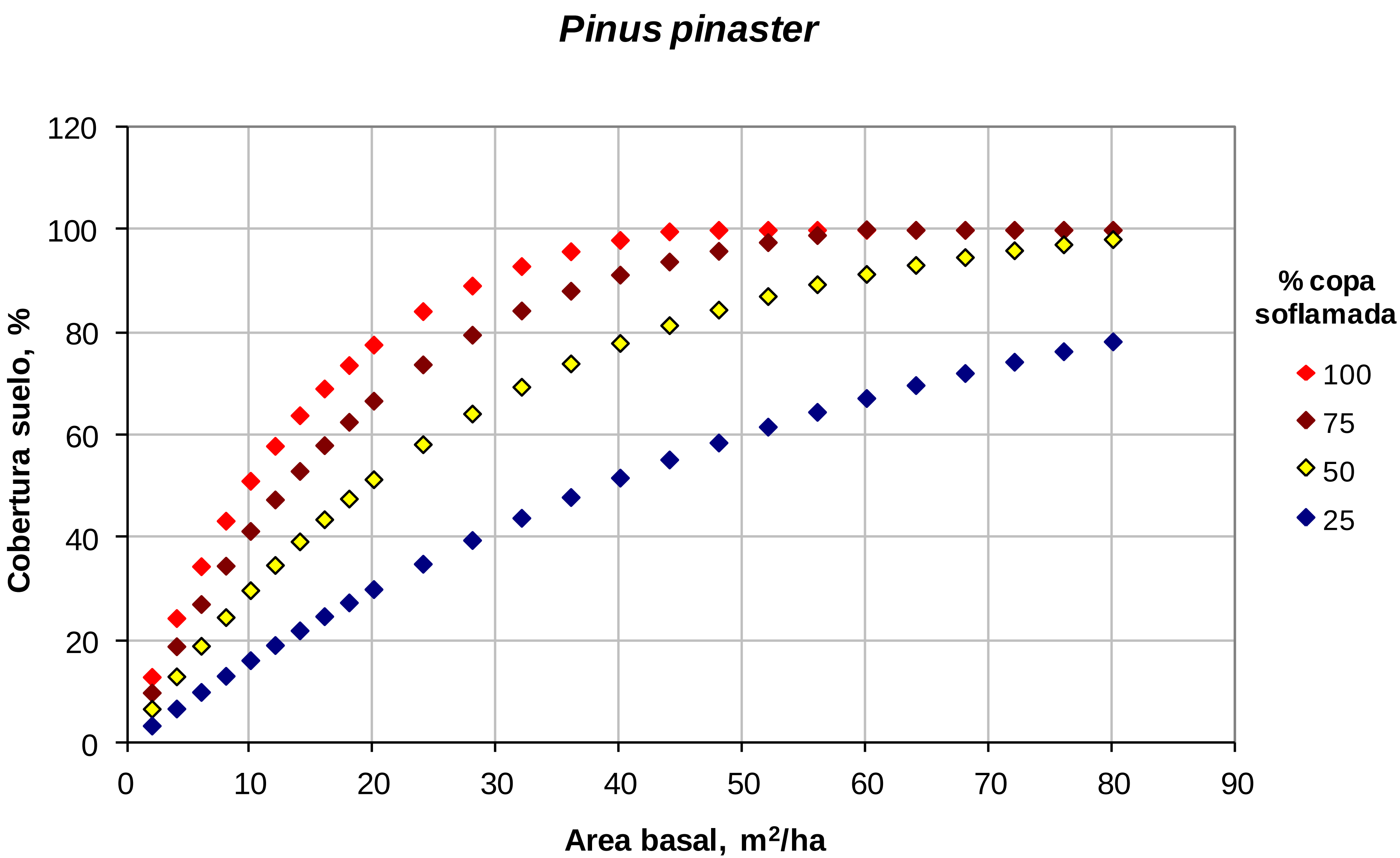
GUÍA PARA SU PLANIFICACIÓN EN GALICIA

José A. Vega, Teresa Fontúrbel, Cristina Fernández, Antonio Arellano,
Montserrat Díaz-Raviña, Mª Tarsy Carballas, Angela Martín,
Serafín González-Prieto, Agustín Merino, Elena Benito

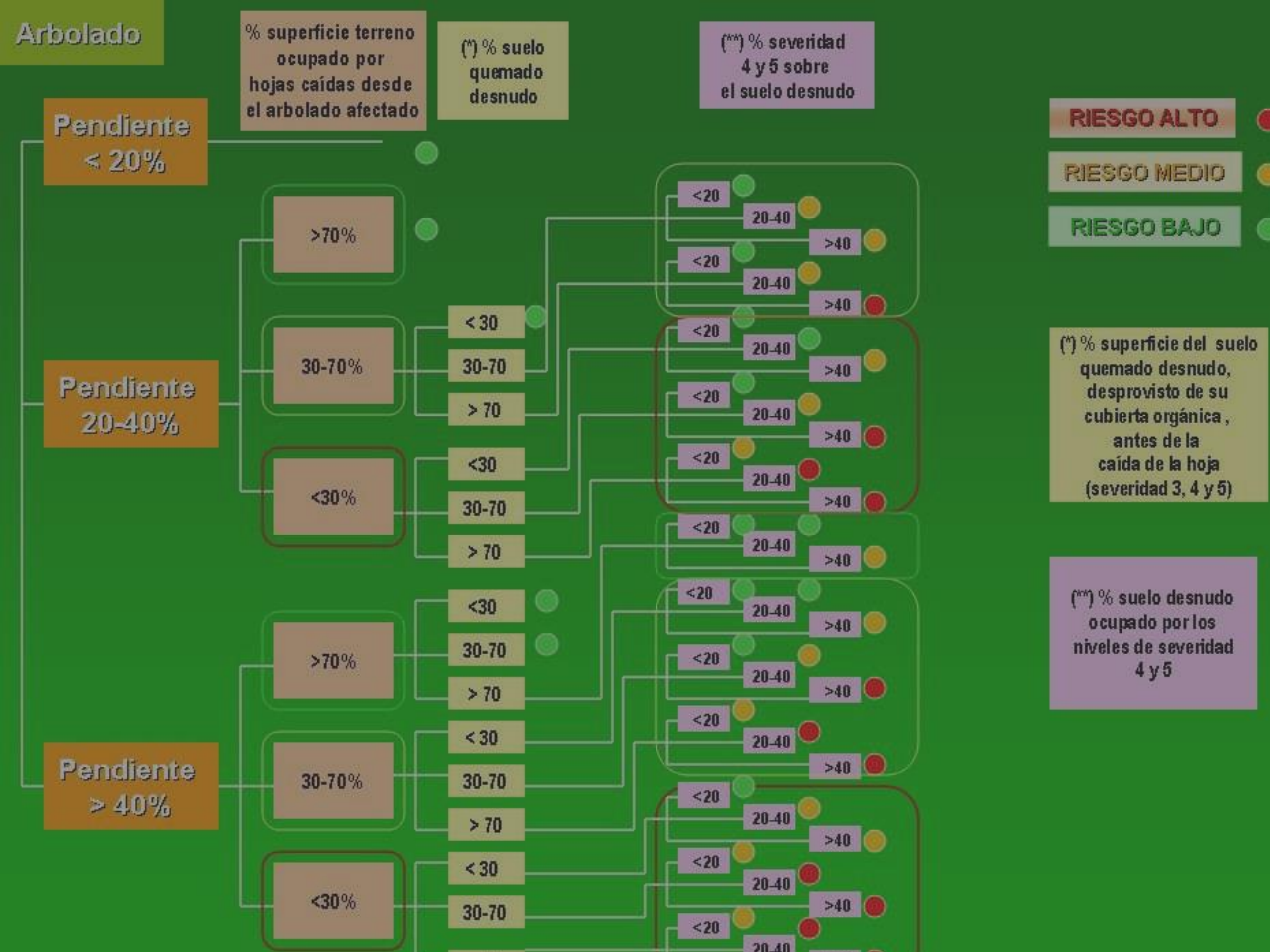
XUNTA DE GALICIA

FUEGORED


Preplanning
Wildfire documentation
General and specific severity indicators
Mapping and Thematic GIS layers
Soil burn and vegetation severities
Field evaluation
Soil and vegetation characteristics
Hydrological and erosive risk
Climatic features
Remote sensing evaluation
Priorities
Hydrological modelling of runoff and peak discharge
Values of threaten resources
Lives and properties
Hydrological resources
Ecological resources
Facilities
Cultural legacies
Soil erosion modelling
Treatment selection & application
Monitoring



Pinus pinaster
Cobertura suelo, %
0
20
40
60
80
100
120
0
10
20
30
40
50
60
70
80
90
Area basal, m2/ha
% copa soflamada
100
75
50
25


Arbolado
% superficie terreno ocupado por hojas caídas desde el arbolado afectado
(*) % suelo quemado desnudo
(**) % severidad 4 y 5 sobre el suelo desnudo
RIESGO ALTO
RIESGO MEDIO
RIESGO BAJO
Pendiente < 20%
Pendiente 20-40%
Pendiente > 40%
>70%
30-70%
<30%
< 30
30-70
> 70
<20
20-40
>40
(*) % superficie del suelo quemado desnudo, desprovisto de su cubierta orgánica, antes de la caída de la hoja (severidad 3, 4 y 5)
(**) % suelo desnudo ocupado por los niveles de severidad 4 y 5

FIELD SAMPLING

FICHA DE CAMPO

CARACTERÍSTICAS DEL PUNTO DE MUESTREO

Incendio:.. Fecha incendio:...................... Fecha medición:......................

Nº punto		Localización		Coorden. N		Coorden. W	

Pendiente terreno		Orientación		Altitud	

Tipo de relieve	Plano	Quebrado	Ondulado	Pend. plana	Pend.cóncava	Pend.convexa	Terrazas	Otros

Actividades forestales previas	

Profundidad del suelo						Litología
Somera (< 30 cm)		Media (30-50 cm)		Alta (< 50 cm)		

Vegetación pre-incendio	Especies arbóreas dominantes	
	Especies matorral dominantes	

Tipo de erosión	Laminar	Regueros	Cárcavas	Deslizamiento terreno en masa

DATOS POST-INCENDIO: SEVERIDAD DEL FUEGO

ARBOLADO

(Parcelas circulares de radio = 15 m, cuando densidad ≤ 1500 pies/ha, y de radio = 10 m, cuando densidad > 1500 pies/ha)

Especie dominante		Densidad		FCC estimada	

Nivel de severidad[a]	Hojas totalmente consumidas	Soflamado total	% volumen copa árbol soflamado [b]	Dosel arbóreo intacto

[a] Inmediatamente después del incendio. [b] Estimado visualmente

Arbol nº	Especie	Diámetro	Nivel de severidad

Arbol nº	Especie	Diámetro	Nivel de severidad

% de superficie de terreno ocupada por hojas caídas desde el arbolado quemado[c]	>70%	30-70%	<30%

[c] Pocos días después del incendio.

