DEKLIM Emissions Workshop

MPIC Mainz, 2-3 December 2002

Coupling Anthropogenic and Climate-driven Changes of Fire Regimes:

Challenges for Vegetation and Fire Modelling

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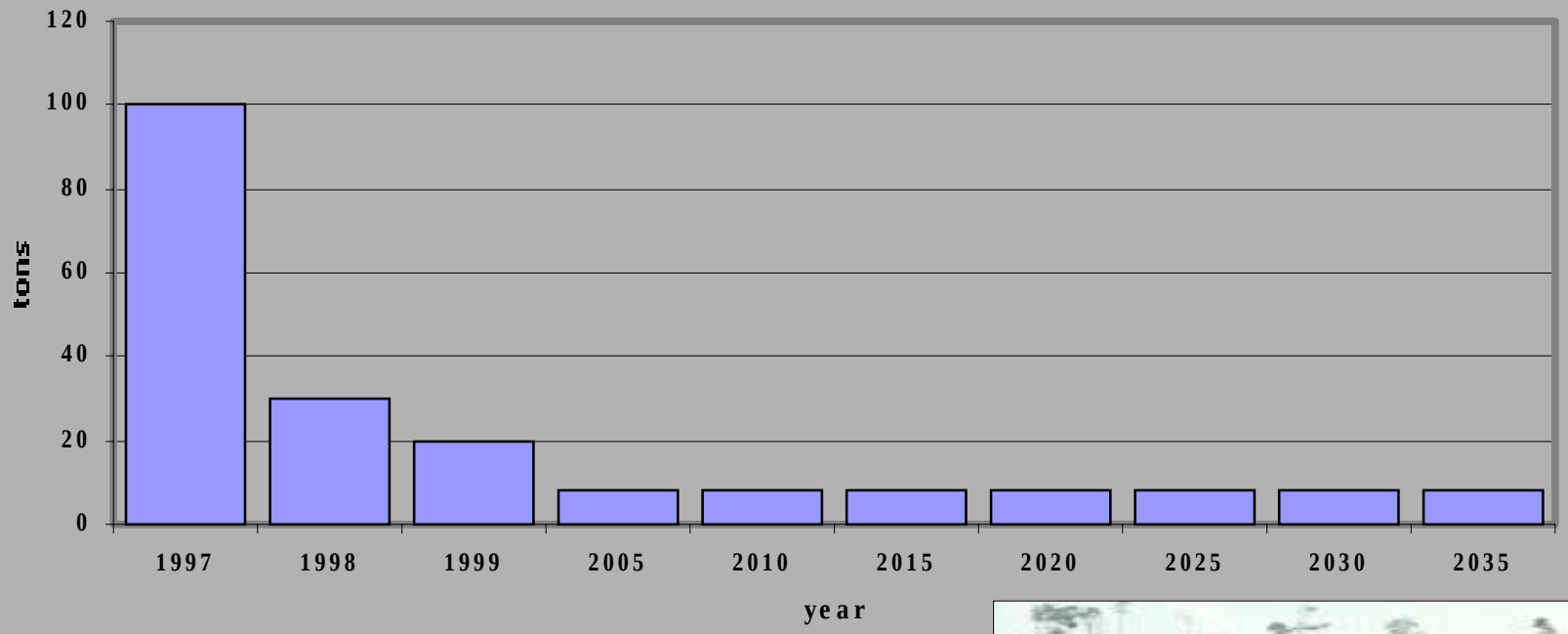
Global Fire Monitoring Center (GFMC)

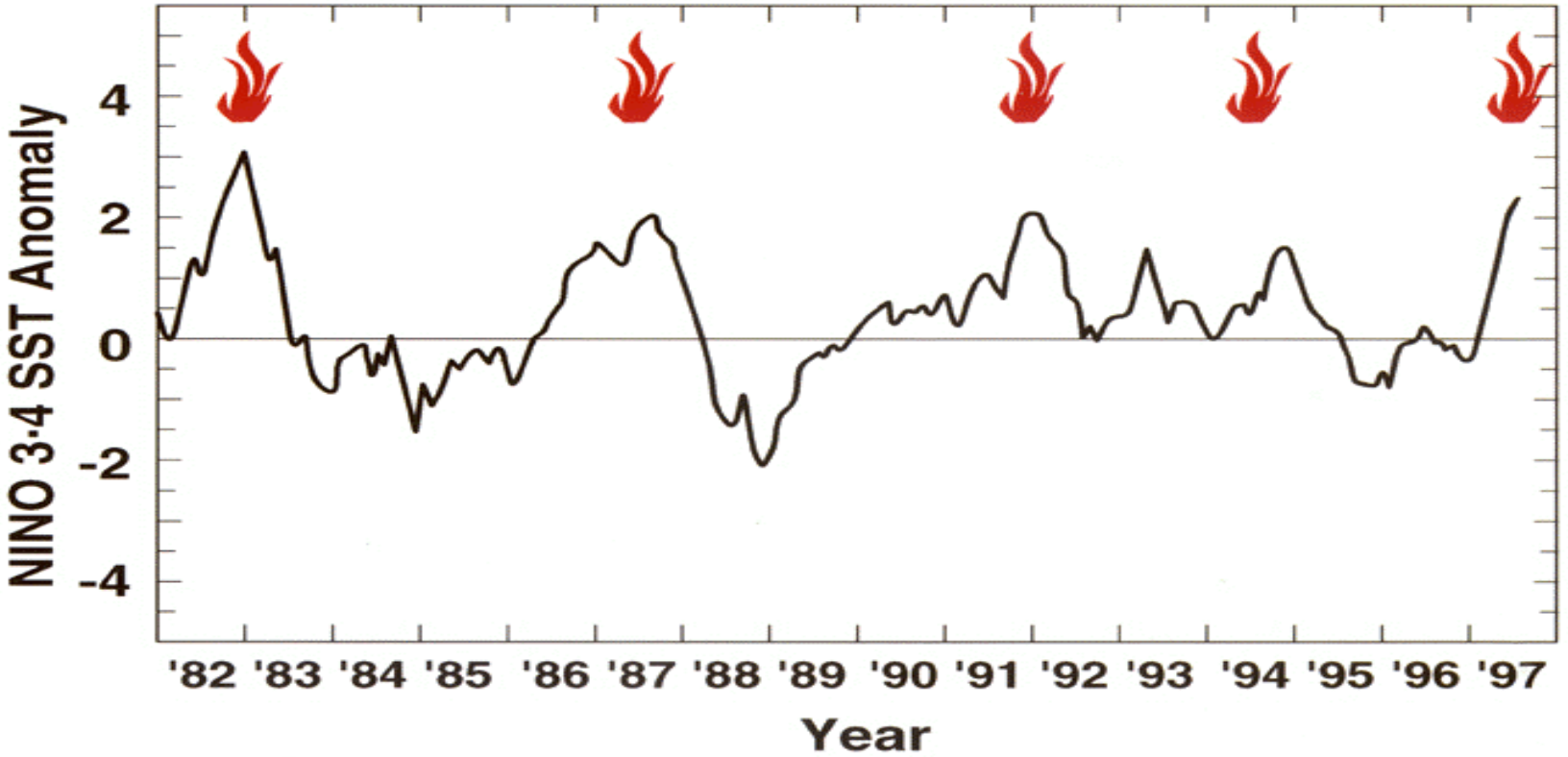
Case I:
Abrupt Tropical Rain Forest Conversion

Abrupt conversion

Case I:
Abrupt Tropical Rain Forest Conversion
Gross Carbon Release Pulses



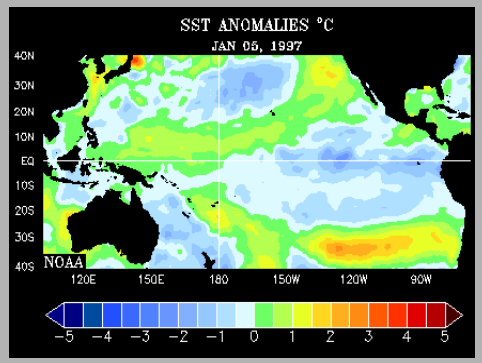
Abrupt conversion



El Niño and Burning / Smoke Episodes in Indonesia

Return intervals of inter-annual extremes:

Response of ENSO to global warming?

