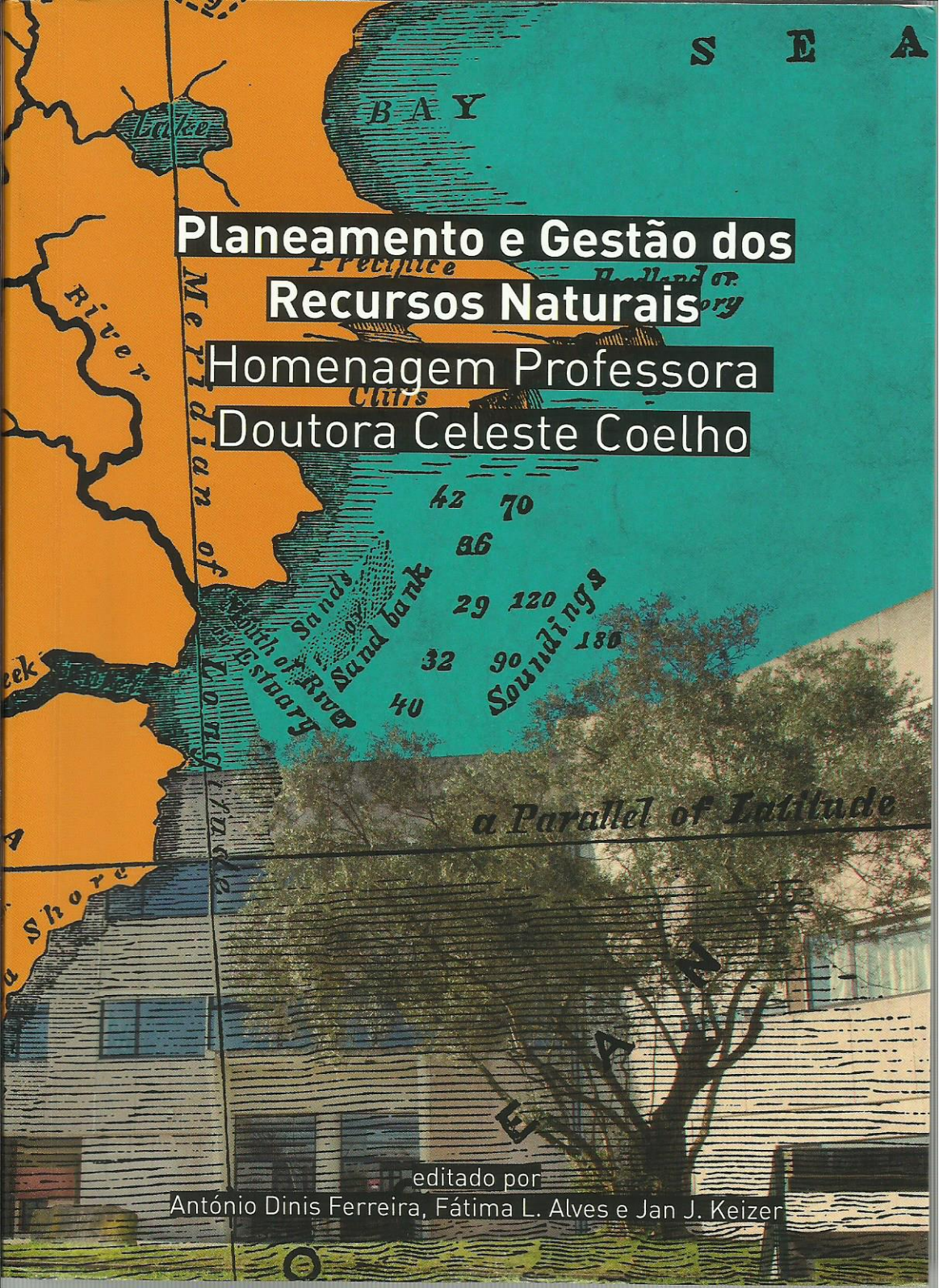


S E A

# Planeamento e Gestão dos Recursos Naturais

## Homenagem Professora Doutora Celeste Coelho



a Parallel of Latitude

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## **Dendrocaustology – The Science of Wildland Fires**

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## Abstract

Wildland fires are a generalised and recurrent problem. However, due to the high number of natural and human variables directly and indirectly involved, the study of Wildland fires is extremely complex and difficult. Step by step, with the universalization of scientific research on wildland fires we have witnessed the gradual establishment of a new, very particular science, given that the same object of study is being approached by many sciences, methodologies, scales of analysis, and even with different aims.. Nevertheless, there is no specific designation for this science. We propose to designate the science of wildland fires as Dendrocaustology so that fire scientists can, from now on, have a single word which they can use to designate their science.