MATORRAL

(Parcelas circulares de radio = 15 m)

Especies dominantes		% de cobertura	

% de superficie ocupada por las siguientes categorías	Hojas completamente consumidas	Hojas chamuscadas parcial o totalmente

SUELO Y CUBIERTA ORGÁNICA

Distancia en el transecto [d]	Nivel de severidad [e]	Repelencia al agua [f]	% superficie con pedregosidad [g]	

USDA

United States Department of Agriculture

Forest Service

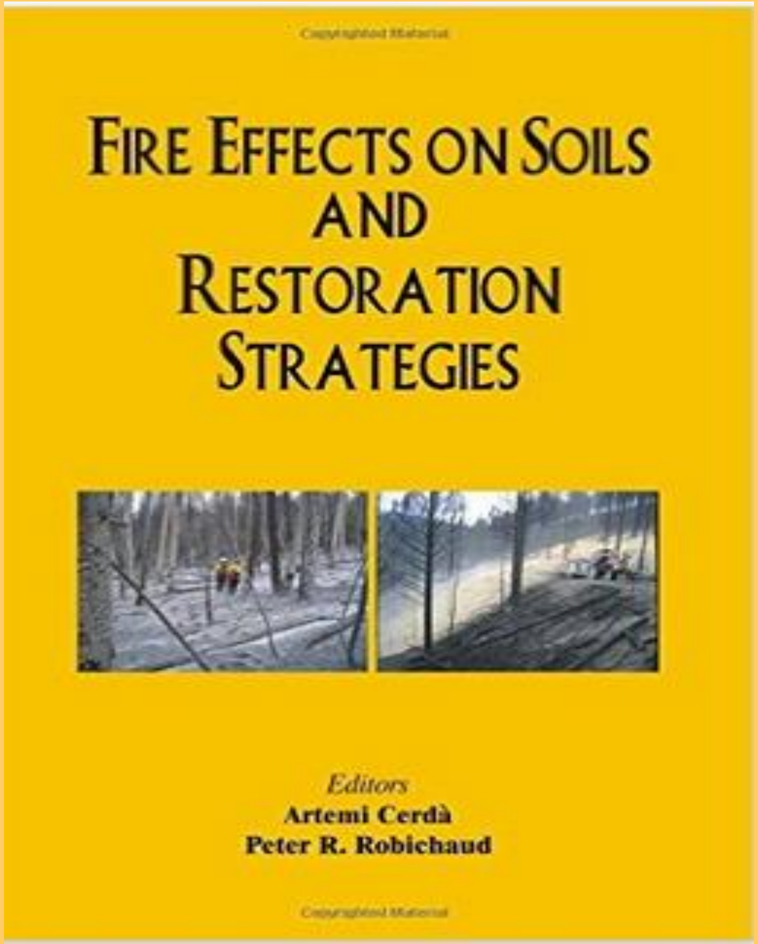
Rocky Mountain Research Station

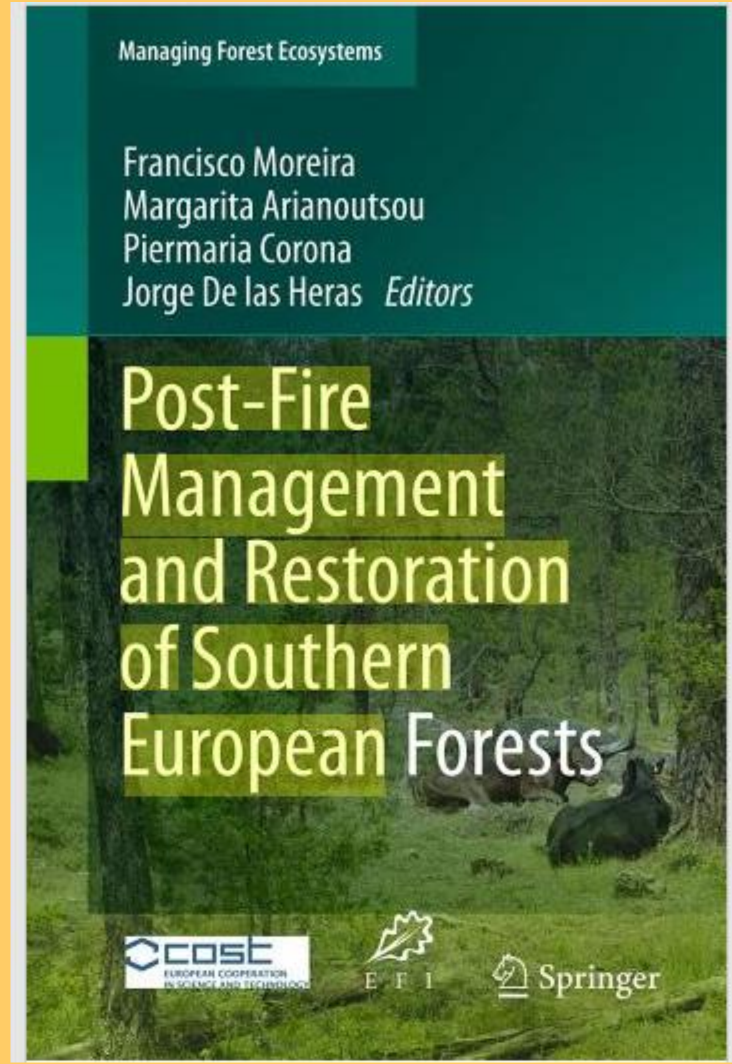
General Technical Report RMRS-GTR-243

October 2010

Field Guide for Mapping Post-Fire Soil Burn Severity

Annette Parsons, Peter R. Robichaud, Sarah A. Lewis, Carolyn Napper, and Jess T. Clark


FIRE EFFECTS ON SOILS AND RESTORATION STRATEGIES
Editors
Artemi Cerdà
Peter R. Robichaud


Managing Forest Ecosystems
Francisco Moreira
Margarita Arianoutsou
Piermaria Corona
Jorge De las Heras Editors
Post-Fire Management and Restoration of Southern European Forests
cost
E F I
Springer

FUEGORED 2010

Santiago de Compostela, 6-8 de octubre de 2010

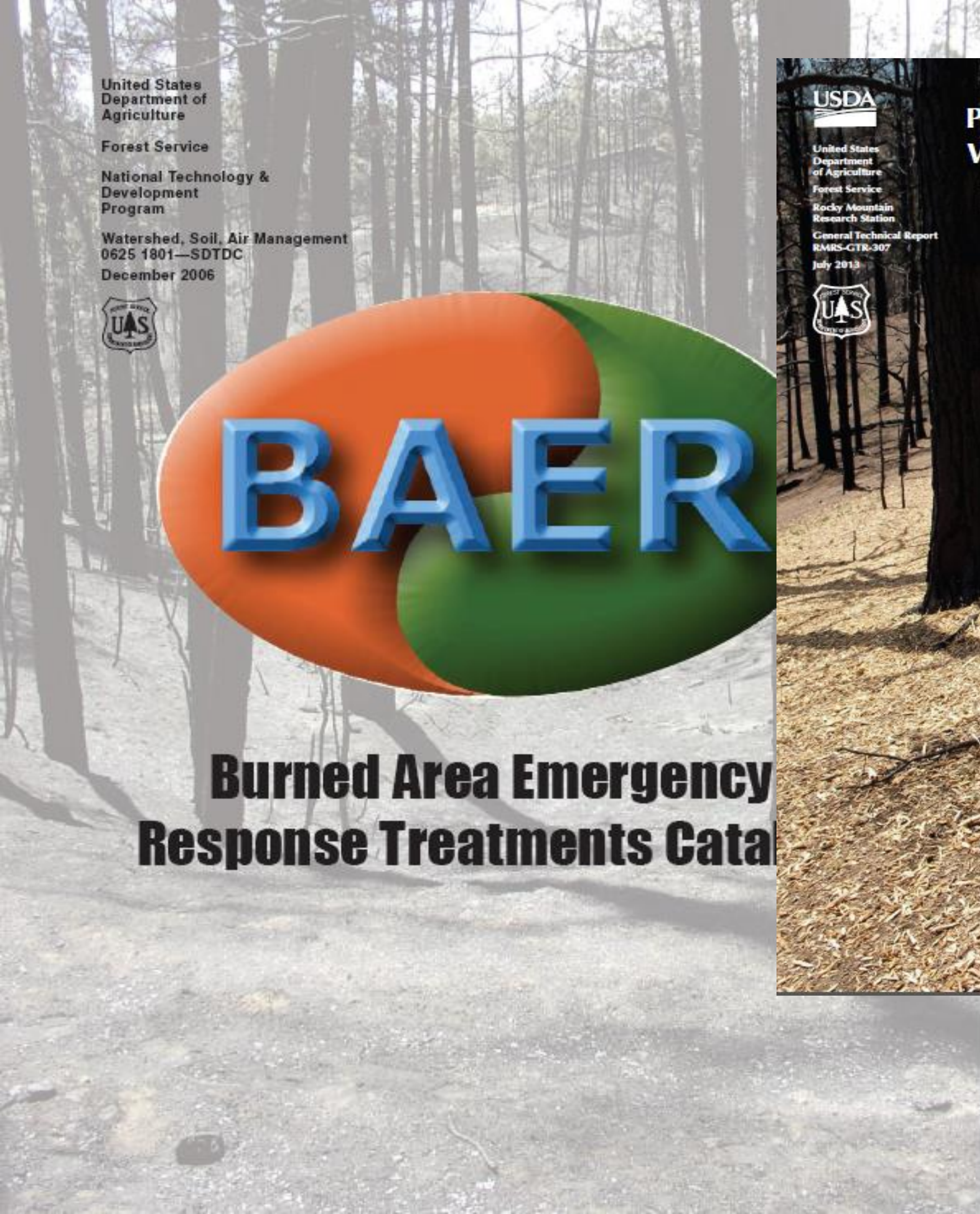
Jornadas Internacionales

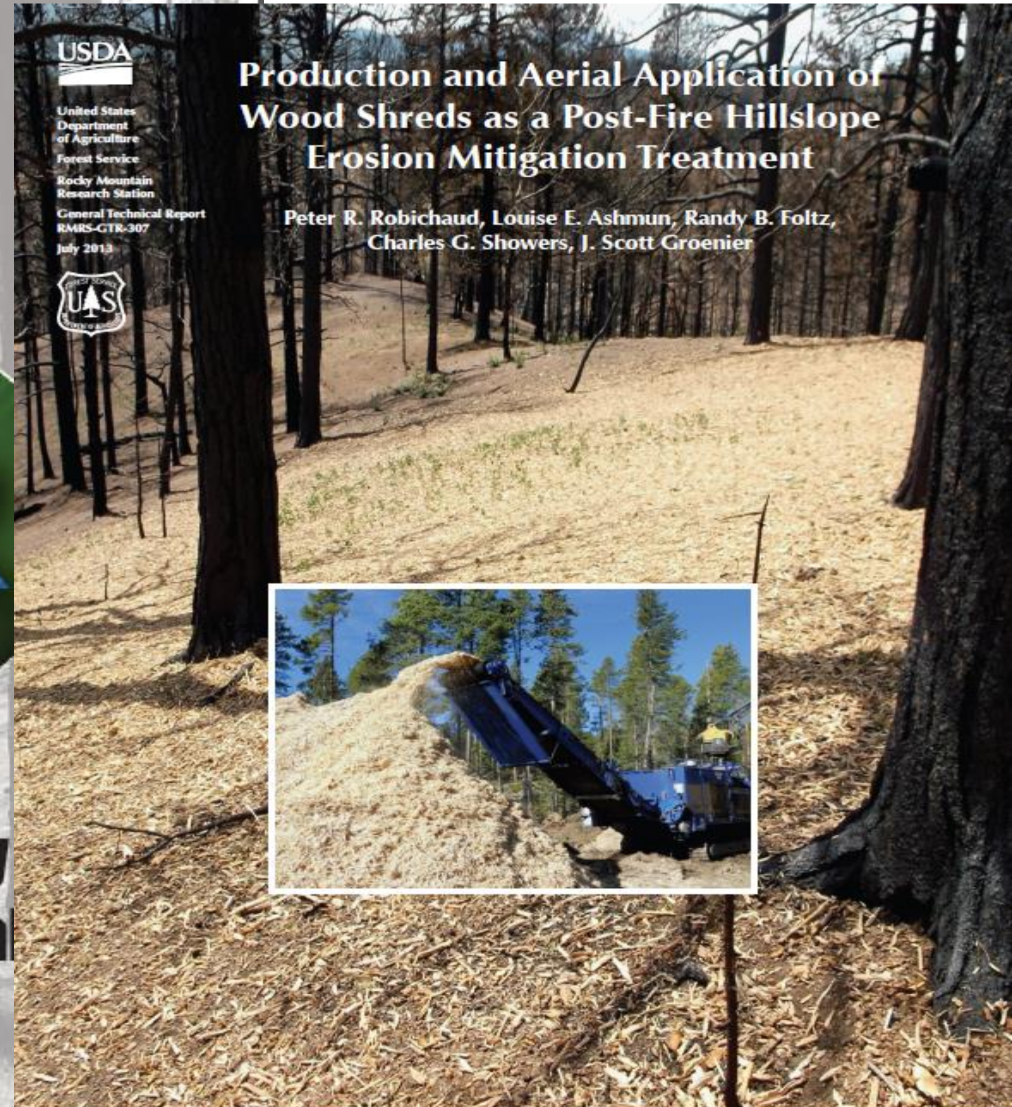
INVESTIGACIÓN Y GESTIÓN PARA LA PROTECCIÓN DEL SUELO Y RESTAURACIÓN DE LOS ECOSISTEMAS FORESTALES AFECTADOS POR INCENDIOS FORESTALES