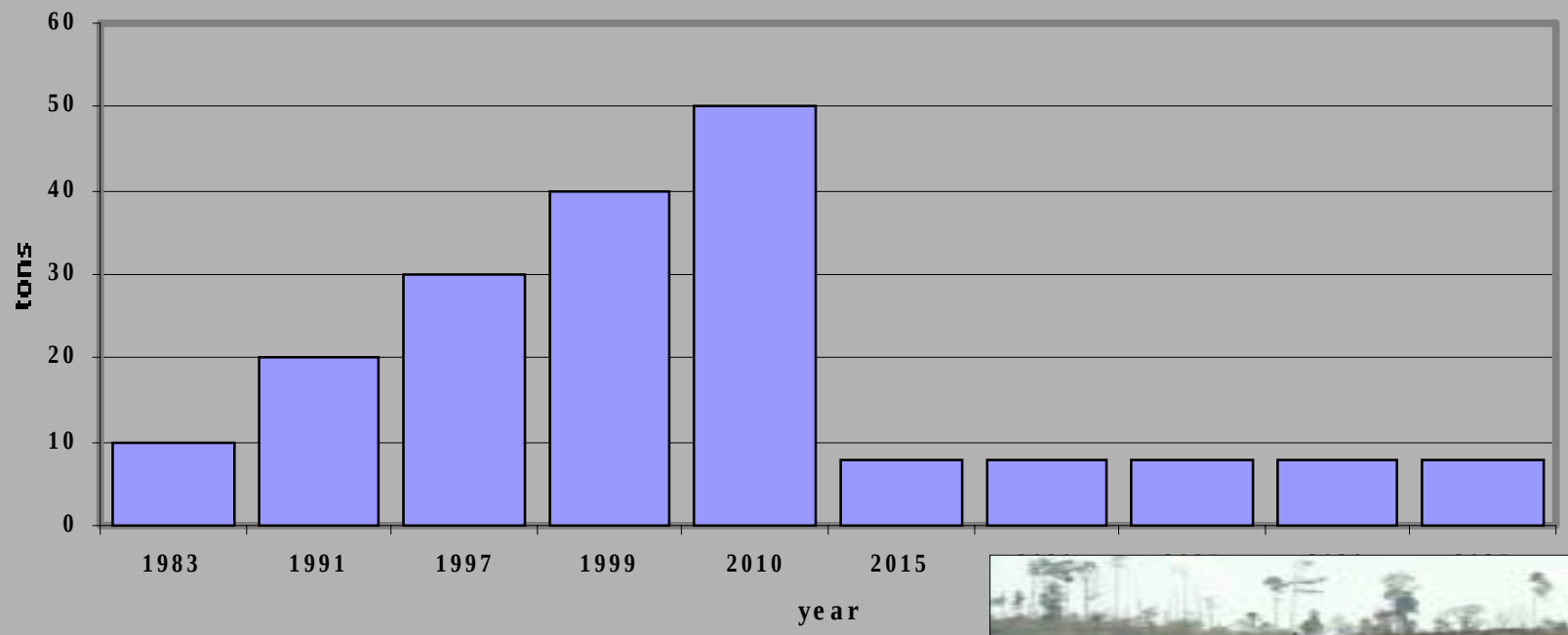


El Niño: Desiccation of the equatorial rain forest

Increase of mortality and available fuels; change of microclimate

Case II:
Forest degradation
by multiple fire events

Case II:
Tropical Rain Forest Degradation
Gross Carbon Release Pulses



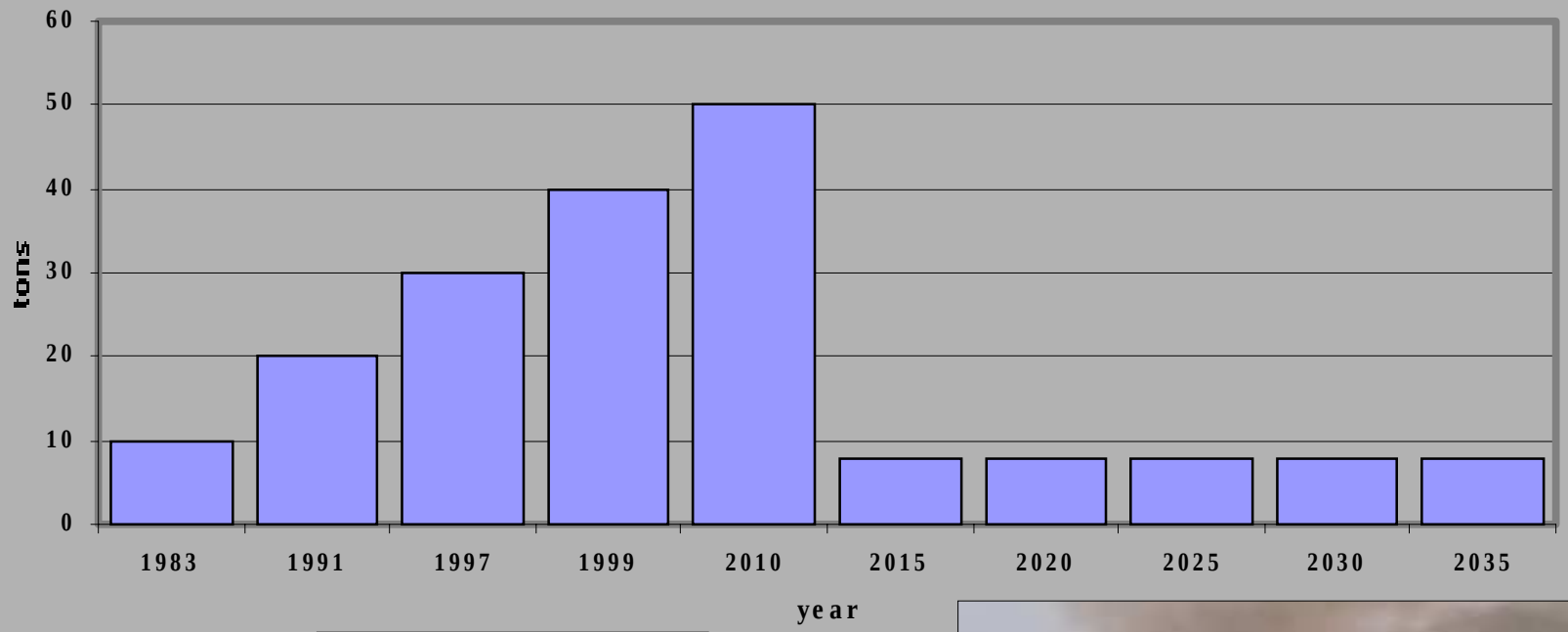
Successive degradation

Case III:
Tropical Peat Swamp Forest Degradation

Penetration of wildfires
into drained & desiccated
peat-swamp biomes

Initial fire and wood harvesting, followed by degradation

