EFFECT OF WILDFIRE ON SPIDER COMMUNITIES IN THE WORLD'S FORESTS

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Introduction

Wildfires are an important factor in many ecosystems throught the world (Moretti *et al.,* 2002) and have an effect on the fauna in those habitats.

Some authors underline that optimal habitat for fire intolerant species, or late successional species, would never develop under a regime of frequent fires while other authors point out the importance of fire for invertebrates in creating a habitat mosaic of different successional stages (Buddle *et al.*, 2000).

Reasons for the apparently contradictory effects of fire on invertebrates include the varying fire regimes, differing ecological pre- and post-fire conditions, the difference in the taxonomic groups in focus, as well as the season.

Fire has a more severe impact on species richness at times when animals are active near the surface (spring and summer) than when they are inactive (Riechert & Reeder, 1972).

Spiders are diverse and ubiquitous predatory group, individual species distributions are tightly linked to the structural attributes of the habitat, both hunting and web-buildig spiders are sensitive to changes with litter depth and nutrient content and they are a key element of the detritus-based (Langlands 2011).

Hence, they are a potentially ecological indicators, ideal for examining post-fire responses (Larrive *et al.,* 2005).

The **aim** of the present study is to make a review about the effect of wildfires on spiders communities in the world forests.

How great are any differences among post-fire ages in abundance or species richness? Are the functional traits different between burned and unburned zones?

Hypothesis

1. If the pre burned area is homogeneous the fire will increase the spiders richness creating new microhabitats. However, If there are microhabitats previously established, the fire could destroy it and cause a loss of diversity.
2. Species with resitant structures (heavy sclerotisation of the cephalotorax, hunting or burrowing strategies or species of open forest) will be tipical of recently burned habitats.
3. The more recurrent is a fire , the less severity it will have. Consequently it will have less impact on spider assemblages, even a posittive effect on richness.
4. Species richness will be reduced immediately after the fire, then it will recover until the initial richness.

Materials & methods

An extensive research in online article databases have provided the information to make the review.

Some databases used are: Web of Science, CSIC, Tesis en Xarxa, Research Gate and Scopus.

Key words taped in order to find information were: wildfire, spiders, araneae, arthropods, effects of perurtbation.

Different forests reviewed: mediterranean (Greece), chestnuts forest (Switzerland), coniferous forest (Orgeon), boreal forest (Canada), *Pinus sylvestris* (Finland) and an arid meadow (Australia).

Results & discussion

Functional traits per site

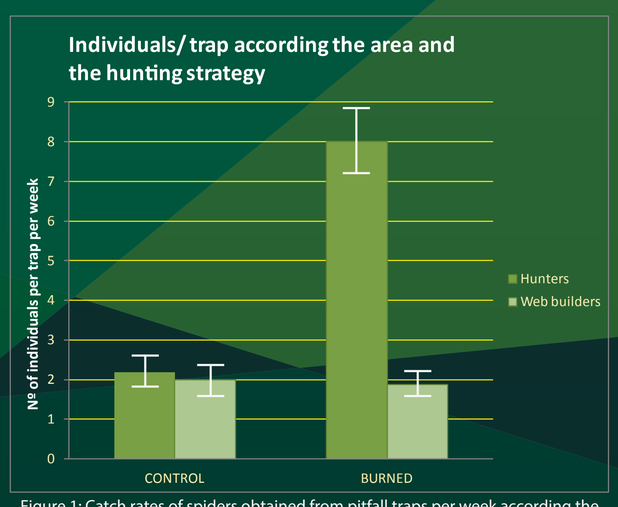

Figure 1: Catch rates of spiders obtained from pitfall traps per week according the area and the hunting strategy in a Boreal forest (Quebec). The study was carried on two years after the fire. There is significant difference between treatments. Source: Larrivée *et al.,* 2005.

In the burned area hunting species increase significantly compared to the control (fig1).

Uetz 1975 describe hunting spiders as opportunistic spiders that hunt on open forest floors and rapidly colonize recently disturbed habitats (Buddle *et al.,* 2000).

They can also move deeper into the soil during the fire, consequently they could be insulated from lethal soil temperatures (Moretti *et al.,* 2002).

When there is a fire...