International Workshop

RESEARCH AND POST-FIRE MANAGEMENT: SOIL PROTECTION AND REHABILITATION TECHNIQUES FOR BURNT FOREST ECOSYSTEMS

M. Díaz Raviña, E. Benito, T. Carballas, M. T. Fontúrbel, J. A. Vega (eds.)


United States Department of Agriculture
Forest Service
National Technology & Development Program
Watershed, Soil, Air Management 0625 1801—SDTDC
December 2006
BAER
Burned Area Emergency
Response Treatments Catal


USDA
United States Department of Agriculture
Forest Service
Rocky Mountain Research Station
General Technical Report RMRS-GTR-307
July 2013
Production and Aerial Application of Wood Shreds as a Post-Fire Hillslope Erosion Mitigation Treatment
Peter R. Robichaud, Louise E. Ashmun, Randy B. Foltz, Charles G. Showers, J. Scott Groenier

DNBR (Diference of Normalized Burned Rate)

PRE-INCENDIO

1. IMÁGENES SATÉLITE LANDSAT 8

POST-INCENDIO

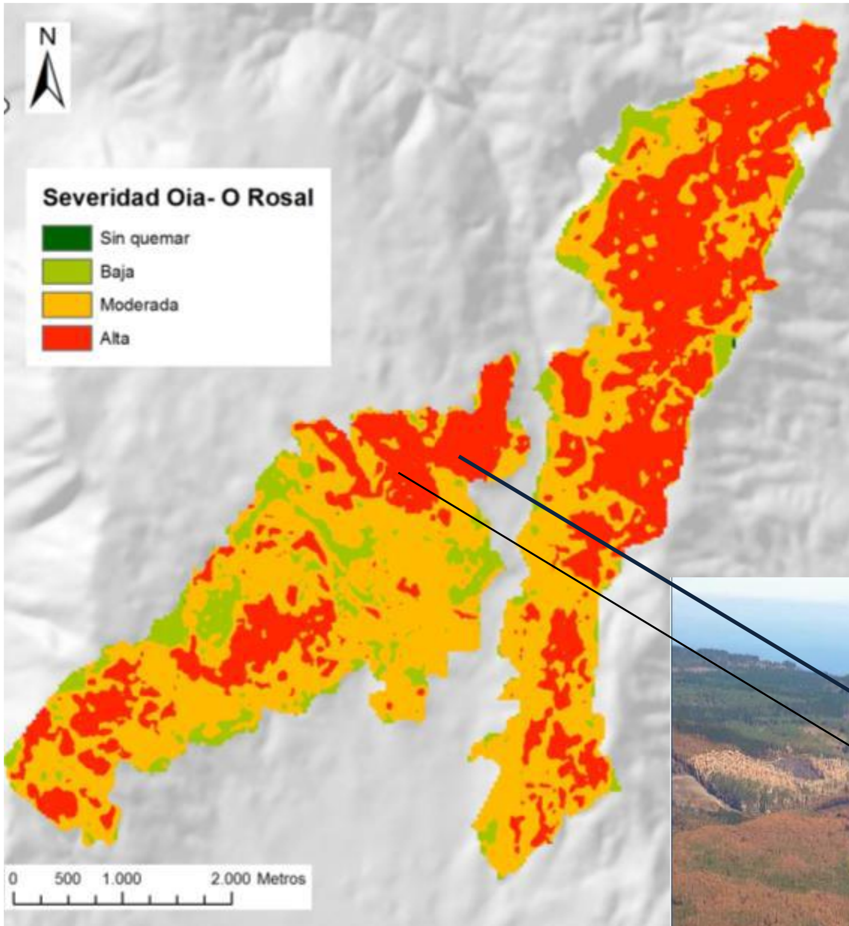
2. ANÁLISIS Y PROCESADO DE LAS IMÁGENES SATÉLITE

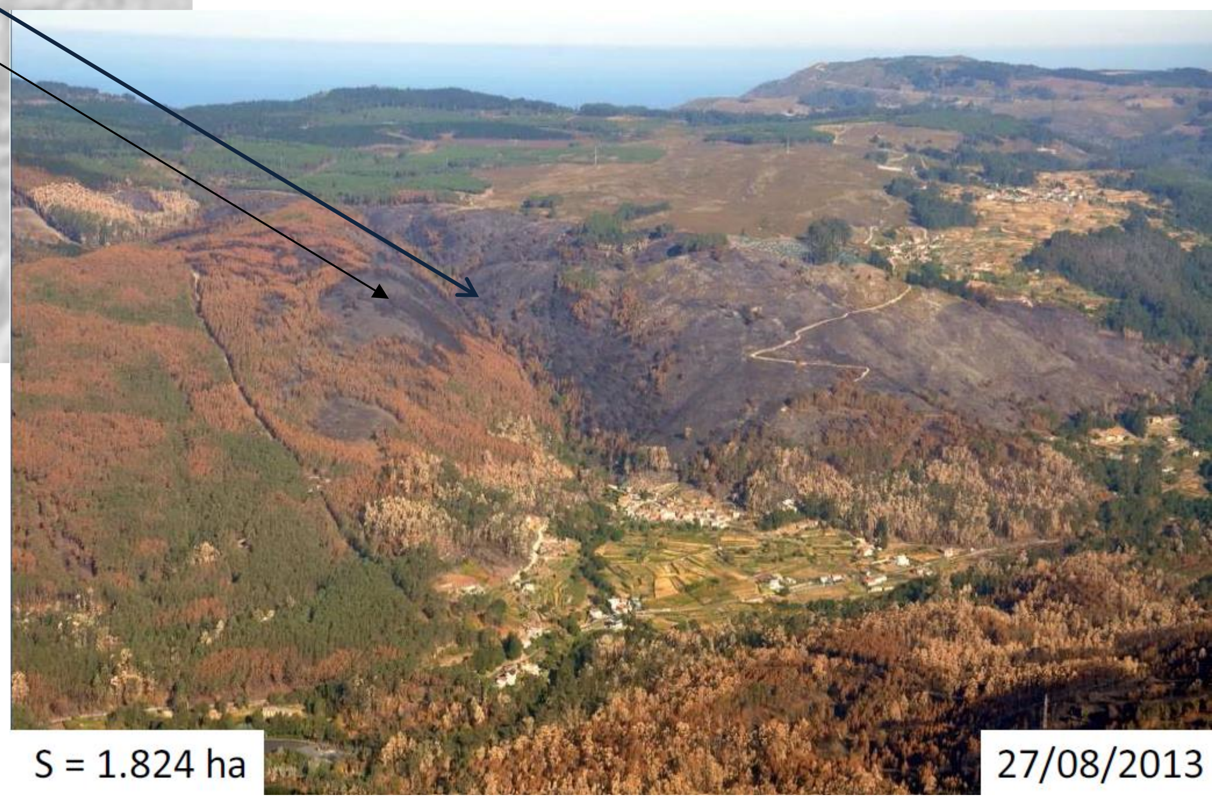
Clasificación de los niveles de severidad USGS FIREMON

- Sin quemar
- Severidad baja
- Severidad baja-moderada
- Severidad moderada-alta
- Severidad alta

Incendios de Oia/ O Rosal 2013

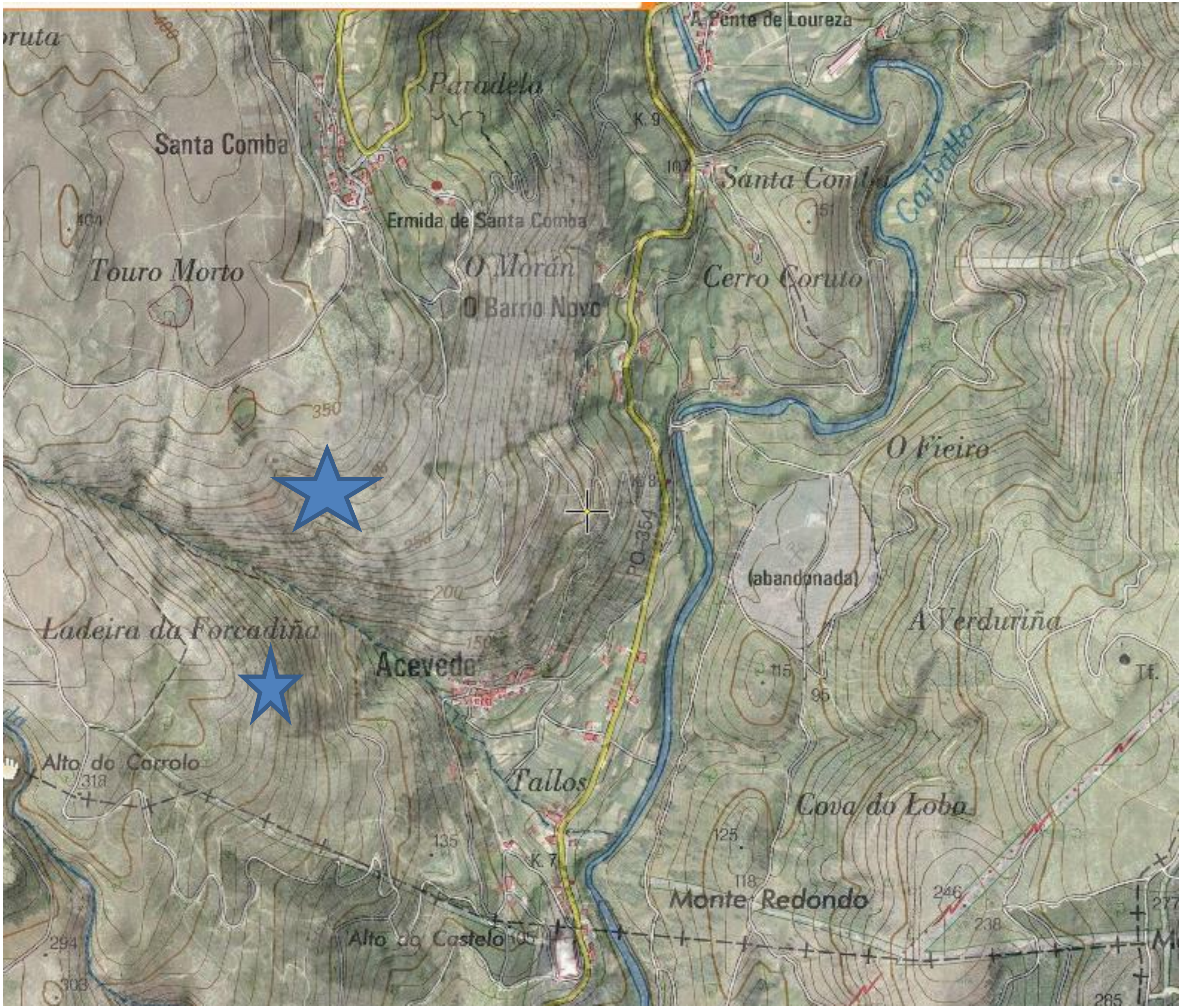
Severy map obtained from Landsat imagery (dNBR)