Case III:
Tropical Peat Swamp Forest Degradation
Gross Carbon Release Pulses

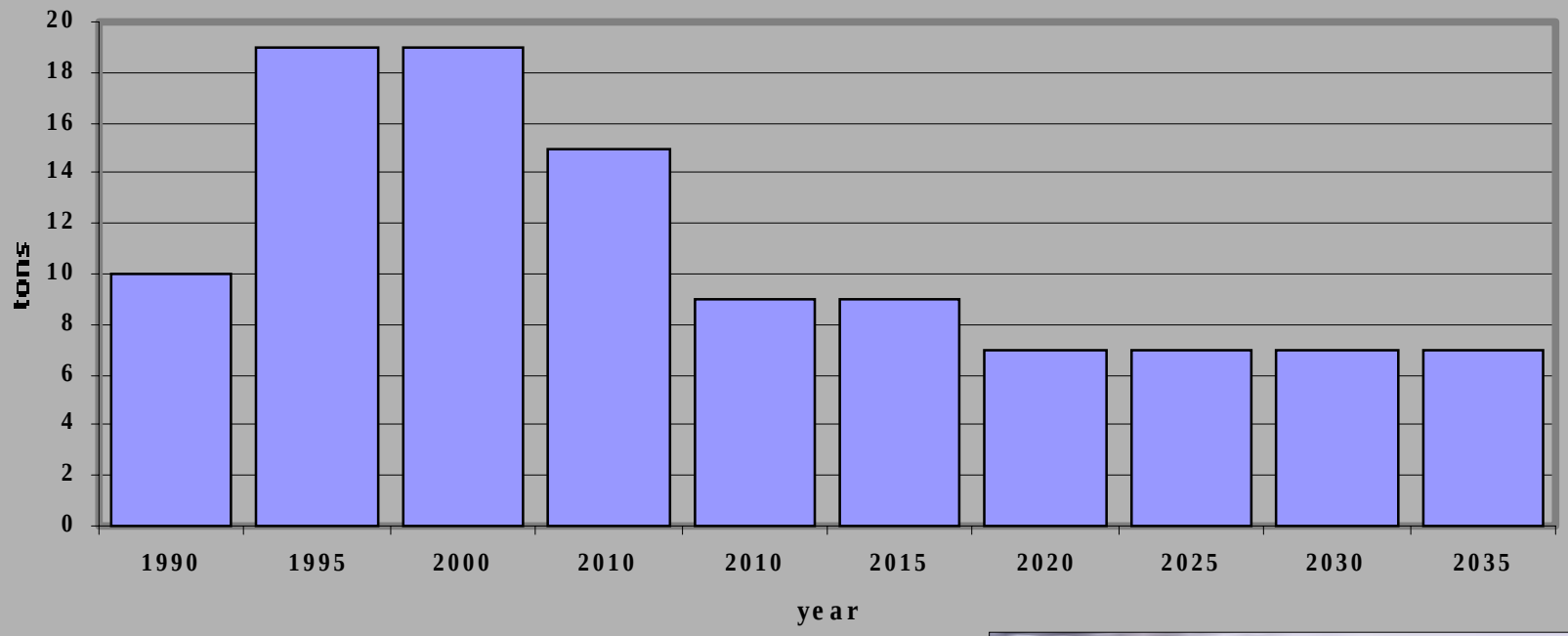


Drainage

Case IV:
Tropical Monsoon / Dry Forest Degradation

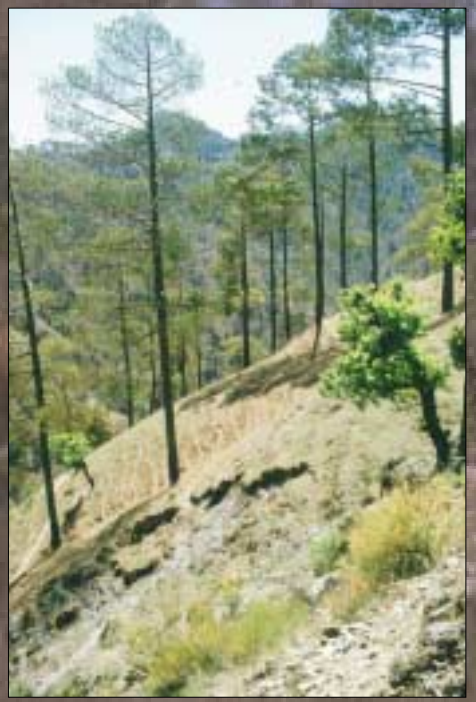
Case IV:
Tropical Monsoon / Dry Forest Degradation

Case IV:
Tropical Monsoon Forest Degradation
Gross Carbon Release Pulses

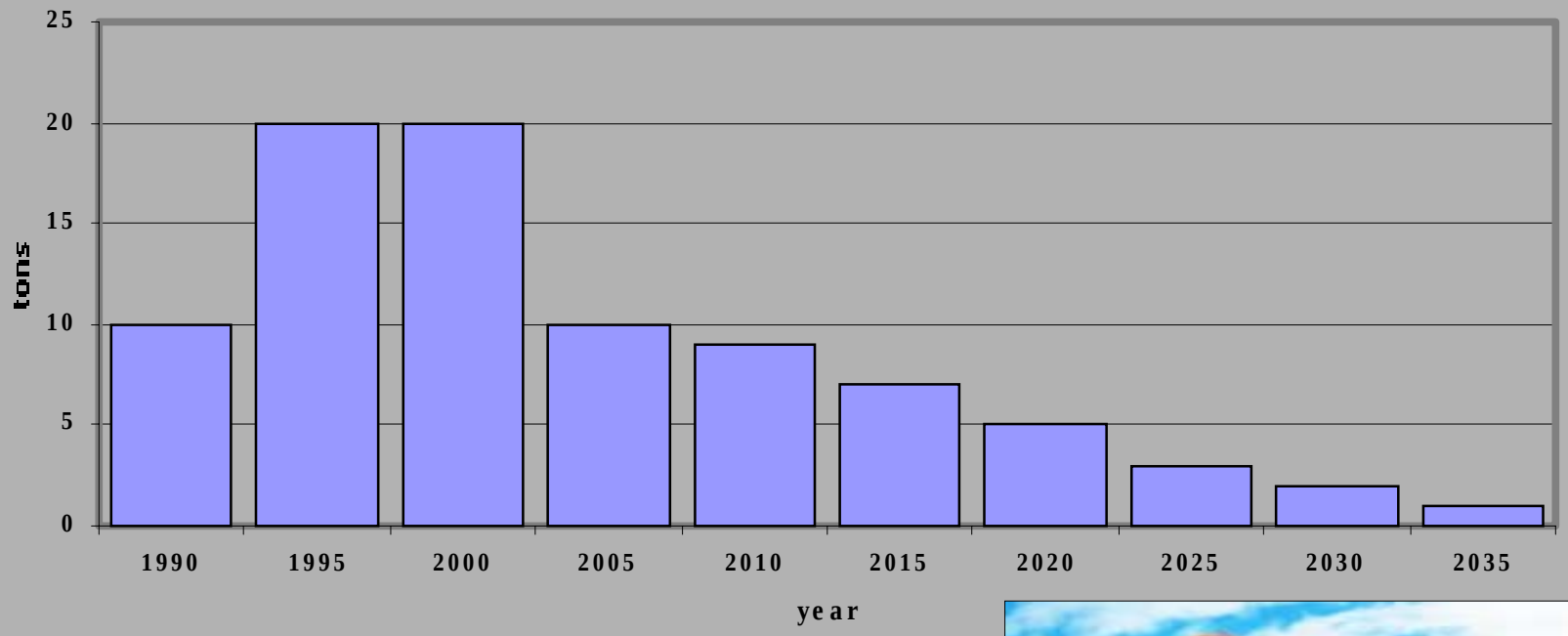


Degradation

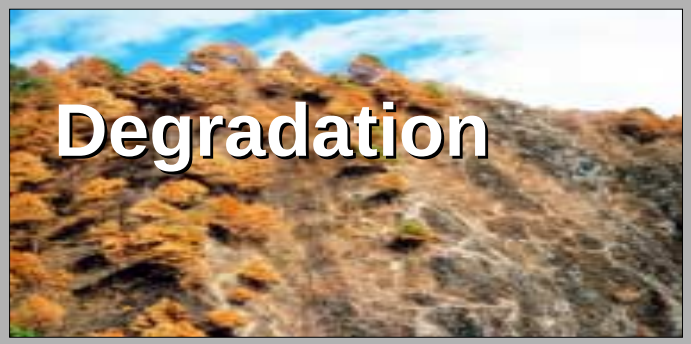
Case V:
Tropical Subtropical Mountain Forest Degradation



