

# Fire History in the Mixed Pine-Oak Forest on the National Park Chipinque, in Monterrey, Nuevo Leon, Mexico<sup>1</sup>

Marco Aurelio González Tagle,<sup>2</sup> Javier Jiménez Pérez,<sup>3</sup> Klaus von Gadow<sup>4</sup>

## Abstract

Forest ecosystems throughout the world have evolved over millions of years with fire as a common disturbance process. The assessment of the historical disturbance effects across landscapes can provide an important foundation for land management decisions, aimed at ecosystem restoration and maintenance. There are not many investigations in Mexico regarding the historic disturbance patterns, until now. Little research has been concluded locally in the Sierra Madre Oriental, the main research has been in 1998. But, these research has provided just general information about disturbance patterns, the ecological impact and succession.

The different effects forest fires have on biodiversity and successional patterns are considered by using examples from the Sierra Madre Oriental mixed forest, Parque Ecológico Chipinque in northeast Mexico. This is a synthesise paper on forest fire history in Chipinque Park. The Park Chipinque has a territorial extension of 1624 ha in the municipality of San Pedro Garza Garcia, Nuevo Leon. Forest fires have been determined from 1860 and onwards, by dating fire scars on living individuals of *Pinus pseudostrabus* and *Pinus teocote*.

## Introduction

Historical disturbance in plant communities is an important subject for study as it provides necessary information for creating goals in the management and handling of ecosystems (Agee, 1993, Jiménez 1998). Forest fires occur in forest ecosystems all over the world and also, controversially, occur in areas of biological management and conservation (Pyne 1996). In the case of Mexico, forest fires are an extremely common phenomenon in protected areas such as national parks, biosphere reserve. (Jardel 2003).

In Mexico an average of de 8,903 fires are registered every year with a surface area of 324,865 hec. burned (CONAFOR, 2003). There has been scant research into the historical pattern for this disturbance. Until now research projects have been carried out in the Eastern Sierra Madre, in 1998 but they only provide general information on the patterns of disturbance and succession (Jiménez, 1998). There are also few studies on the frequency and history of fires.

---

<sup>1</sup> An abbreviated version of this paper was presented at the second international symposium on fire economics, policy, and planning: a global view, 19–22 April, Córdoba, Spain.

<sup>2</sup> Ph.D. Student at the Georg-August University, Göttingen, Germany email marco.gonzalez@web.de

<sup>3</sup> Professor at Faculty of Forestry Sciences, University of Nuevo Leon, Mexico.

<sup>4</sup> Professor at Faculty of Forestry Sciences, University, Göttingen, Germany.

The initial attempts at explaining ecological effects of fires lacked ecological data and a description of the fire regime in ecosystems. Research into the frequency and the period when fires occurred go back to 1940.

Terminology used in the history of fires has been standardised over time. Some of the definitions used in this investigation are *fire frequency*, which refers to the recurrence of a fire in a specific area over time. *Mean fire return interval* is the arithmetical average of all the intervals of fires in a specific area and within a given period of time.

The *Fire Regime* describes the patterns of fires and the effect on the ecosystem . These may also be described through their physical characteristics such as for example *fire frequency*, *mean fire return interval* , and their ecological effects such as the influence on the composition of species. There are several methods of determining the frequency of fires and for our study we used the method known as MFI (*Mean Fire Interval*). The abstract concept of the method is as follows: determine how many years on average occur between fires in a specific point of the study area.

### **Objective**

The main objectives of this study are: a) reconstruction of the history of fire frequency in the region of the Eastern Sierra Madre, b) to document the patterns of appearance of fires in the park, and c) to determine by using fire frequency the arithmetical average in the region and within a specific period (*Mean Fire Interval*).

## **Methodology**

### *Study area*

The area studied is located in the Parque Ecológico Chipinque in the state of Nuevo León situated 25<sup>o</sup> 33' and 25<sup>o</sup> 35' North Latitude 100<sup>o</sup> 18' and 100<sup>o</sup> 24' Latitude East, bordering the Sierra Madre Oriental.