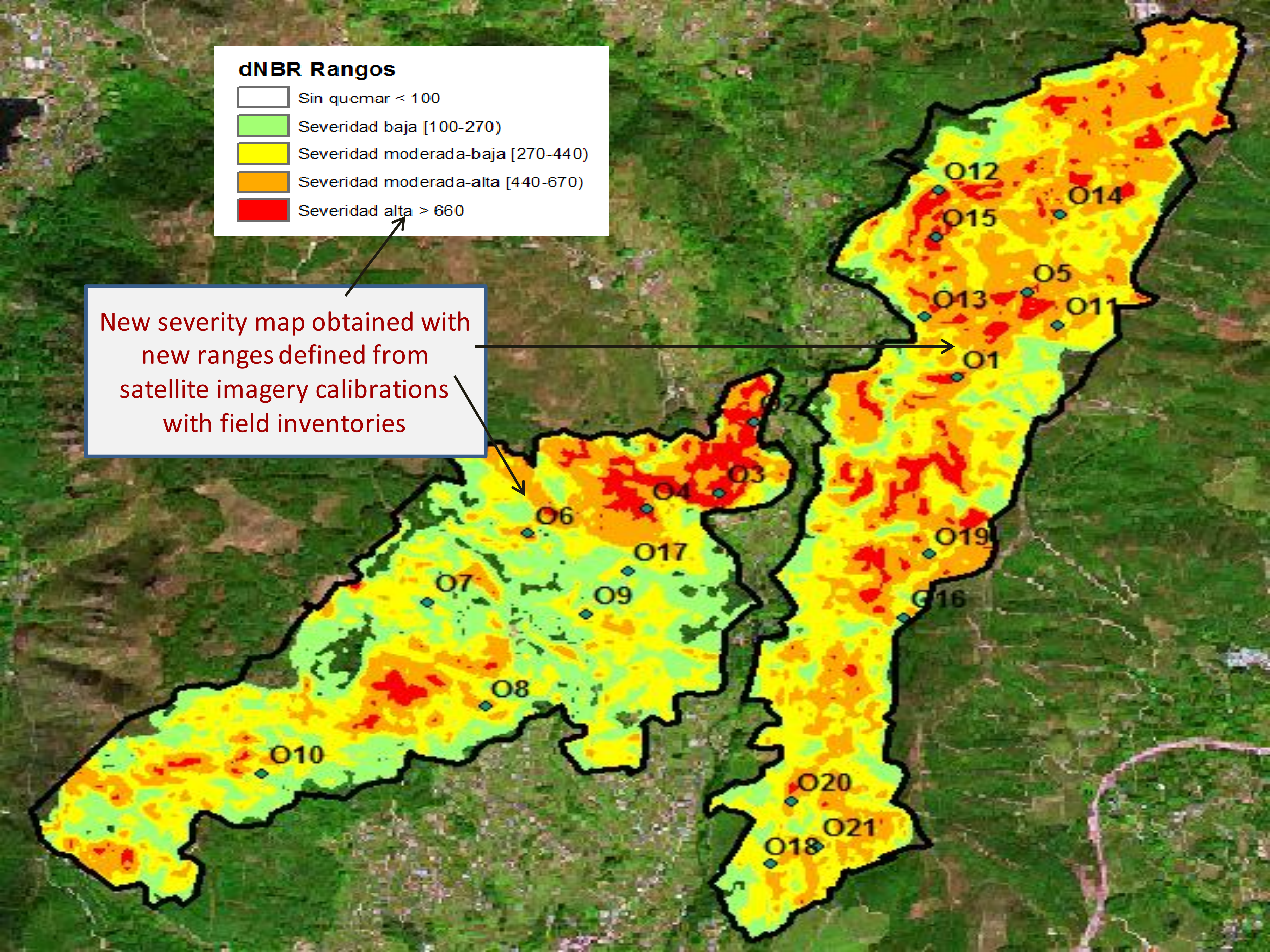


S = 1.824 ha

27/08/2013


A Ponte de Loureza
Paradela
Santa Comba
Santa Comba
Ermida de Santa Comba
Touro Morto
O Morán
O Barrio Novo
Cerro Coruto
Carballo
O Fieiro
(abandonada)
A Verduriña
Ladeira da Forcadiña
Acevedo
Alto do Corrolo
Tallos
Cova do Lobo
Monte Redondo
Alto do Castelo
PO-354
K. 9
K. 7
350
200
150
318
135
125
118
115
95
246
238
294
303
285

Crown fire with very high soil burn severity


dNBR Rangos
Sin quemar < 100
Severidad baja [100-270)
Severidad moderada-baja [270-440)
Severidad moderada-alta [440-670)
Severidad alta > 660
New severity map obtained with new ranges defined from satellite imagery calibrations with field inventories
O12
O14
O15
O5
O13
O11
O1
O3
O4
O6
O17
O19
O7
O9
O16
O8
O10
O20
O21
O18

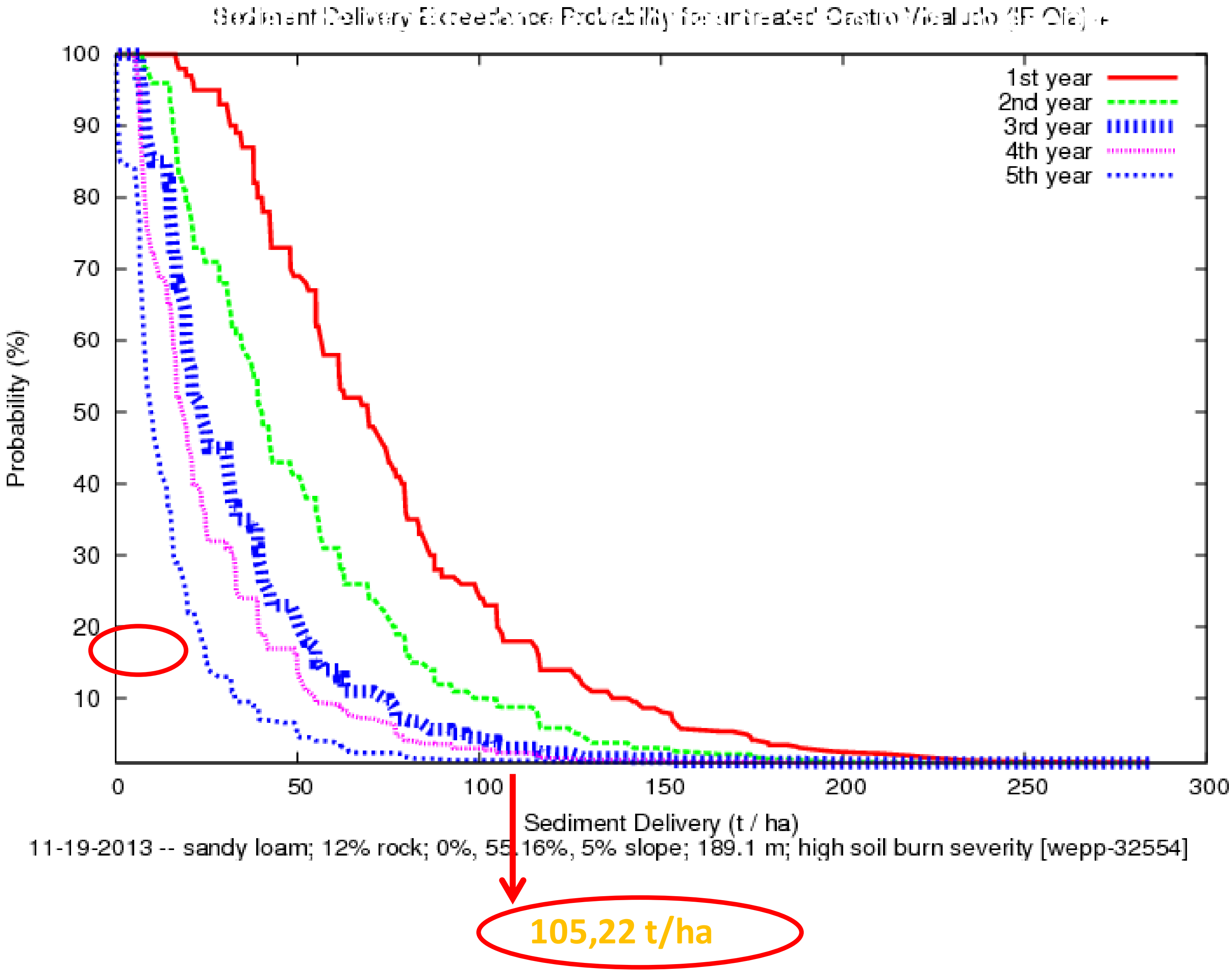
RUSLE, MORGAN-MORGAN FINNEY-DISTURBED WEPP MODELS

	RUSLE (t/ha)	DISTURBED WEPP (t/ha)	MORGAN-MORGAN FINNEY (t/ha)
L = 50 m	95,26	26,19	18,90

DISTURBED WEPP MODEL

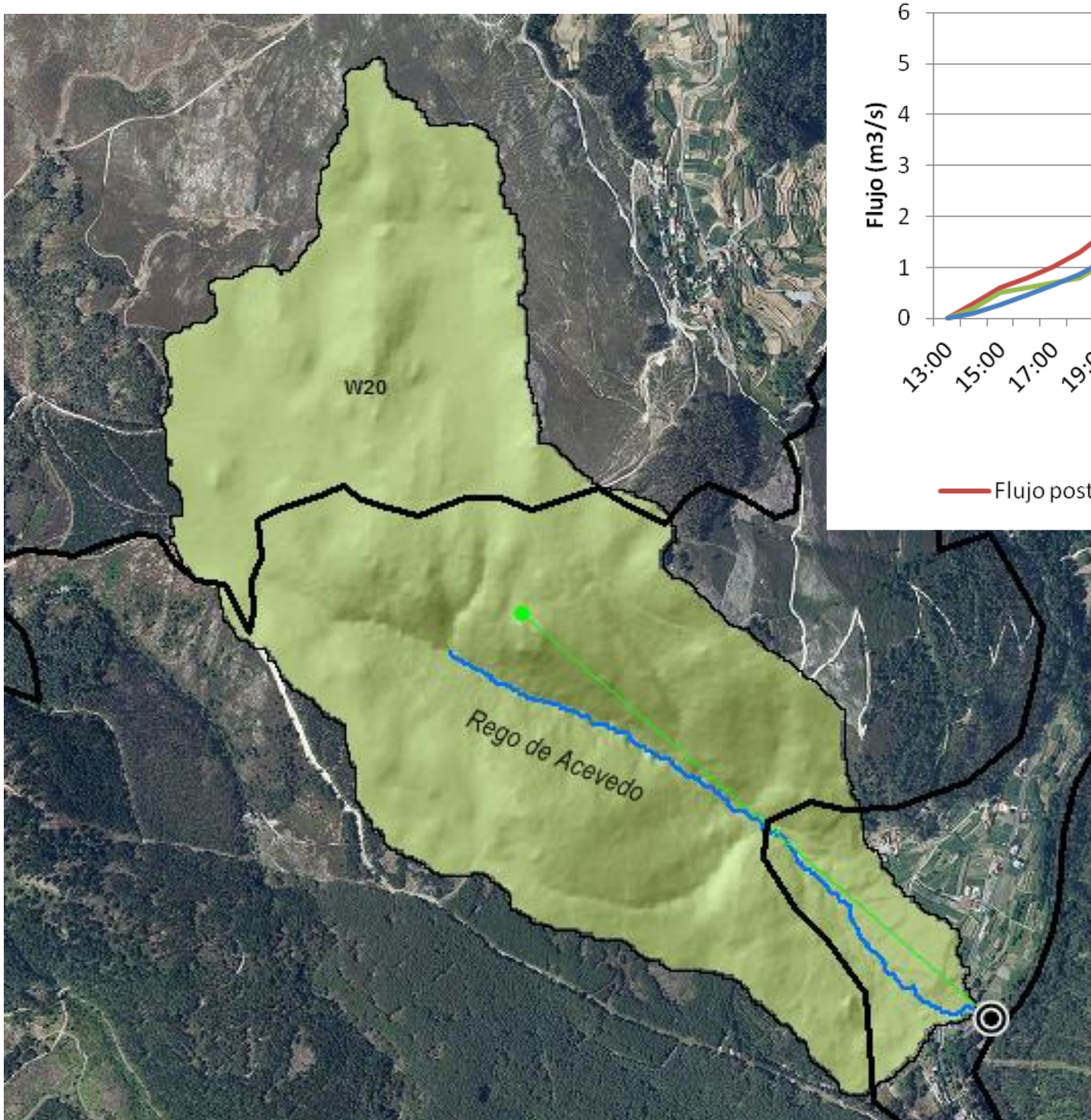
	RETURN PERIOD	SOIL LOSSES (t/ha)
L =189,1 m	10 YEARS	134,19
	5 YEAR	114,11
	2 YEARS	56,03
	1 YEAR	22,57
	MEAN	69,90