Case V:
Tropical Subtropical Mountain Forest Gross Carbon Release Pulses



Overcutting, grazing, trampling, fire

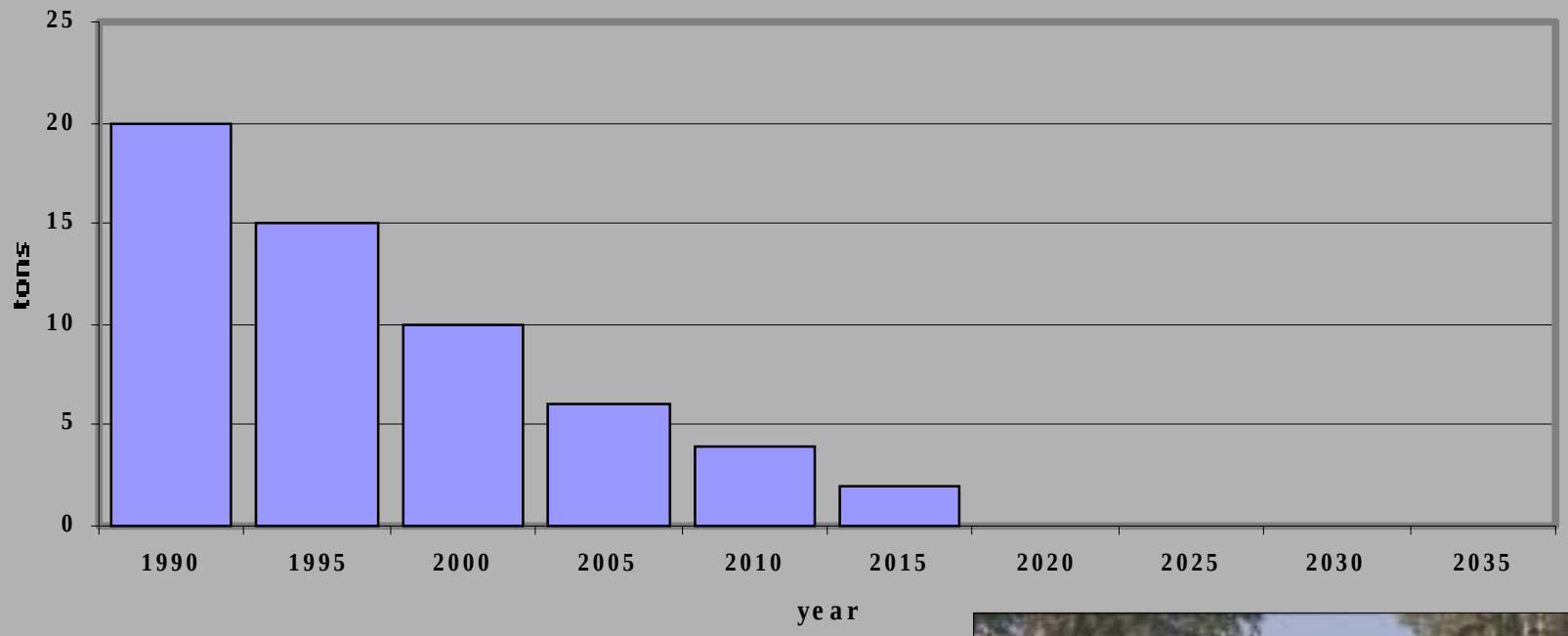


Case VI:
Tropical Tree-Brush-Grass Savannas
Fragmented, Depleted, Overpopulated

Case VI:
Tropical Tree-Brush-Grass Savannas
Fragmented, Depleted, Overpopulated

Competitive utilization of phytomass

Case VI:
Tree-Brush-Grass Savannas Overpopulated
Gross Carbon Release Pulses



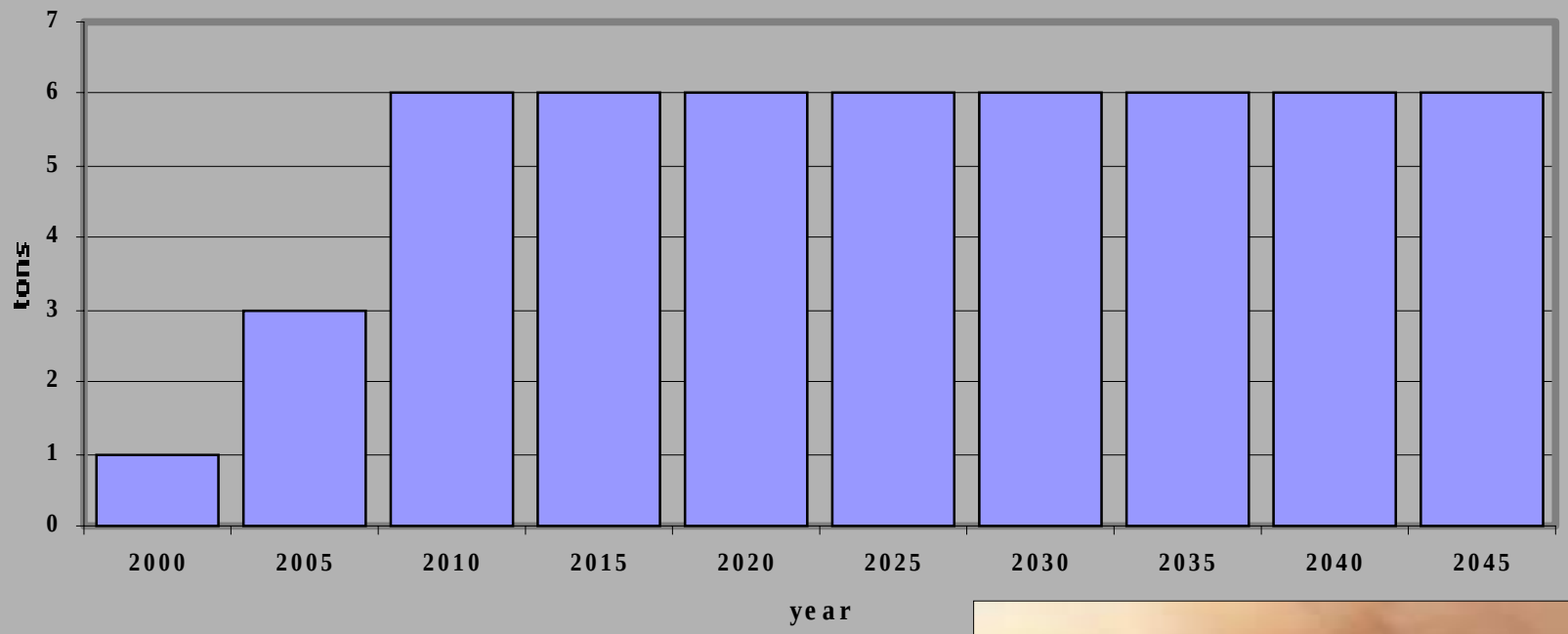
Export

of Phytomass

Case VII:
Tree-Brush-Grass Savannas Depopulated (AIDS Scenario), partially fragmented,

Increase of total and available fuel loads resulting in re-establishment of fire regimes and vegetation mosaics

Case VII:
Depopulated Savannas (AIDS Scenario)
Gross Carbon Release Pulses



Recovery of fire regimes

Case VIII:
Baltic Region
Densely Populated Industrial Countries

Successful fire protection,
increase of forested land area

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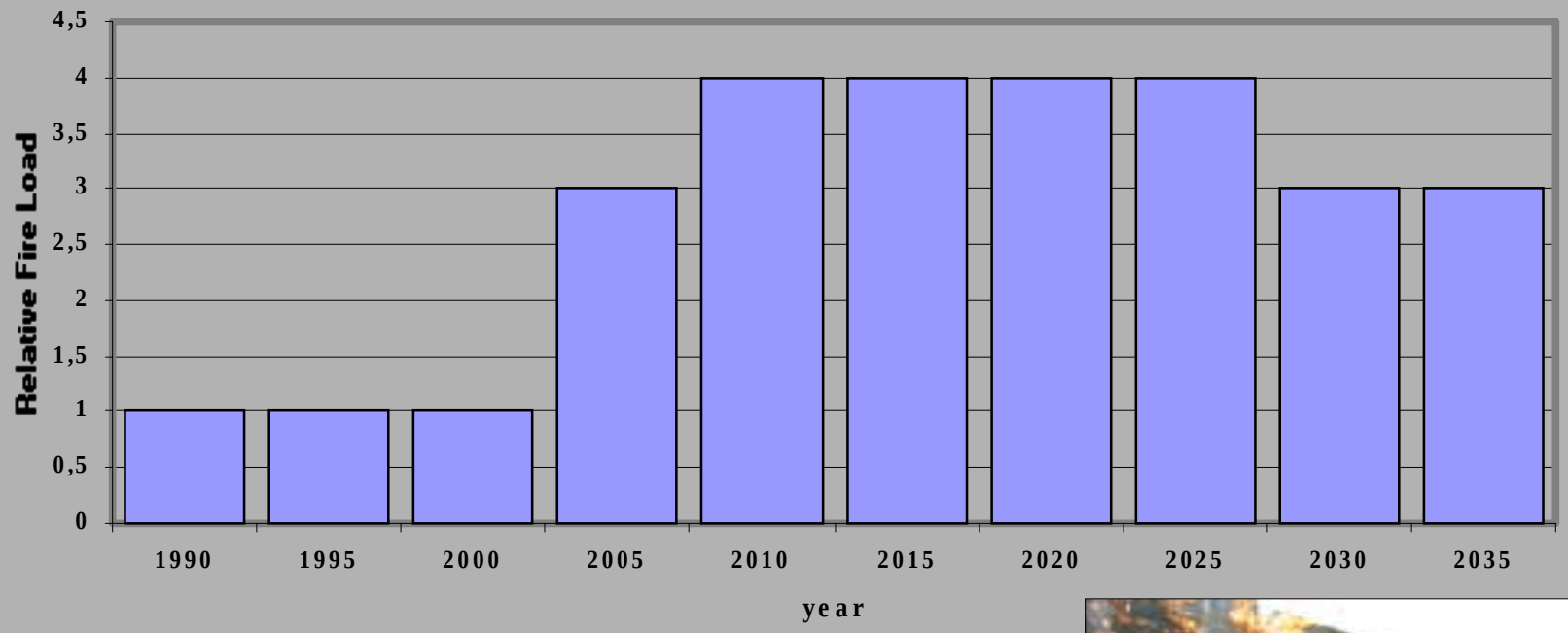
Baltic Region
Densely Populated Industrial Countries