Temperature at 2-5 cm under the soil: 35ºC
At the surface: 700ºC

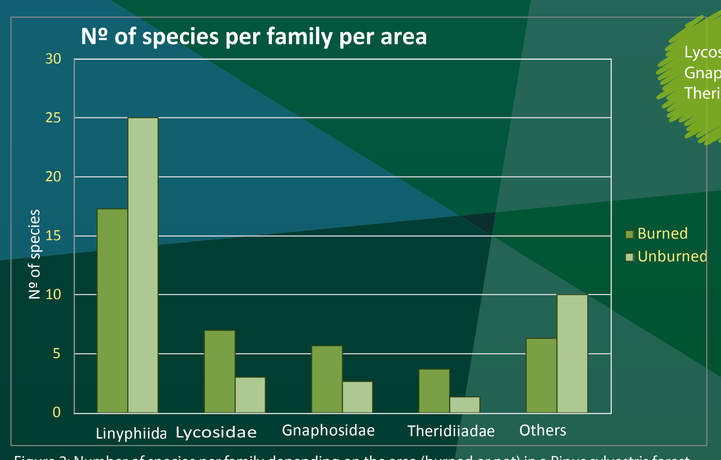

Figure 2: Number of species per family depending on the area (burned or not) in a Pinus sylvestris forest (Finland). Source: Koponen 2005.

Lycosidae
Gnaphosidae
Theridiidae

Hunter species preferring open and warm areas (Buddle *et al.* 2000).

Often caught in high numbersat burned localities (*Fig 1*).

	Interior forest species	Open forest species	Edge forest species
Species richness	↓ significantly by increasing of fire frequency (P<0,05)	↑ significantly by increasing of fire frequency (P<0,01)	↑ significantly by increasing of fire frequency (P<0,001)
Number of individuals	↓ significantly by increasing of fire frequency (P<0,01)	↑ significantly by increasing of fire frequency (P<0,01)	↑ significantly by increasing of fire frequency (P<0,01)

Table 1: Effects of fire frequency on species richness in European chestnut forests (Switzerland). Source: Moretti *et al.,*2004

Open forest species increase significantly after repeated fires (Table 1). That is due to the lack of big canopies of trees in the burned forests.

The post-fire forests conditions (Table 2) benefits **open forest species** (Table 1).

Environmental variables	Unburnt (n=6)	Single fire (n=8)	Repeated fires (n=8)
Tree cover (%)	90 ± 5,5	85 ± 29,7	80 ± 33,5
Bush cover (%)	5 ± 6,1	10 ± 5,9	20 ± 7,9
Grass cover (%)	8 ±13,6	14 ±22,7	33 ± 20,2
DBH of dominant trees (cm)	30 ± 0,3	25 ± 0,9	10 ± 0,5

Table 2: Environmental variables (mean ± SD) sampled at sites with different fire frequency: Unburnt sites which did not burn in the last 30 yr; Single fire: sites where fire occurred once in 30 yr; Repeated fires: sites where fire occurred 3 - 4 times in the last 30 yr. DBH: Diameter at breast height.. Source: Moretti *et al.,* 2004.

Significant traits in burned areas:

- Esclerotised cephalothorax (Langlands et al., 2011)
- Open forest species
- Hunting species

Hypothesis nº 2 confirmed.

How affect the recurrency of fire in richness species and density?

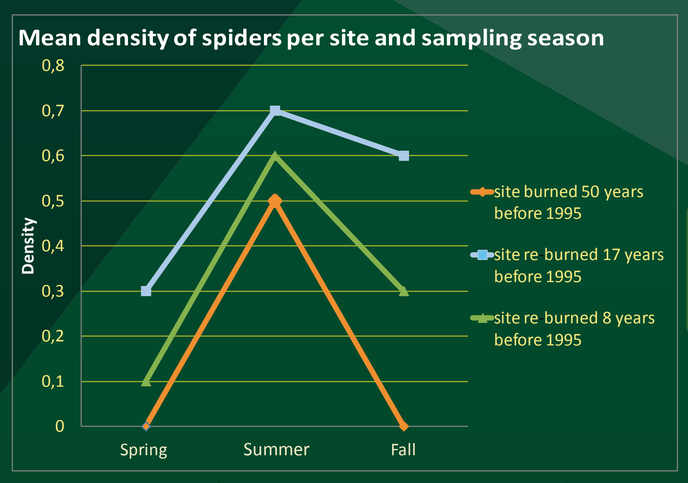

Figura 3: mean density of spiders per site and sampling season in a *Pinus halepensis* forest (Greece). Source: Radea *et al.,* 2010.

With **17 years between fires** there is the major density of spiders (Fig 3).

The forest needs a period of time to recuperate the structure leading the establishmement of different species (Fig 6).