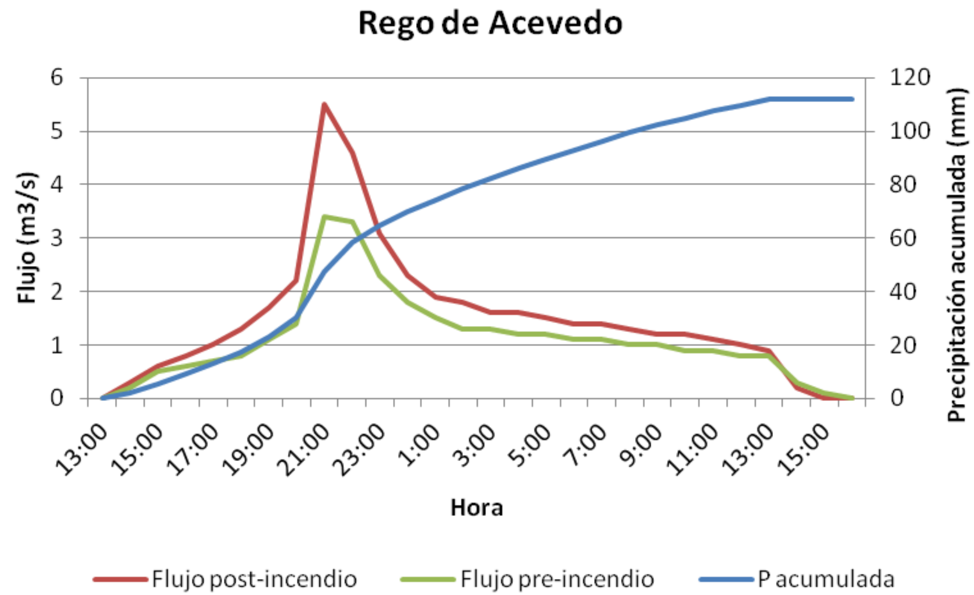
ERMIT MODEL



Probability (%)
Sediment Delivery (t / ha)
1st year
2nd year
3rd year
4th year
5th year
100
90
80
70
60
50
40
30
20
10
0
50
100
150
200
250
300
11-19-2013 -- sandy loam; 12% rock; 0%, 55.16%, 5% slope; 189.1 m; high soil burn severity [wepp-32554]
105,22 t/ha

OIA – O ROSAL (R. Acevedo)





Hydrograph- hietograph

Peak discharge increase 61,76 %

Predictive models for erosion and hydrological changes

Runoff, hydriogrphs and dischrage peaks under a simulated storm

*Curve number .

* WILDCAT4, FYREHIDRO, TR-55, WMS y HEC-HCM.

Erosion

*RUSLE

*WEPP

*ERMiT

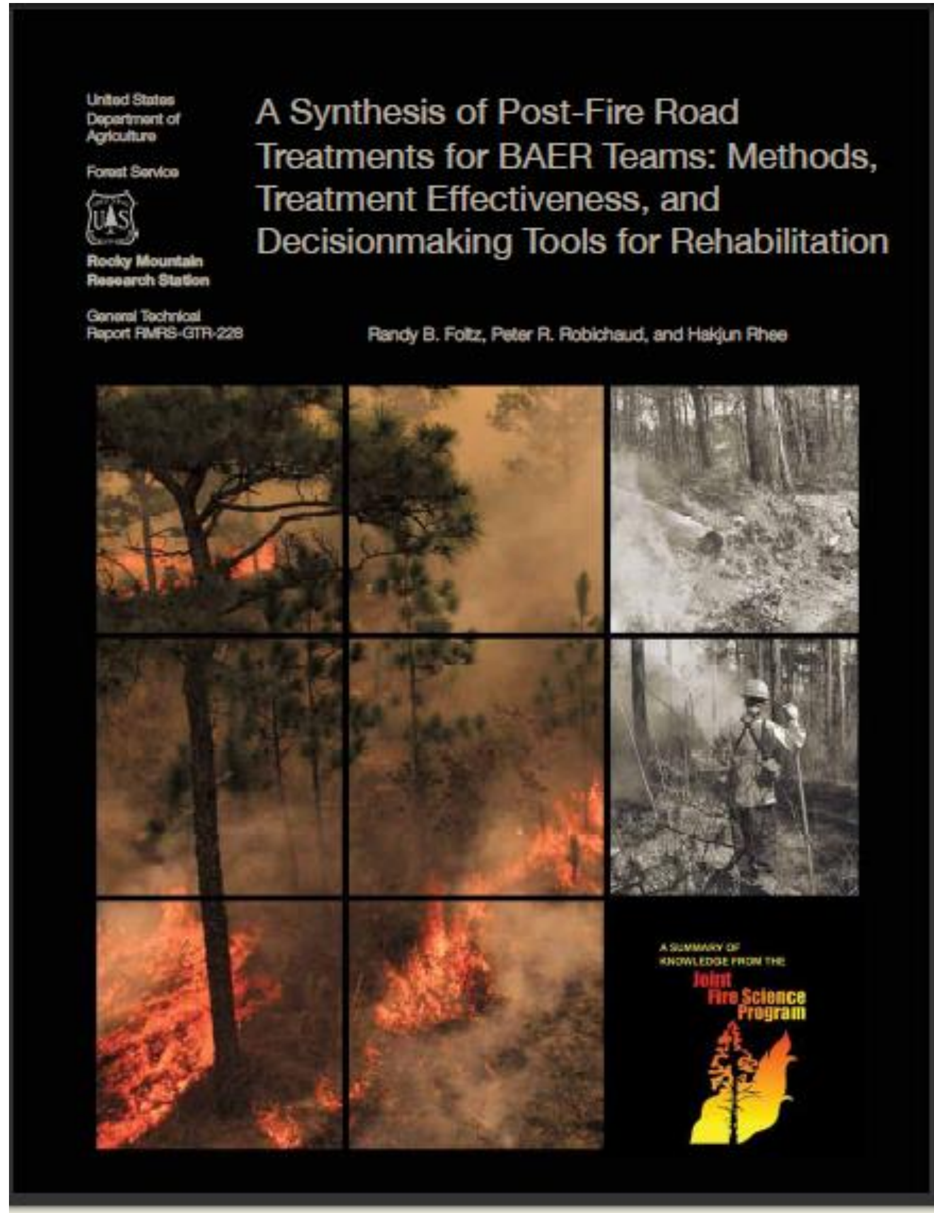
*DISTURBED WEPP

*GeoWEPP

* PESERA

*FERGI

*EMPIRICAL MODELS



Effectiveness of Post-fire Burned Area Emergency Response (BAER) Road Treatments: Results from Three Wildfires

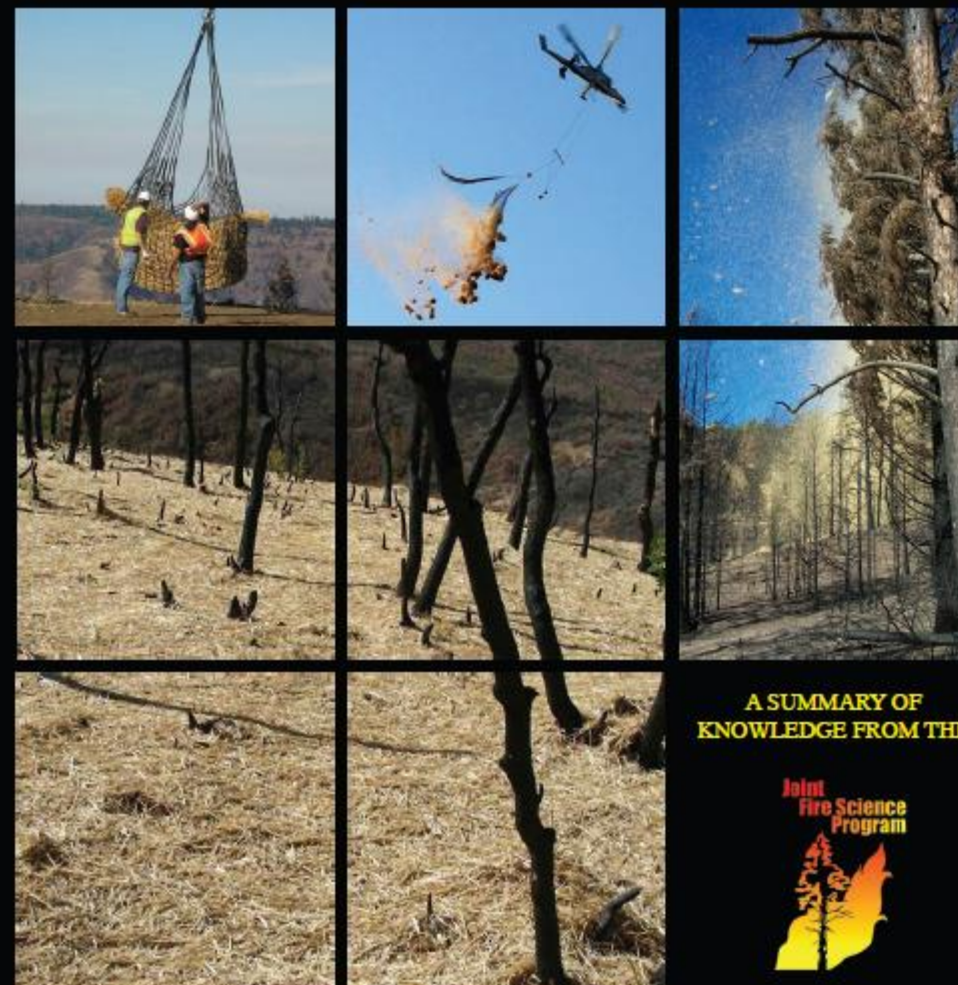
Randy B. Foltz and Peter R. Robich

USDA United States Department of Agriculture / Forest Service
Rocky Mountain Research Station
General Technical Report RMRS-GTR-313
October 2013

USDA United States Department of Agriculture
Forest Service
Rocky Mountain Research Station
General Technical Report RMRS-GTR-240
August 2010