### *Sample*

A dendrochronological analysis determined the dates of fires. A database was then compiled for the fire history. *Cross dating* (Bergeron, 1989, 1998; Everett, 1998; Stickney 2000) was used to determine the annual growth rings. In order to determine the date of previous fires, a sample was taken of individual trees of the species *Pinus pseudostrobus* and *Pinus teocote* which showed fire scarring. Various parameters were assessed to quantify the changes of vegetation occurring over time in different burned areas (diameter, height, azimuth angle length and width of the crown).

## **Results and Discussion**

A natural chronological sequence was established of over 140 years. Which was

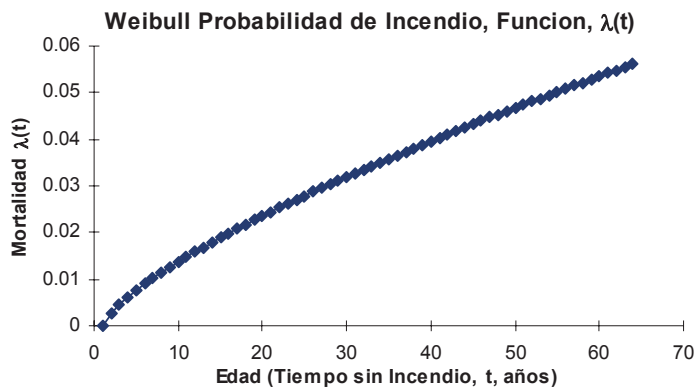
reconstructed for the mixed woodland community of the Parque Ecológico Chipinque. The chronological sequence comes from different burned areas, five fire dates were established from 1860 to 1998. From these events it was possible to establish and reconstruct the history of fire frequency. In accordance with the registered events the interval of fires was calculated, resulting in the equation  $MFI = \sum^n I_i$  (Mean Fire Interval) for the region, which was 34.5 years. The WMPI (Weibull Median Probability Interval) was calculated. Table 1

**Table 1**— Parameters for interpretation of MFIM. (Method for defining mean fire interval). Weibull Median Probability Interval.

Parameters		Value
MFI		34.5
WMPI		37.06

In the light of the value 34.5, the region is classified within the range of severe Frequent Fires (an average interval of 25-50 years.)

With details of Weibull distribution factor by means of  $\lambda(t) = c * t^{c-1} / b^c$  the probability of a new fire in a specific stand was obtained. Graph 1 shows the probability according to the Weibull function for Parque Chipinque 1860 -1998.



**Figure 1**— Probability of fire according to the Weibull distribution factor obtained for the period 1860 -1998

Finally it is important to understand the ecological processes involved in forest fires for the management and conservation of our forests particularly those designated as protected areas.

## Bibliography

- Agee, J. 1993, Fire Ecology of Pacific Northwest forest, Island Press. 53:75
- Bergeron, Y. et. al.; 1998. Variability in Fire Frequency and Forest Composition in Canada's Southeastern Boreal Forest: A challenge for sustainable forest Management
- Bergeron, Y. and M. Dubuc. 1989 Succession in the southern part of the Canadian boreal forest, Vegetation 79: 51:63
- CONAFOR (Comisión Nacional Forestal, 2003. Reporte semanal de resultados estadísticos y acciones realizadas (1. enero- 31 Jul. 2003)
- Everett, 1999, Fire history in the ponderosa pine/Douglas-fir forests on the east slope of the Washington Cascades, Forest Ecology and Management 129(2000) 207-225.
- Fall, J. 1998; Reconstructing the historical frequency of Fire: A modeling approach to developing and test methods.
- Jiménez, J.; O. Aguirre, 1998. Evaluación de daño de los incendios ocurridos en 1998 en el Parque Ecológico Chipinque, FCF-Parque Chipinque
- Stickney, P. and Campbell, 2000, Data Base for early postfire succession in Northern Rocky mountain forest. General technical report RMRS-GTR-61CD