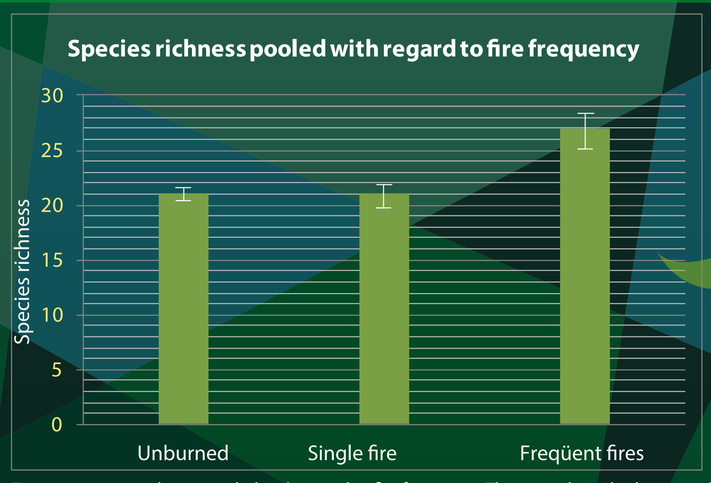

Figura 4: species richness pooled with regard to fire frequency. The control site had never suffered from fire in the last 35 yr. Chestnut forest (Switzerland). Source: Moretti *et al.,* 2004.

The unburned patches of ground and the varying severity of burning across the landscape, would enhance the structural complexity of the forest floor after a wildfire (Moretti *et al.,* 2002).

That leads to a more variable species composition of spider assemblages.

Density and **richness** increase with frequent fires (Fig 3, Fig 4).

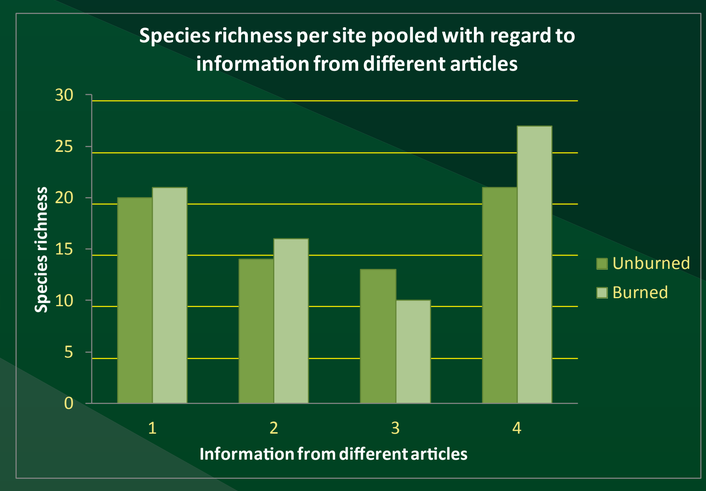

Figure 5: species richness per site pooled with regard to information from different articles. Article 1: Moretti *et al.,* 2002. Article 2: Niwa i Peck, 2002. Article 3: Larrivé *et al.,* 2005. Article 4: Moretti *et al.,*2004

The species richness evolution after the fire

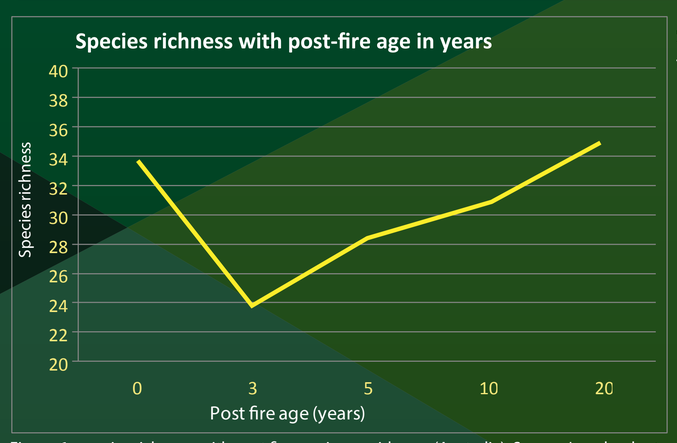

Figure 6: species richness with post fire age in an arid zone (Australia). Source: Langlands *et al.,* 2012

Species richness decreases immediatly after the wilfdire until the third year.

The richness increases more than the initial after the third year the initial (fig 6).

Richness seems to react differently depending on the fire turn over intervals In boreal forests, richness species decreases during at least 7-15 years after the fire (Koponen 1995).

Hypothesis nº 4 not confirmed. Richness species depends on the type forest and the time elapsed since the last fire.

Frequent fires benefit species richness if the forest has the enough time between fires to regenerate.

Hypothesis nº 3 confirmed. Fire severity not checked.

Conclusions

Fire is an important factor to spiders, controllating the communities and its diversity. Whereas fire can reduce the number of individuals, it does not necessarily have a negative effect on species richness., it can even be positive.

This depends on the severity of the fire and how it propagates during the event (Moretti *et al* 2002).

It has been confirmed that hypotheses 2, 3 and 4 are true, however, hypothesis 1 was impossible to check due to the lack of information about pre fire condictions in each zone.

For a better knowledge of the effect of fire more specific taxa should be included in future analyses, promising a better understanding of the complex ecological interactions, and minimising the risk of generalising statements, based on studies with low level of identification.

It would be interesting to do more studies about the effect of fire in different forests, with the same pattern leading to a better comparasition for each forest and weather.

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