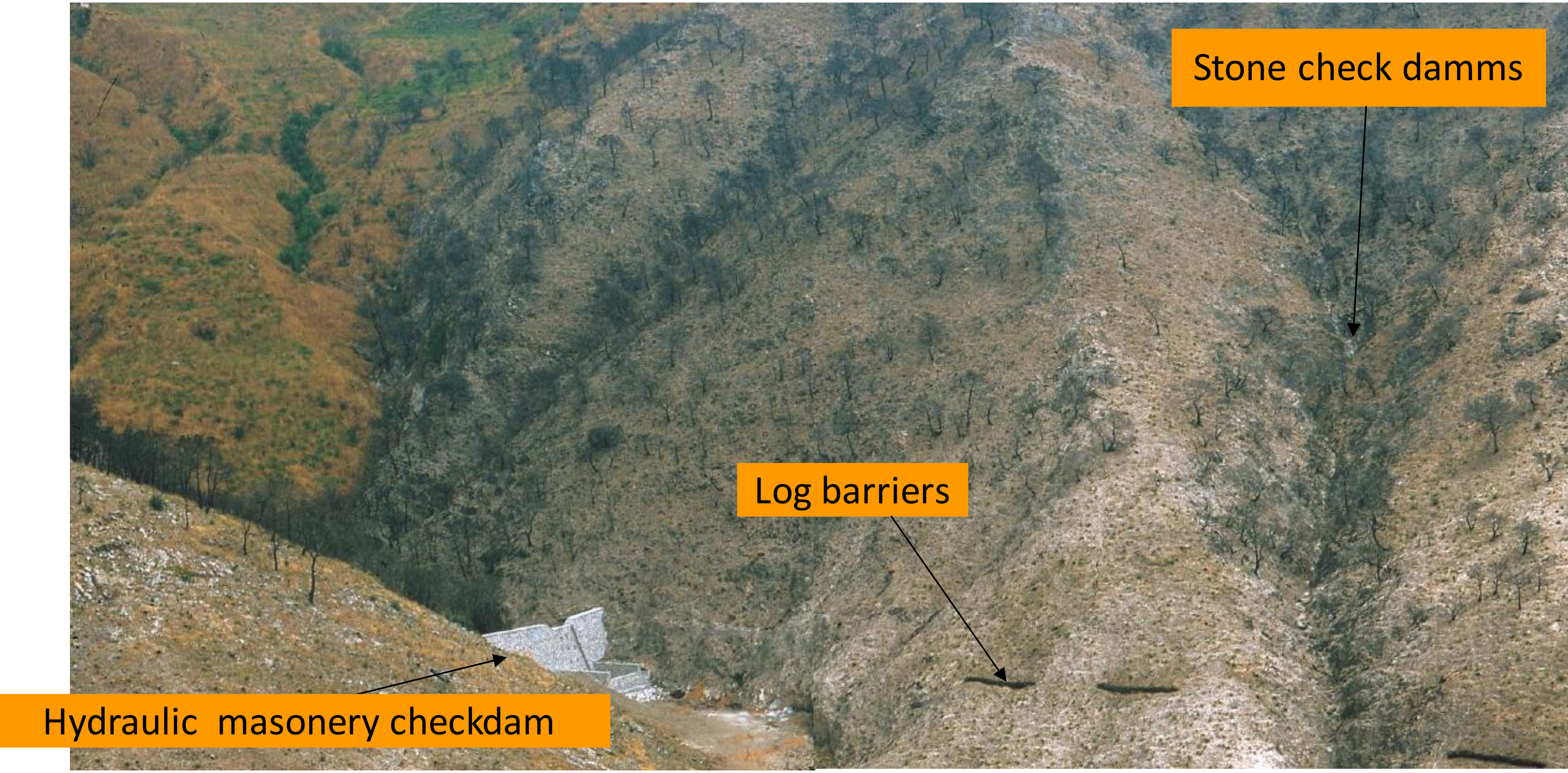
Post-Fire Treatment Effectiveness for Hillslope Stabilization

Peter R. Robichaud, Louise E. Ashmun, and Bruce D. Si



A SUMMARY OF
KNOWLEDGE FROM TH

Joint Fire Science Program



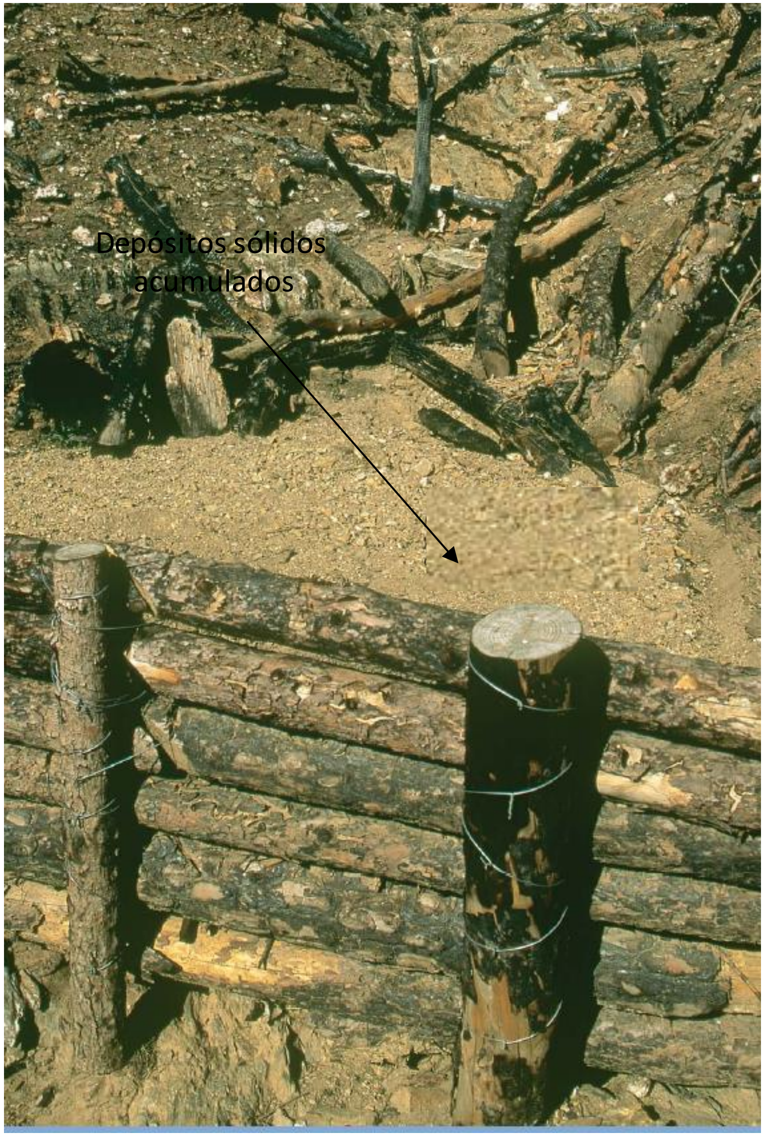
Examples of combined post-fire treatments for sediment controlon hillslopes and channel

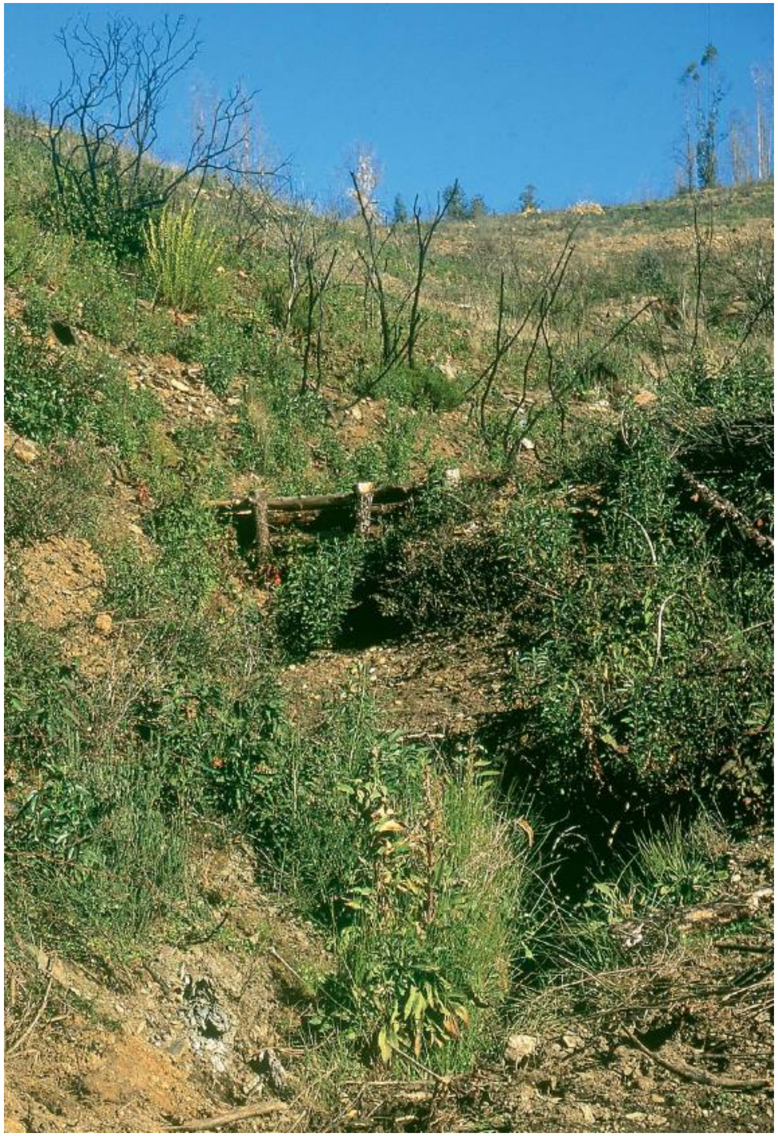
These classic techniques have been and are being currently used usadas to mitigate post-fire flood risk in unstable hillslopes in mediterranean areas

Masonery dam collecting debris following
Cázulas y Almijara range wildfire, (1999)
2390 ha

Rocks checkdams in ephemeral channels to trap sediments and reduce sediments delivered to channels

Log barriers and log checkdams work directly on hillslopes trapping sediments





They can trap sediments when are well constructed They can favor plants regeneration

Sierra Pelada wildfire(Huelva, 2003).
2590 ha

However they take time to be properly installed.Soil contact is important .
Cost high


Effciciency is low because of limited sediment trapping capacity


Seeding

Advantages**:**
Rapid
Relatively low cost
Limitations:
Low effectiveness
Interference with natural
Regeneration
Scarcity of native grasses seed

Mulching

Vegetal residues homogenenously spread over ground to reduce the impact of rain drops (splash) and runoff, increasing infiltration

Straw mulching

- Advantages**:**
- **Availability**
- **Good soil coverage**

- Wind blown
- **Introduction of undesired species**

Hydromulch

•Adventages
•Uniform application
• Immediatley soil cover
•Good performance in areas with rapid vegetation regeneration

•Limitations.
•Rapidly destroyed
•Expensive ($US 6000/ha)

Wooden mulch(slabs or straw)

- Advantages**:**
- **Production close to application place**
- **Fuel reduction, not wind blown**
- **Immediately soil cover**

Limitations

Expensive

special technology for slab production and spreading

Log barri

Advantages:

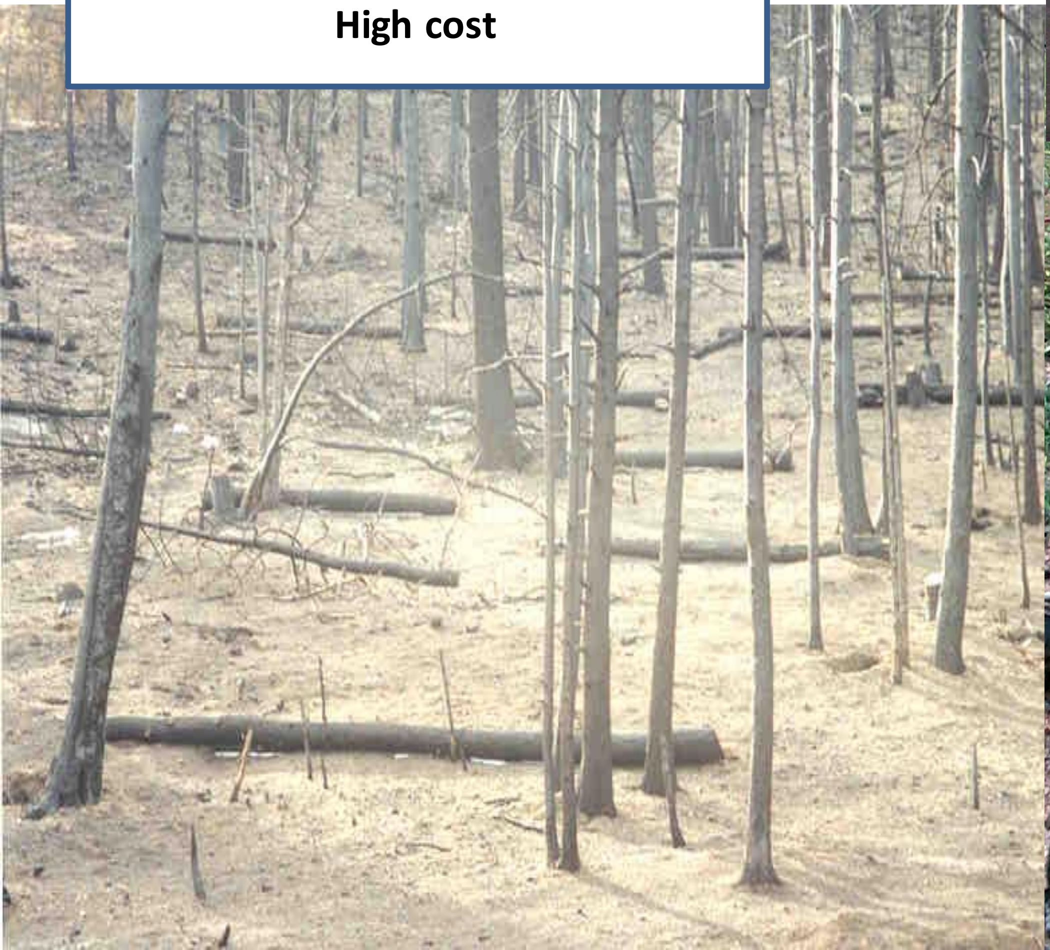
Material close to appliacation place.