Restoration of cultural fire regimes


Eero Järnefelt 1873
Raatajat rahanalaiset
Ateneum, Helsinki

Case VIII:
Baltic Region
Gross Carbon Release Pulses



Successful wildfire protection, prescribed fire

Case IX: Mediterranean Basin

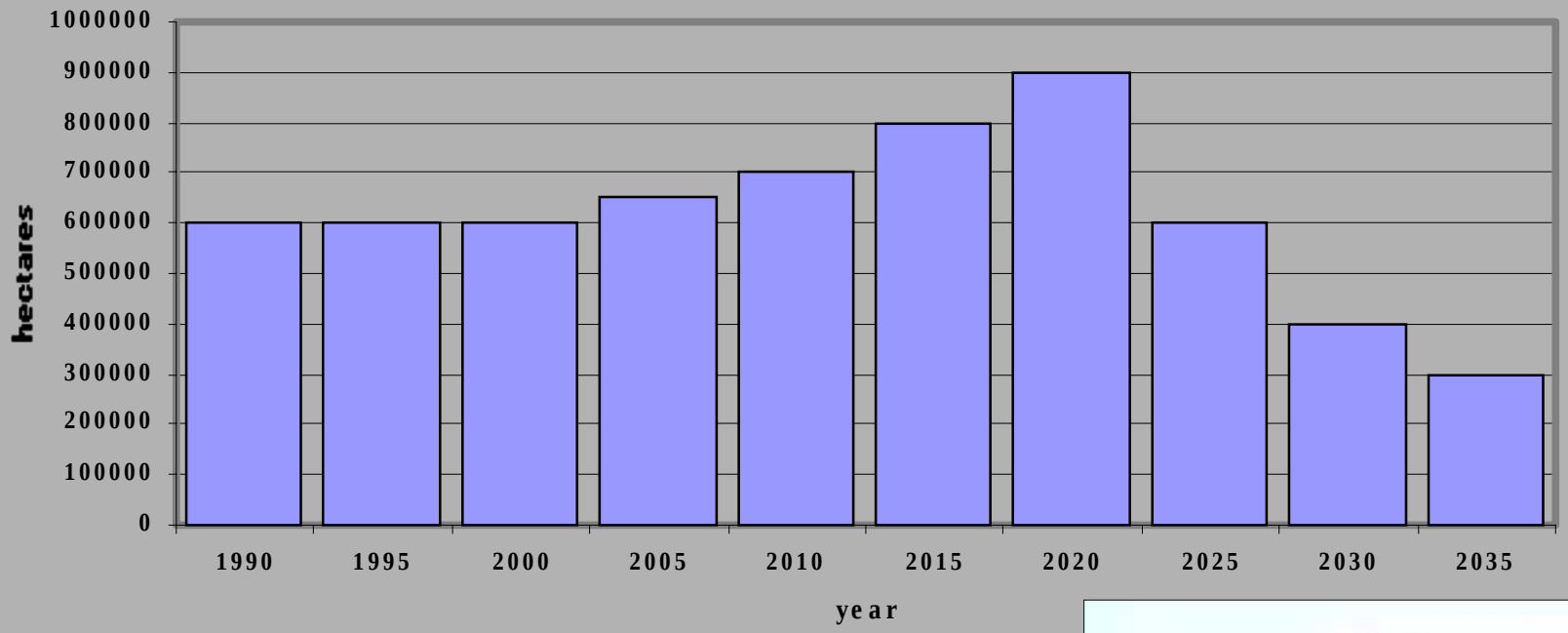
Dynamic History and Fire Regimes

Case IX:
Mediterranean Basin

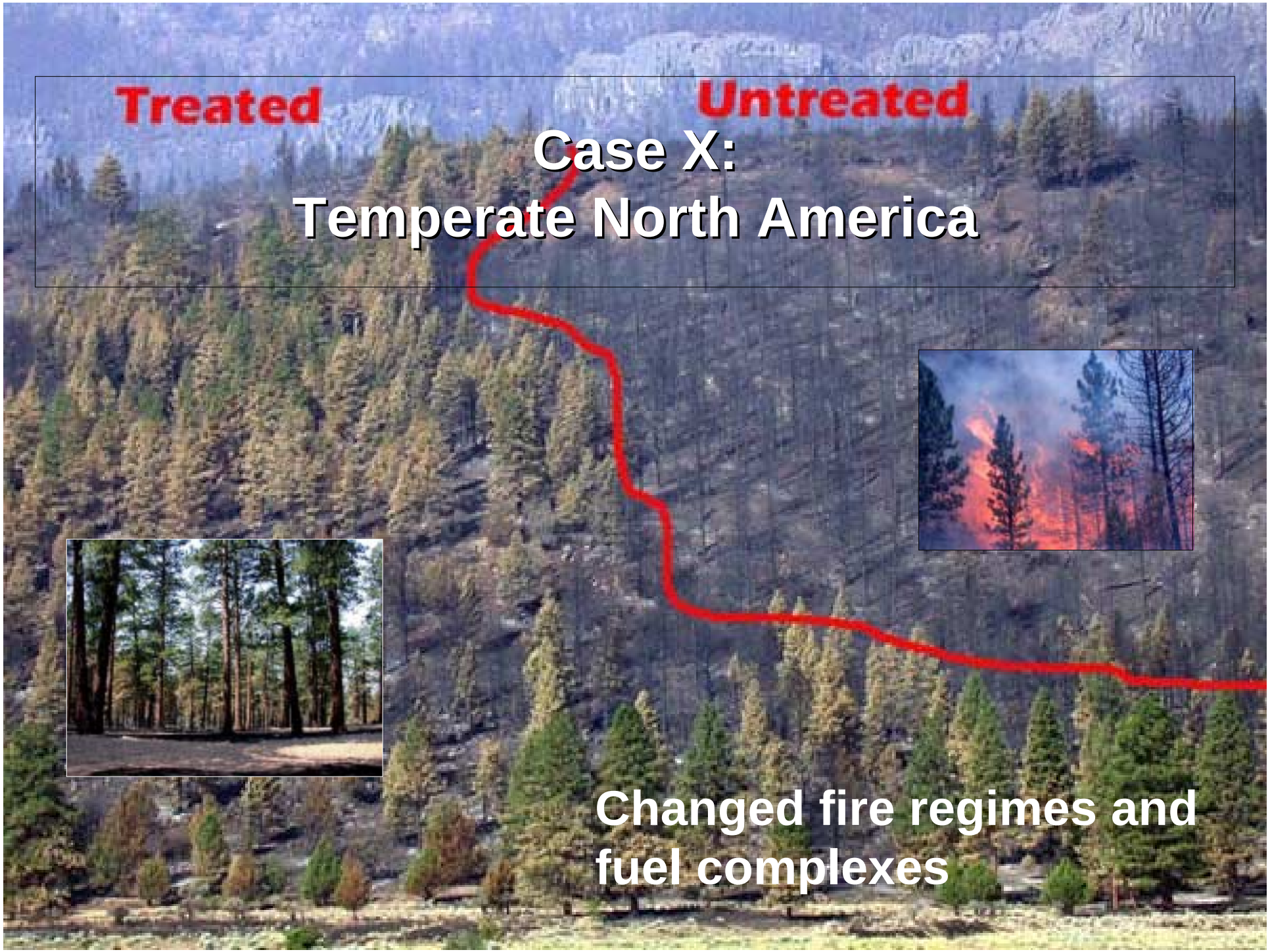
Intensive utilization and depletion of vegetation resources .....