**Keywords:** Wildland fires, Science, Dendrocaustology.

## Introduction

Although wildland fires are characteristic of certain regions and seasons, vegetation fires (including grass fires, forest fires and scrub fires) are a global phenomenon which occur in the tropical, temperate, and boreal regions (Fig. 1) (González-Pérez et al, 2004) and they can occur in the most unfavorable places. The great Alaskan wildland fires of 1988 is one such example. Although Alaska has a boreal climate, the intense drought witnessed in 1988 contributed to burn over 880 000 hectares of forest (Rebelo, 1994).

It has been estimated that more than 30% of the global land surface is subject to a considerable frequency of fires (Chuvieco et al., 2008).

It is clear that for millennia fires were a natural phenomenon (Pausas et al., 2008) and there is unambiguous evidence that wildfires go back to the Famennian Age (Devonian/Carboniferous periods) (Jones and Rowe, 1999). Pausas and Keeley (2009) argue that the appearance of wildfires is concomitant with the origin of terrestrial plants.

Even today, in some climates, fires are a natural phenomenon, but most of the fires are caused by human activity and only a minor part are pro-

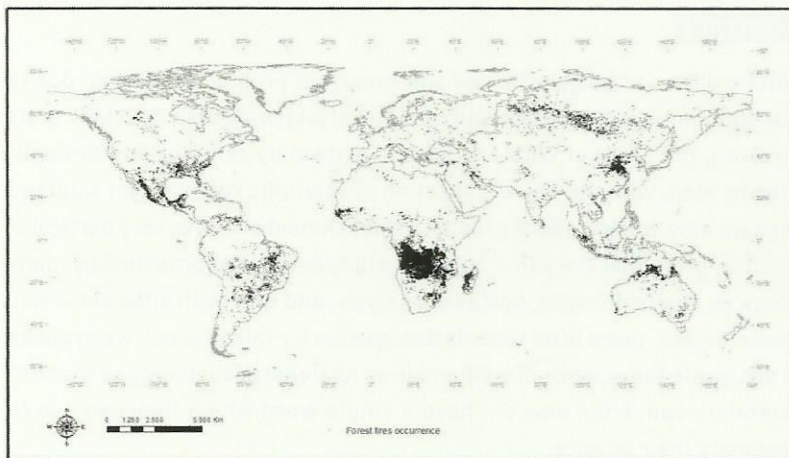


Fig. 1 - Global fire map (period: 09/06/2011 - 16/06/2011)

Source: <http://maps.geog.umd.edu/firms/shapes.htm>

duced by environmental factors (FAO, 2001). Equally, a only relatively small number of forest fires are responsible for the very high proportion of the total damage (Strauss et al., 1989).

The study of wildland fires is a difficult and complex endeavour due to the high number of natural and anthropogenic variables involved either directly or indirectly. The high level of complexity associated with wildland fires, which are usually framed as a climate risk (one of the risks referred to as natural), makes them an excellent example of a mixed risk, due to their concurrent natural and human causes (Rebelo, 2003).

Currently, wildland fires are one of the major risks studied in the context of the "cindinic" sciences (Riscos, 2010). However, when this field emerged under the auspices of the 1987 Paris UNESCO "International Conference on the Domain of Technological Risks", the key research purposed centred on the so-called "major risks" - major natural disasters, responsible for one and half million deaths between 1970 and 1985, and technological risks responsible, for the same period, for 50000 deaths. In the initial context wildland fires were not considered (Bento Gonçalves, 2011). However, in just two decades they achieved a position of great prominence, as attested by





Photo 1 – Wildland fire in Serra do Gerês (Portugal)

Photo by A. Bento-Gonçalves [2011]

the high number of communications in international conferences on risks (e.g. Riscos, II International Congress of Risks, Coimbra, 2010) .