Liimitations

Time consuming

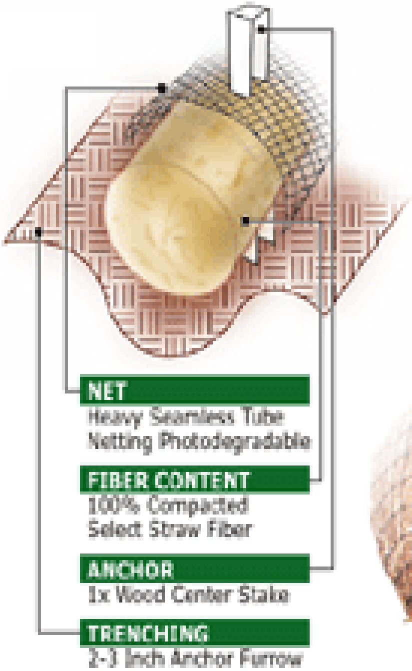
Low efficiency

High cost



Wattles (nets filled with straw or wooden slabs)

Foto 40


NET
Heavy Seamless Tube
Netting Photodegradable
FIBER CONTENT
100% Compacted
Select Straw Fiber
ANCHOR
1x Wood Center Stake
TRENCHING
2-3 Inch Anchor Furrow

Comparing two empirical approaches for post-fire soil hazard modeling in contrasting environments

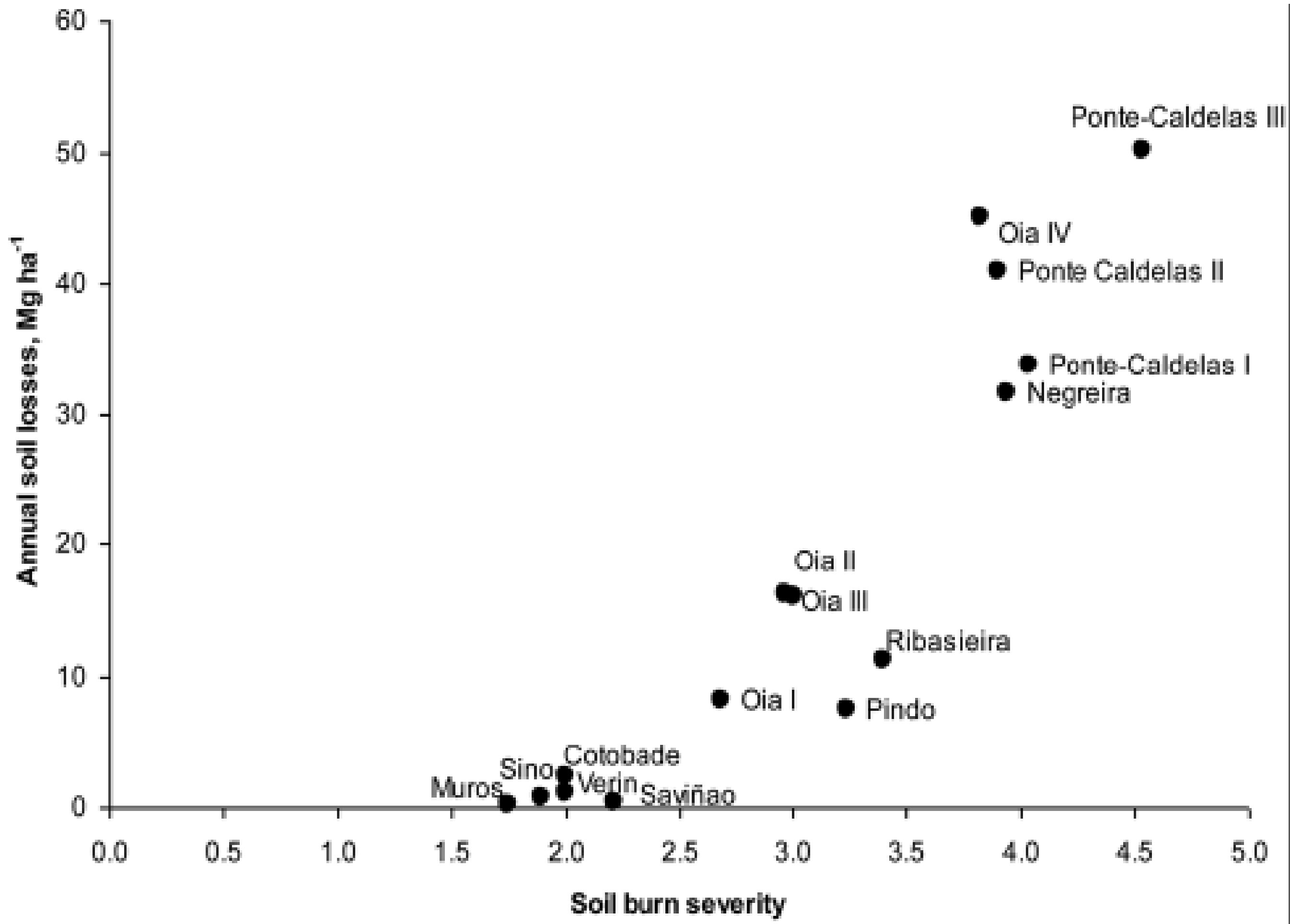
A) Estimated soil losses (Mg/ha) during the first year after wildfire in the NW of Spain (Fernandez and Vega , 2015)

1. **Soil burn severity** . A slightly modified version of the index proposed by Vega et al (2013) was used. In this study the level 4 (D) was splitted in two levels : 4 and 5 depending of the depth of the soil aggregation loss; 4 was asigned to the soil where that thickness was < 1cm and 5 for those of > 1cm. A mean burn severity index value was computed for each plot by adding the respective products of the index value for each severity level by the fraction of cover occupied on each plot.
2 . **Rainfall parameters** annual precipitation, rainfall erosivity factor, mean and maximum rainfall intensity,mean maximum rainfall intensity in 30 minutes and mean and maximum rainfall intensity in 10 minutes.
3 . **Terrain characteristics**: soil depth, stoniness and slope percentage
4 . **Land use factor,** considered as a dummy variable, with three levels :

1 Young pine plantations (> 6 years) Early agricultural lands, abandoned at least 30 years previously. Site preparation for planting included soil ripping, grading/tilling. Alternatively. Shrubland areas burned in last five years before wildfire.

2 Shrubland areas not burned in the previous five years. Forest stands harvested in the previous five years

3. Pine or eucalypt stands (old growth or pole size trees). Well developed litter and duff organic layers were present in both cases. Shrubland areas not burned for more than 10 years and with a conspicuous organic layer.



Mean value of the soil burn severity index and mean sediment yield for the first post-fire year in each study site (65 plots- of 80 m2 each- across 10 study sites burned by wildfires in NW Spain)

$$SE = a * e^{(b\ SBSI)} * P * LU$$

residual standard error = 2.16.

where SE is the soil erosion in the first year after fire (in Mg ha^{-1} $yr.^{-1}$); SBSI is the soil burn severity index value; P the annual precipitation (in millimetres); LU the land use factor; $a = 0.0004$ (standard error = 0.0001); $b = 0.7284$ (standard error = 0.0585).

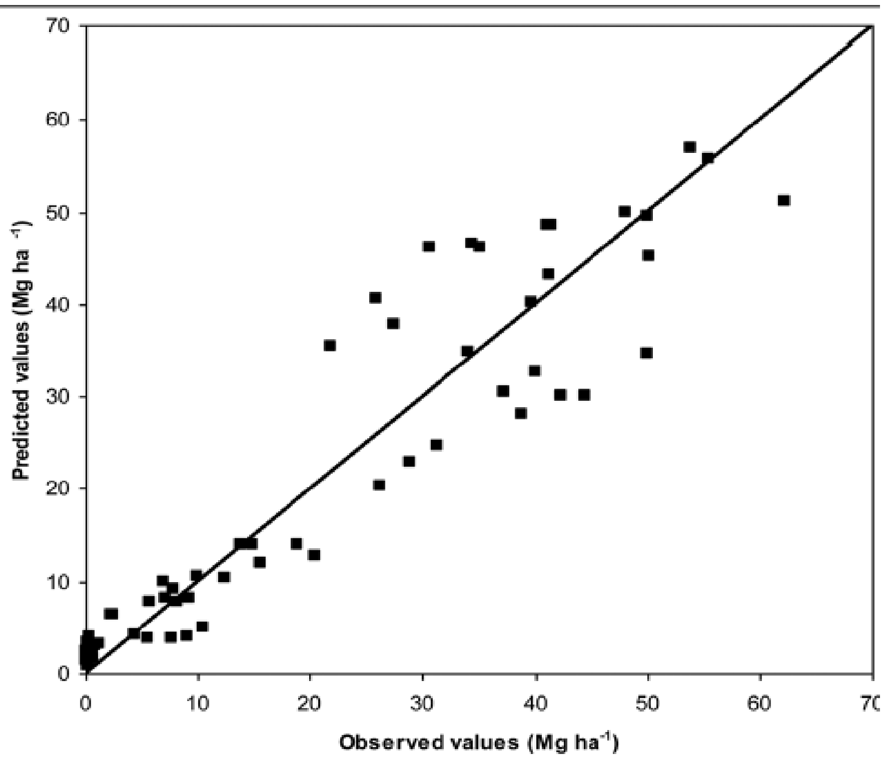


Figure 3. Predicted versus observed sediment production values fc he model data set.

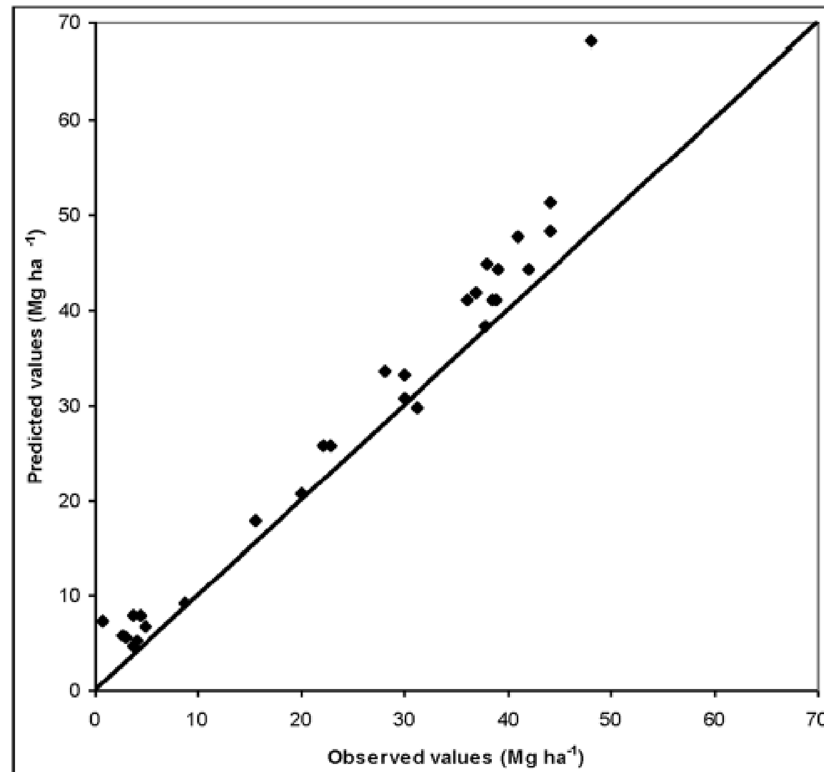


Figure 4. Predicted versus observed sediment production values for the validation data set.

