discussed in detail in Krier, Pedersen, and Williams (Chapter 1). This volume.

Northern Patagonia, Argentina

9. Fire History and Vegetation Changes in

and Daino, C. Lornaz

Thomas J. Tebben, Thomas Kizhener, Estela Kihara


In recent decades a new understanding of forest dynamics has helped both set
The Environment of Northern Patagonia

Variation in the Along the Rain Forest-Steppe Gradient

The rainfall distribution forms mixed stands with N. domingui and N. argentina, the center of N. domingui distribution being in the width of the 3-6 mm Pan de Azúcar Chubut Province. The distribution of the rain forest species is also influenced by the climate and soils of the region. Species such as N. domingui are found in the rain forest understory, while N. argentina is found in the drier areas. The influence of altitude on species distribution is also evident, with N. domingui occurring at lower altitudes and N. argentina at higher altitudes. The landscape of Northern Patagonia is characterized by a gradual change in vegetation from forest to steppe, with N. domingui dominating the lower altitudes and N. argentina the higher altitudes. The transition between these two ecosystems is marked by a gradual change in species composition, with N. domingui giving way to N. argentina as the altitude increases.
Run Forest Dominated by Fitzroya Cupressoides and Nothofagus Domainty

Despite the high precipitation characteristic of Fitzroya-dominated forests, fire is a major source of disturbance. Fires in these monsoon-forests occur naturally or are set by humans during drought years. Fitzroya usually survives fire but emerges from fire-blackened stumps. Fitzroya cupressoides and Nothofagus Domainty indicate that scattered old (<100-year-old) Nothofagus forests occur naturally or are set by humans during drought years (Kitching, 1989). Fitzroya and Nothofagus Domainty indicate that scattered old (<100-year-old) Nothofagus forests occur naturally or are set by humans during drought years (Kitching, 1989). Fitzroya and Nothofagus Domainty indicate that scattered old (<100-year-old) Nothofagus forests occur naturally or are set by humans during drought years (Kitching, 1989). Fitzroya and Nothofagus Domainty indicate that scattered old (<100-year-old) Nothofagus forests occur naturally or are set by humans during drought years (Kitching, 1989).

Fire Behavior and Its Consequences in the Major Ecosystem Types of Northern Patagonia

Table 9.1. Traits of common trees and shrubs of northern Patagonia relevant to their resistance to and recovery from fire

<table>
<thead>
<tr>
<th>Species</th>
<th>Think-barked fire and resistant</th>
<th>Resprouting capacity</th>
<th>Prolific postfire seeding</th>
<th>Buried viable seed</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Araucaria araucana</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td>Irregularly root suckers and basal sprouts</td>
</tr>
<tr>
<td>Austrocedrus chilensis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large trees resist fire</td>
</tr>
<tr>
<td>Fitzroya cupressoides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large trees resist fire; irregularly root suckers</td>
</tr>
<tr>
<td>Nothofagus antarctica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vigorously resprouts from lignonubers and basal buds</td>
</tr>
<tr>
<td>N. dombei</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Large trees weakly resist fire</td>
</tr>
<tr>
<td>N. nervosa</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Large trees resist fire: resprouting is irregular</td>
</tr>
<tr>
<td>N. obliqua</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large trees resist fire; irregularly resprouts</td>
</tr>
<tr>
<td>N. pumilio</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Small trees are thin-barked and easily killed by fire</td>
</tr>
<tr>
<td>Saxegothaea conspicua</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Even large trees are thin-barked and easily killed by fire</td>
</tr>
<tr>
<td>Shrubs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aristotelia chilenis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Resprouts from basal buds</td>
</tr>
<tr>
<td>Berberis spp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vigorously resprouts from basal buds</td>
</tr>
<tr>
<td>Chusquea caluera</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Resprouts from rhizomes; highly flammable</td>
</tr>
<tr>
<td>Diospyros junceo</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>Highly flammable: resprouts from basal buds</td>
</tr>
<tr>
<td>Discaria articulata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Resprouts from large tap roots</td>
</tr>
<tr>
<td>Embothrium cocineum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Highly flammable: resprouts from basal buds</td>
</tr>
<tr>
<td>Fabiana imbricata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Resprouts from basal buds and lateral roots</td>
</tr>
<tr>
<td>Lomatia hirsuta</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vigorously resprouts from basal roots</td>
</tr>
<tr>
<td>Maytenus boaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Schinus patagonicus</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Sources: Tortonelli 1947, 1956; McQueen 1976; Seibert 1982; Veblen and Lorentz 1987; Ghersiandini 1982.
null


![Image](https://via.placeholder.com/150)

**Figure 9.3**

**Prevalence of number of pairs of eyes and range by vibration type in N. Nevosa.**

*Note: The figure shows the prevalence of number of pairs of eyes and range by vibration type in N. Nevosa. The y-axis represents the number of pairs of eyes, while the x-axis represents different types of vibrations. The bars indicate the percentage of prevalence for each vibration type.*
Pre-1800: Native American Influences

Human Impacts on the Region

Bounded steps by the abundance of water now grow.

The horizon can now be seen.

Recall the April 1864, book, "The Lake Country,"

"The Great Lakes,"

69th Annual Board of Directors, Part I

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Figure 9.1: Records of regional ends in the occurrence band (a) percentage of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.2: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.3: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.4: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.5: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.6: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.7: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.8: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.9: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.10: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.11: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.12: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.13: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.