### **Wildland Fires – a worldwide Research or a Science?**

In recent decades, there has been a noticeable increase in the number of wildfires in the Mediterranean countries (Moreno et al., 1998, Piñol et al., 1998, Viegas 1998, Xanthopoulos 2000, Pausas 2004). The total area scorched has also increased in some Mediterranean countries of the European Union (Xanthopoulos 2000).

Large wildfires are a relatively recent phenomenon in the Mediterranean basin, particularly in regions of wildland-urban interface (wui). Accordingly, people perceive them as catastrophic events, with the media amplifying this common perception (Pausas et al. 2008). Although revealing regional distinctions, this trend is being globalised, with special emphasis in the United States of America and Australia

Due to ongoing global changes (Tavsanoğlu and Úbeda, 2011), it is expected that fire regimes will immediately respond to climate change (Bento-Gonçalves et al., 2011) in terms of frequency, size, seasonality, recurrence, and fire intensity and severity. In particular, some studies suggest that current

fire regimes may cause disasters (Kazanis and Arianotsou 2004; Rodrigo et al. 2004; de Luís et al. 2006; Arnan et al. 2007).

These factors have important implications for the management and sustainability of forest spaces and, as a result, this has led in an increase in the scientific interest from the fire research community in issues related to wildland fires.

Accordingly, since the late 1980s/early 1990s we have witnessed a growing interest and body of literature (Books, Journals, Phd Tesis, Papers and Reports) on wildland fires (USA: wildland fire; Canada: forest fire and wildfire; Australia: bushfire and wildfire; UE: forest fire) (Bento-Gonçalves et al., 2011) as evidenced by the convening of several local (e.g., United States of America, Canada, Australia, South Africa, Brazil, Chile, Russia, Israel, Portugal, Spain, Greece, Italy) and international meetings focused on this field of research (e.g. the "International Wildland Fire Conference", a conference conducted under the auspices of the United Nations' International Strategy for Disaster Reduction – ISDR / Global Fire Monitoring Center – GFMC – and the Food and Agriculture Organization of the United Nations – FAO – founded in 1989 in Boston, with five editions already carried out and a sixth planned for 2015 in Korea, the "International Conference on Forest Fire Research", held every 4 years in Coimbra – Portugal – beginning in 1990 and counting with 6 realized events– and the "Wildland Fire Safety Summit" presented by the International Association of Wildland Fire – IAWF) which in 2011 completed eleven editions after its initiation in 1997.

Other more thematic meetings and conferences are common, such as the "International Meeting of Fire Effects on Soil Properties" (photo 2), the "International Conference on Modeling, Monitoring and Management of Forest Fires", the Conference "Exploring the Mega-fire Reality 2011", the "Fire Behavior and Fuels Conference", "Symposium on Fire and Forest Meteorology", ...

Currently, more than 40 countries archive datasets for "forest or wildland fires" (World Bank and United Nations, 2010). For instance, the Global Fire Monitoring Center (<http://www.fire.uni-freiburg.de>) compiles country



reports and several government agencies (for example, the European Commission of the European Union, European Forest Fire Information System, <http://effis.jrc.ec.europa.eu/>) monitor and report on fires on an annual basis, and in the United States data on fires is compiled by the National Interagency Fire Center (<http://www.nifc.gov/>).



Photo 2 – 3<sup>rd</sup> International Meeting of Fire Effects on Soil Properties (FESP III) (University of Minho, Guimarães, Portugal)  
Photo by A. Bento-Gonçalves (2011)

However, when searching the *world wide web* the designation “fire science” appears (e.g. *The Journal of Fire Sciences*; *The Joint Fire Science Program – JFSP*; *The Encyclopedia of Southern Fire Science*) but it is usually associated more to firefighting and fire safety and not to the science of wildland fires. Accordingly, this designation is primarily oriented towards the operational/technical aspects of the phenomena, rather than referring to an autonomous scientific branch of learning.