B) Pobability of post-fire soil erosion levels in a semiarid area in the SE Spain in the three years followin g fire (Notario and Ruiz Gallardo, 2015)

Table 2
Soil erosion classes and criteria used to classify field plots.

Erosion level	Site indicators and characteristics
0 (Undetectable erosion or slightly eroded)	No erosion evidence found, or sheet erosion patches and some few rills in the A horizon appear. Less than 25% of A horizon has been removed. Frequent soil crusting and bare soil areas.
1 (Moderately eroded)	A horizon with considerable losses (up to 75%). Shallow rills (less than 5 cm in depth). There may be frequent gravels on the soil surface. Tree roots and bases slightly exposed (less than 5 cm).
2 (Severely or extremely eroded)	Removal of almost the whole A horizon. Some gullies (either shallow or deep) become visible. Tree roots largely exposed (>5 cm), or the ground is a mixture of moderate to deep gullies.

Table 3
Fire severity classes and criteria used to classify field plots.

Fire severity class	Description
0 Unburnt or low fire severity	No effects on vegetation, or on average, less than 50% of vegetation cover burnt. Shrub canopy especially affected by the fire. Patches of unburned vegetation may appear. Always less than 30% of the tree canopy (dominant and co-dominant trees) completely burnt. Some trees may be just scorched on the stem base or even intact
1 Moderate fire severity	On average, less than 90% of vegetation cover (trees and understory) burnt. Always less than 75% of the tree canopy completely burnt: most of the small trees killed, but some of them can retain needles and survive. Most (or all) of the shrub canopy has been killed.
2 High fire severity	More than 90% of the vegetation affected and killed.

$$p(Erosion = \text{Low}) = 1/(1 + \exp(-3.243 + 0.196Slope + 3.746MFSev + 6.654HFSev - 2.324North) \quad (5)$$

$$p(Erosion \leq \text{Moderate}) = 1/(1 + \exp(-7.247 + 0.196Slope + 3.746MFSev + 6.654HFSev - 2.324North) \quad (6)$$

where *MFSev*, *HFSev* and *North* are binary variables for moderate fire severity, high fire severity and north-facing slopes, respectively. The probability of erosion degree equal or lower than maximum is always one, so from Eqs. (5) and (6) we can calculate the probabilities for medium or high erosion risk by $p(Erosion \leq \text{Medium}) - p(Erosion = \text{Low})$ and $p(Erosion \leq \text{High}) - p(Erosion \leq \text{Medium})$, respectively.

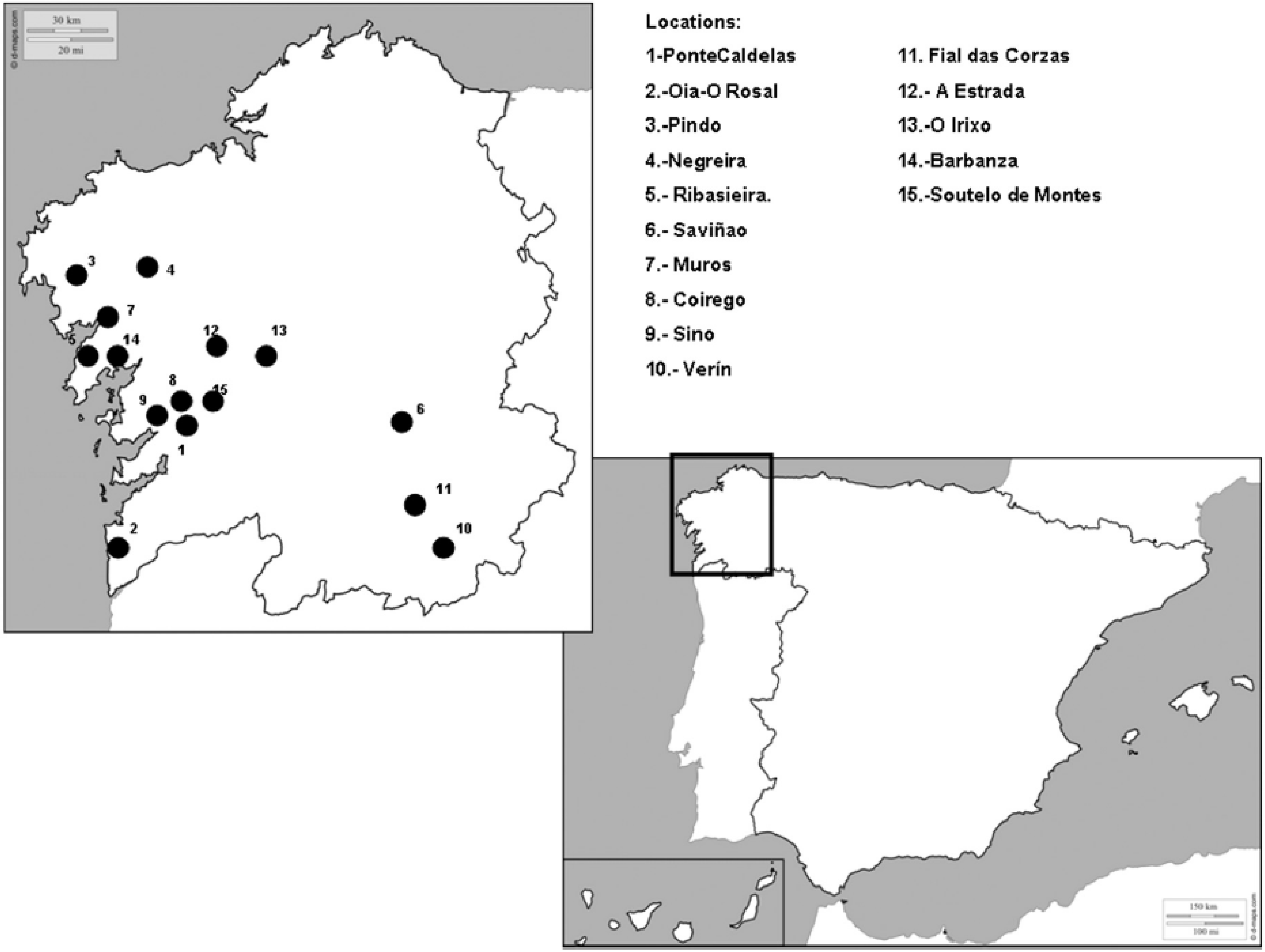


Fig. 1. Location of study areas.

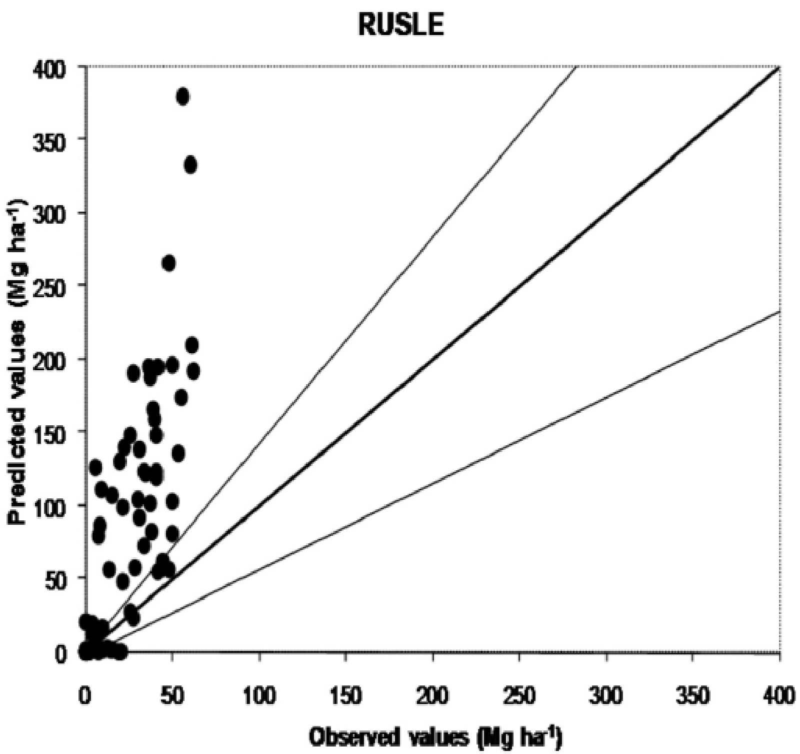


Fig. 3. Sediment yields predicted by RUSLE versus the observed values for each experimental plot. The grey lines are the 95% confidence intervals.

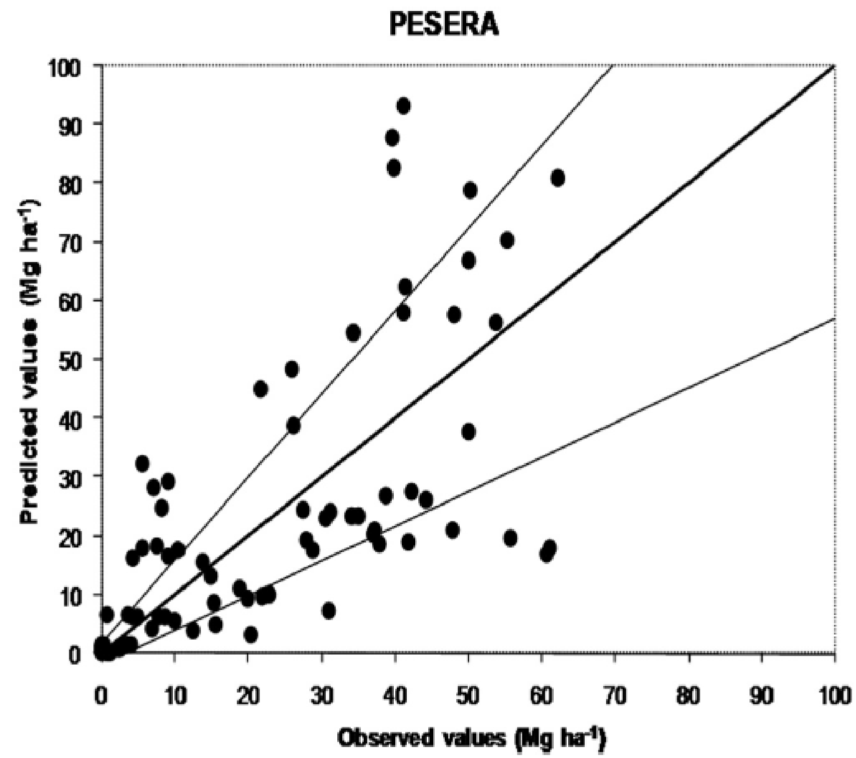


Fig. 5. Sediment yields predicted by PESERA versus the observed values for each experimental plot. The grey lines are the 95% confidence intervals.

Questions

1) To argument how contrasting terrain aspects(placements respect to the cardinal directions, e.g. southern and nothern expositions)and slope(could influence fire severity (note fire severity instead soil burn severity)

Questions

2) To compare the similarities and differences between the two commented empirical models to estimate post-fire erosion risk a) under rainy climate and b)semiarid climate
3) Why not is apparently affecting the slope into the model a)and doing it in b)?
4) Which may be the reason for the lack of influence of rainfall in the model b)?
5) Why precipitation and not rainfall intensity is affecting erosion into the model for temparate and rainy climate?
6) Cause for the apparent lack of influence of exposition in thr model a)?
7) Any reason for the absence of vegetation cover in both models?

Questions

3) Why post-fire soil erosion predictions through RUSLE are well apart from those of measured values?