... followed by rural exodus

Case IX:
Mediterranean Basin
Gross Carbon Release Pulses



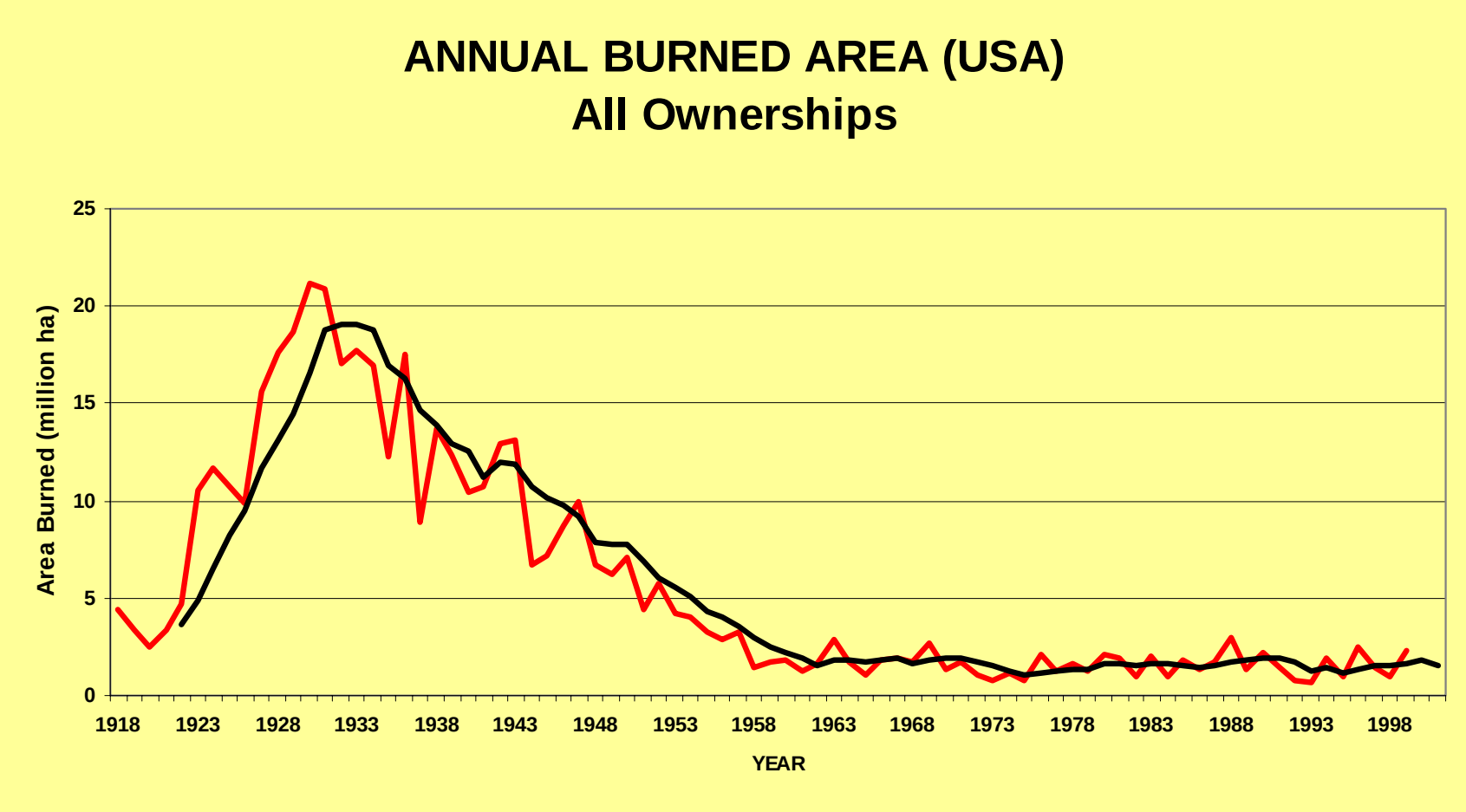
Increase of wildfire occurrence and severity