Figure 9.14: Records of regional ends in the occurrence band on a percentage of regional ends in the occurrence band (b) Australian Woodlands.
The year 1980 is one of the most critical points in the history of European settlement. It marks a significant shift in the pattern of immigration and the establishment of new communities. The data from that year indicates a marked increase in the number of immigrants coming to the region, especially from Eastern Europe and the Mediterranean countries. This influx of migrants has had a profound impact on the social, economic, and cultural landscape of the area.

The year 1980 also saw a notable increase in the level of agricultural productivity, with a significant rise in crop yields and livestock production. This growth in agricultural output can be attributed to a combination of improved farming techniques and favorable weather conditions. The data from this period suggests that the region is well-suited for agriculture and has the potential for sustained growth in this sector.

In addition to the agricultural gains, the year 1980 also witnessed a significant rise in industrial activity. The establishment of new factories and the expansion of existing industries have contributed to an increase in employment opportunities and a corresponding rise in the standard of living for many people. This economic development has had a ripple effect, leading to improvements in infrastructure, education, and healthcare facilities.

Overall, the year 1980 marks a turning point in the region's history, with significant changes occurring in virtually every aspect of life. The data from this period provides a valuable insight into the forces that shaped the region and the challenges that it faced as it entered a new phase of development.

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**Figure 2:** Records of the years indicated (top) and comparison with European records.

**Year:**
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015
- 2020
- 2025

**Records:**
- Top: European records
- Bottom: Records indicated in the text

**Comparison:**
- Line (a): European/Other
- Line (b): Indicated/Other
Landscape Changes Associated with Human-Caused Fires

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LIGHTNING-CAUSED FIRES</th>
<th>HUMAN-CAUSED FIRES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>1930</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>1940</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>1950</td>
<td>25</td>
<td>50</td>
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<td>1960</td>
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<td>60</td>
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<td>1970</td>
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<td>1980</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>1990</td>
<td>45</td>
<td>90</td>
</tr>
<tr>
<td>2000</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 9.7. Annual documentary record of human-induced landscape changes from 1920 to 2000.

The most dramatic temporal change in the occurrence of northern Ponderosa is
decrease of the frequency (Fig. 9.7, 1920 to 1990). This trend is marked by a significant decrease in the number of human-caused fires, from 45 in 1920 to 10 in 1990. This change is likely due to increased fire suppression efforts during this period. The number of lightning-caused fires also decreased slightly, from 35 in 1920 to 25 in 1990.

Figure 9.6. Change in fire occurrence from 1920 to 2000, showing a significant decrease in human-caused fires and a slight decrease in lightning-caused fires.
Figure 9.5: Total area burned (hectares) for the National Forests of the Pacific Northwest, 1980-1990.

Consequences of the area burned: Effects on forest ecosystems, wildlife, and public health.

100 years of especially high burn rates show the other side of very high burning.

Left: Western wildfires.
Right: Eastern wildfires.

The 1944 Pile Year

The year 1944 was a year of extraordinary forest burning in northern Pennsylvania.

Syndromes of Natural Variability and Anthropogenic Influences

The N. domoy (Avery) and L. variegata (Avery) 1947 - 1990 biomass, having expanded in a woodland forest from the northern Great Lakes region to the northwestern United States. This in conjunction with other factors allowed for the expansion of forest fires across the region, leading to increased forest fires in the area.

The year 1944 was a year of extraordinary forest burning in northern Pennsylvania.
Invasion of species in habitats (particularly on permanent water bodies and coastal areas), and the spread of invasive species could be facilitated by human activities such as trade and tourism.

Invasive species are a major threat to the diversity and stability of many ecosystems. They can outcompete native species, disrupt natural food webs, and alter ecological processes. Invasive species can also reduce the carrying capacity of the habitat, leading to a decline in biodiversity.

One example of an invasive species is the Asian giant hornet, which has been successfully eradicated in Washington State. This success story highlights the importance of early detection and rapid response to invasive species threats.

In conclusion, the invasion of species in habitats is a complex issue with far-reaching implications for the health and survival of ecosystems. By understanding the mechanisms that drive these invasions, we can develop more effective strategies to prevent and control them.

References:
References

Conclusion and Management Considerations

The 1996 Chippewa Falls event has served as a catalyst to elevate the awareness of the potential for regulated species to be impacted by changes in the hydrology and water chemistry of the Chippewa River. The event has highlighted the need for a coordinated effort to address the challenges posed by these factors.

Partition of Exotic Tree Species

The potential for exotic tree species to be impacted by the 1996 Chippewa Falls event is significant. The event has highlighted the need for a coordinated effort to address the challenges posed by these factors.

Appendix A (1996 Chippewa Falls event)

The 1996 Chippewa Falls event has served as a catalyst to elevate the awareness of the potential for regulated species to be impacted by changes in the hydrology and water chemistry of the Chippewa River. The event has highlighted the need for a coordinated effort to address the challenges posed by these factors.

Appendix B (1996 Chippewa Falls event)

The 1996 Chippewa Falls event has served as a catalyst to elevate the awareness of the potential for regulated species to be impacted by changes in the hydrology and water chemistry of the Chippewa River. The event has highlighted the need for a coordinated effort to address the challenges posed by these factors.
Western Americas
Ecosystems of the
Change in Temperate
Fire and Climatic

Editors

Thomas W. Swetnam
Glenda Montenegro
William L. Baker

Ecolological Studies