Nevertheless, the growing interest in the scientific research on wildland fires, which is demonstrated by the large number of studies from a variety of different scientific and technical disciplines – such as Geography, Biology, Ecology, Mathematics, Physics, Chemistry, Pedology, Edaphology, Psychology, Sociology, Demography, History, Engineering – has increased the number of international scientific projects and contributed to the rising level of multidisciplinary and international cooperation (e.g. “Determination of forest fire causes and harmonization for reporting them”; “FIRE-PARADOX: An innovative approach of integrated wildland fire management regulating the wildfire problem by the wise use of fire: solving the fire paradox”; “FIRESMART: Forest and land management options to prevent forest



fires"; "FUME - Forest fire under climate, social and economic changes"; "PROMPT - Proactive human response to wildfires breakout: measure and prepare for it"). This greater interaction has led to the universalization of scientific research on wildland fires. As a result, we have witnessed the gradual establishment of a new, very particular, science given that the same object of study is being approached by many sciences, methodologies, scales of analysis, and even with different aims.

This is effectively a new science, since it implies, in its many and varied aspects, a systematic enterprise that builds and organizes knowledge in the form of testable hypothesis and predictions about the world. In other words, it has established itself as **autonomous Science** with various **scientific methods**. The different methods seek to explain the events of nature in a reproducible way, and to use these findings to make useful predictions. This is accomplished partly through the observation of natural phenomena, but also through experimentation that tries to simulate natural events under controlled conditions (Merriam-Webster Online Dictionary).

### **A (new) science with a name - Dendrocaustology**

Researchers of wildland fires have struggled with the lack of a specific term to identify this new science which studies this phenomenon in all its different valences.

After considerable research which failed to uncover any expression in the international literature to identify this science, in 1993 we decided to challenge Professor José Ribeiro Ferreira, professor of the Institute of Classical Studies at the Faculty of Arts, University of Coimbra, to propose a term that could be applied to that end.

The first proposal consisted of a lexical formation based on the Greek *hyle* - "matter", "substance", "forest", "jungle". The term *pirileology* was initially used by the first author in a paper published in Portuguese, in 1994, focusing on how to gather useful pirileological lessons through simple observations (Lourenço, 1994).

Nevertheless, this term did not completely satisfy the proponent, for which he continued to investigate and subsequently propose the term *hilecaustology*.

However, since the elements of hyle are associated to philosophy, in words like hylomorphism, eventually the greek term *dendron* was adopted as the foundational constituent. In fact, this element is much closer to forestry as we can testify in words like *dendrology*, the science that deals with the study of trees, and *dendolatry*, the worship or adoration of trees.

In turn, the term *kaustos* is present in, for example, the original Greek *holocaust*, a sacrifice in which the victim was completely (*holos*) immolated, burned by fire, which often also happens in the forest, in which the trees and especially the shrubs are totally consumed by fire.

Thus, ten years after the aforementioned publication (where the term *pirileologia* was applied) and following numerous discussions with various teachers at the Institute of Classical Studies at the Faculty of Arts, University of Coimbra (Portugal), including Professor Maria Helena da Rocha Pereira, whose authority and expertise in this area is internationally recognized, the term *dendrocaustology* was ultimately chosen to identify the science that deals with the many facets that cover the study of wildland fires (Lourenço, 2004).

The label, like many others that also identify neighbouring sciences, has its origins in the Greek language. More precisely, its origins can be found in the following terms:

- *dendron* – which means “tree”;
- *kaustos* – “that which burns” (derived from the verb *kaio* or *kao* – “burn”, “to burn”, “to consume by fire”, “to incinerate”);
- *logos* – “word”, “speech”, “reason”, “science”, “treaty”.

Accordingly, the research carried out helps provide scholars of wildland fires with a linguistic tool which from now on allows researchers to utilize a single word (*dendrocaustology*) to explain what once was described by several words (science studying wildland fires). The simplicity in translating it to various other languages (e.g. English, French, Italian, Portuguese, Spanish, ...) also allows for an easy inclusion in the international scientific lexicon, giving it a universal character.



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