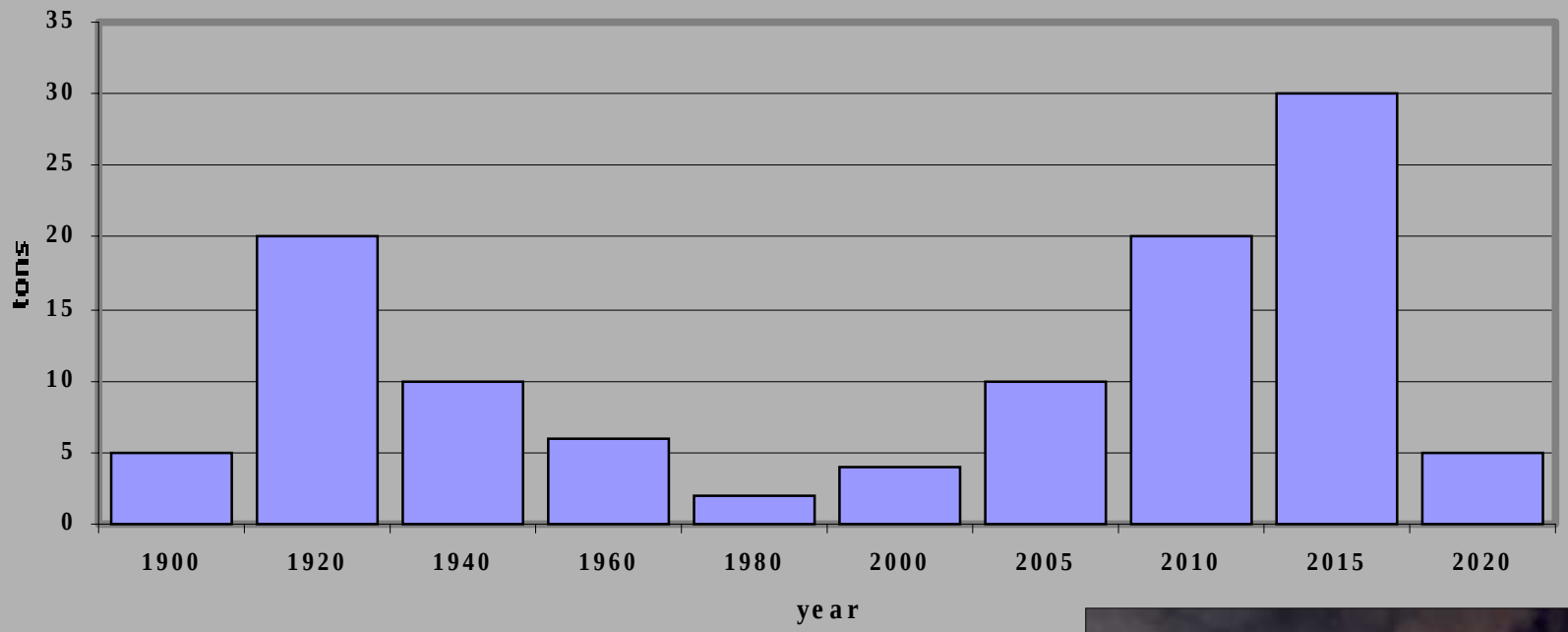
Case X:
Temperate North America

Changed fire regimes and fuel complexes

Case X:
Temperate North America
Gross Carbon Release Pulses

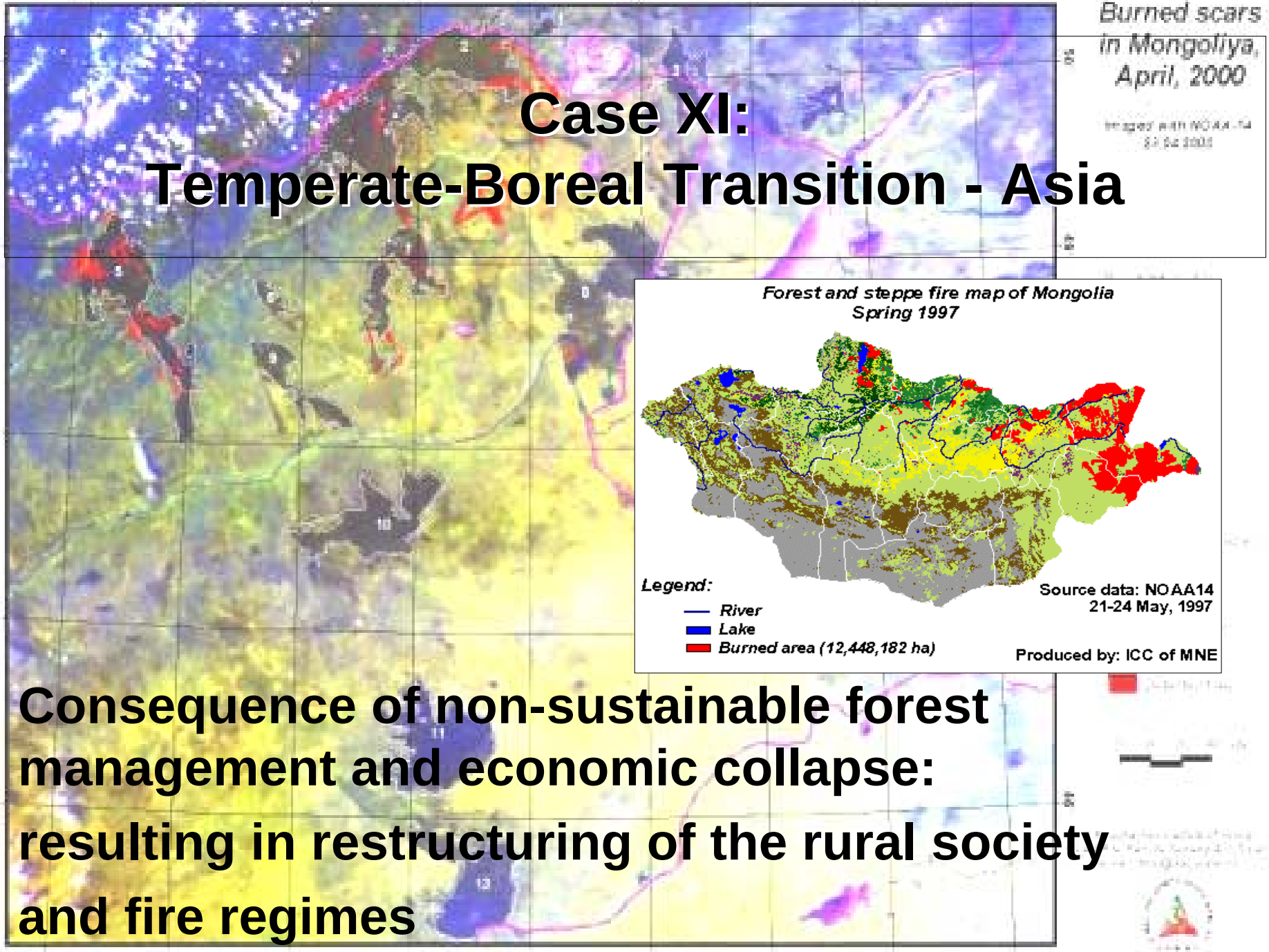


Case X:
Temperate North America
Gross Carbon Release Pulses



Successful wildfire protection, prescribed fire

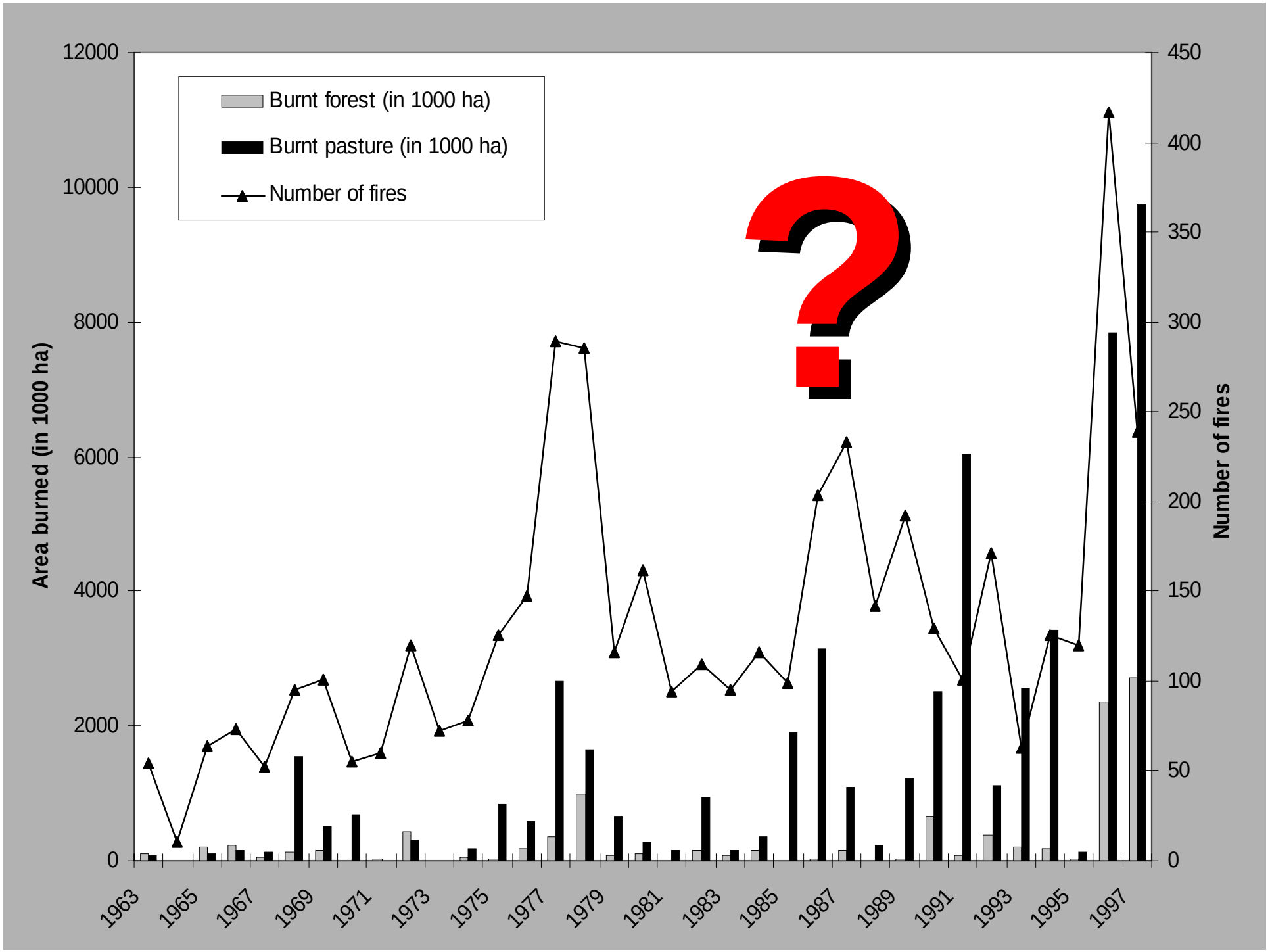
Case XI:
Temperate-Boreal Transition - Asia



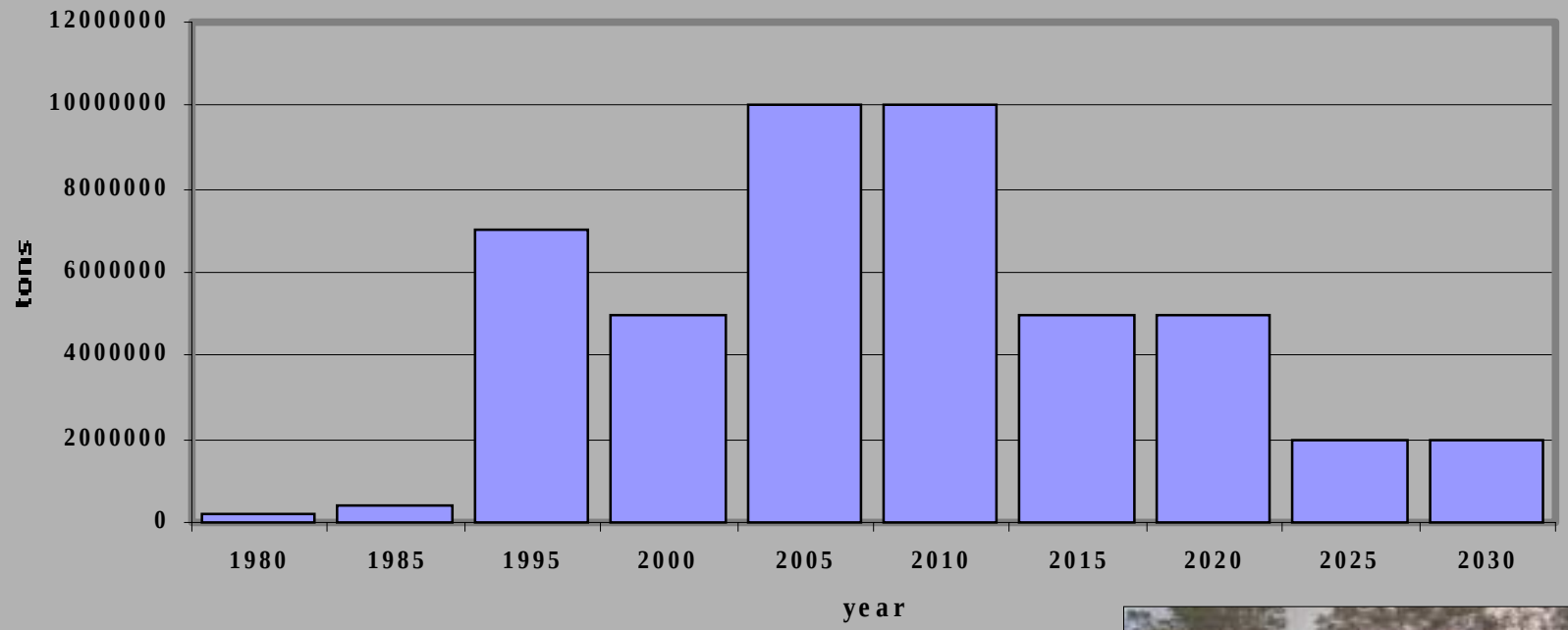
Consequence of non-sustainable forest management and economic collapse:

resulting in restructuring of the rural society and fire regimes

Case XI:
Temperate-Boreal Transition - Asia


Burnt forest (in 1000 ha)
Burnt pasture (in 1000 ha)
Number of fires
Area burned (in 1000 ha)
Number of fires
12000
10000
8000
6000
4000
2000
0
450
400
350
300
250
200
150
100
50
0
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997

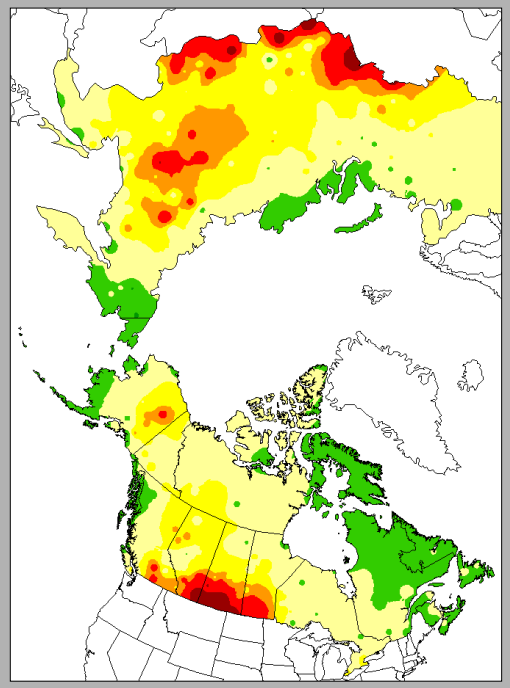
Case XI:
Temperate-Boreal Transition - Asia
Gross Carbon Release Pulses



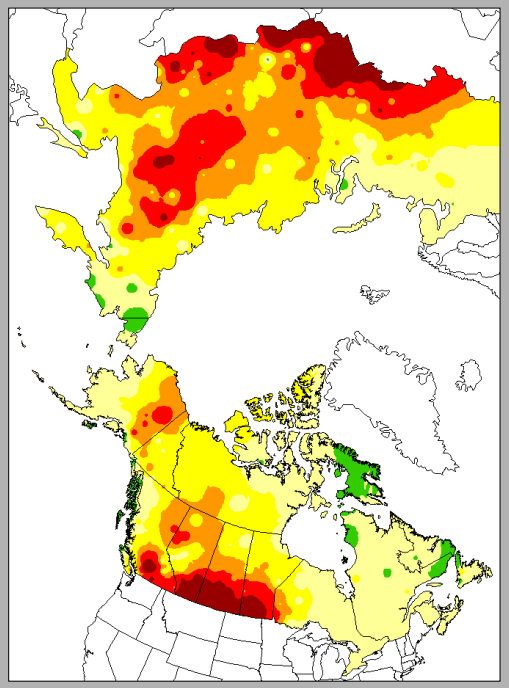
Escalating destruction of montane-boreal forests

Case XII:
Boreal Forests

Potential Effect of Climate Change on Fire Hazard in the Boreal Zone – the Canadian Climate Center GCM



Historic Fire Weather



CCC 2 x CO_2

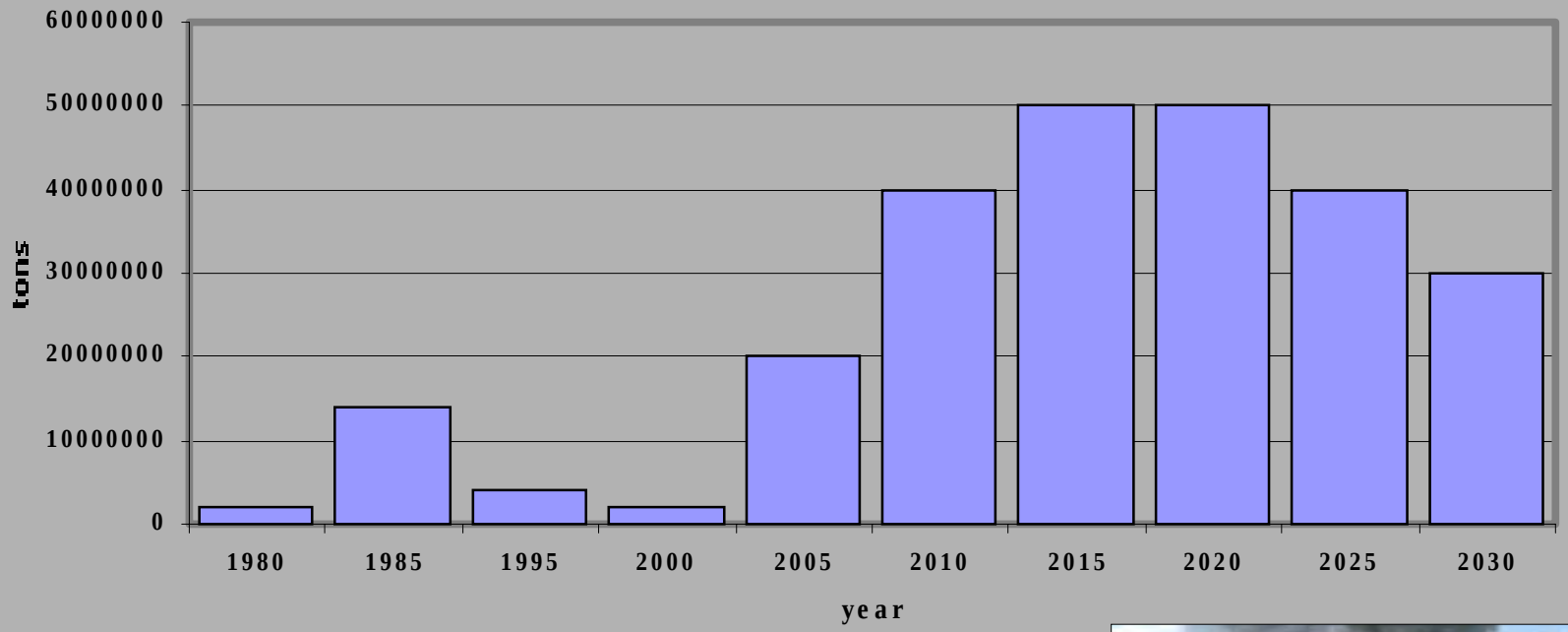
Moderate dryness:

Low-intensity surface fires (beneficial)

Extreme dryness:

High-intensity crown fires (destructive)

Case XII:
Boreal Forests
Gross Carbon Release Pulses



Escalating replacement of boreal forests

Global Fire Modelling

Quo vadis ?