

Untangling the factors that cause fire regime changes in West African savannas



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Professor

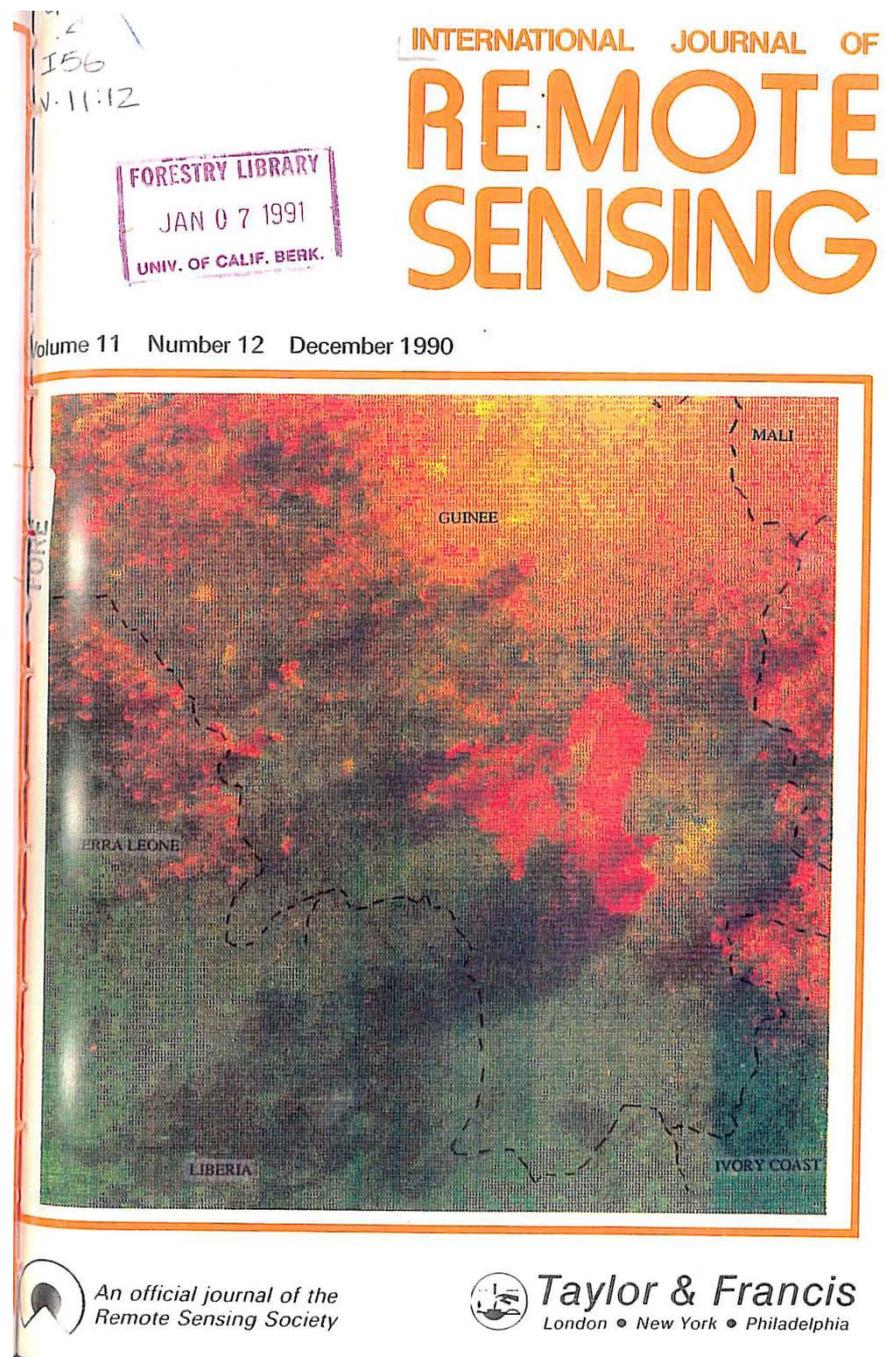
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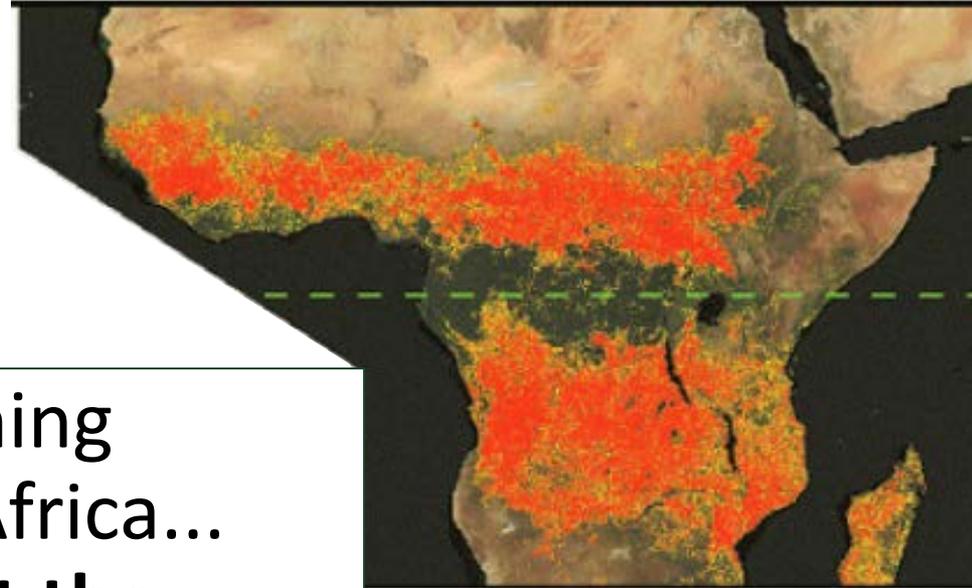
California USA

Why do fire regimes vary from place to place?

“Fires...were probably lit by pastoralists for grass regeneration or hunting. In the absence of a tight landscape organization the process of burning went *out-of-control* with the result depicted in the image...Towards the Ivory Coast, the *mixed pattern of ...land use suggests a form of landscape organization* different from Guinea...while the area is *densely occupied, better fire management* practices have evolved (2123, emphasis added).



Low inter-annual variability of African savanna fires



“The most extensive burning consistently occurred in Africa... [However], **we found that the lowest interannual variability** in area burned occurred **in the savannas** of Southern- and Northern-Hemisphere Africa” (Giglio et al. 2010: 1184).

African Fires
Cochrane 2009



How and why do fire regimes change?

Biophysical Causes

- Climate/weather
- Land Cover Change
- Landscape Pattern Change
- *Vegetation* Cover Change

Human Causes

- Land Use Change
- Population Density Change
- Policy Change
- Burning Practice Change



How and why do fire regimes change in African Savannas?

Biophysical Causes

Human Causes



- Climate/weather
- Land Cover Change
- Landscape Pattern Change
- *Vegetation Cover Change*

- Land Use Change
- Population Density Change
- Policy Change
- *Burning Practice Change*

NORTH (arid)

SOUTH (moist)

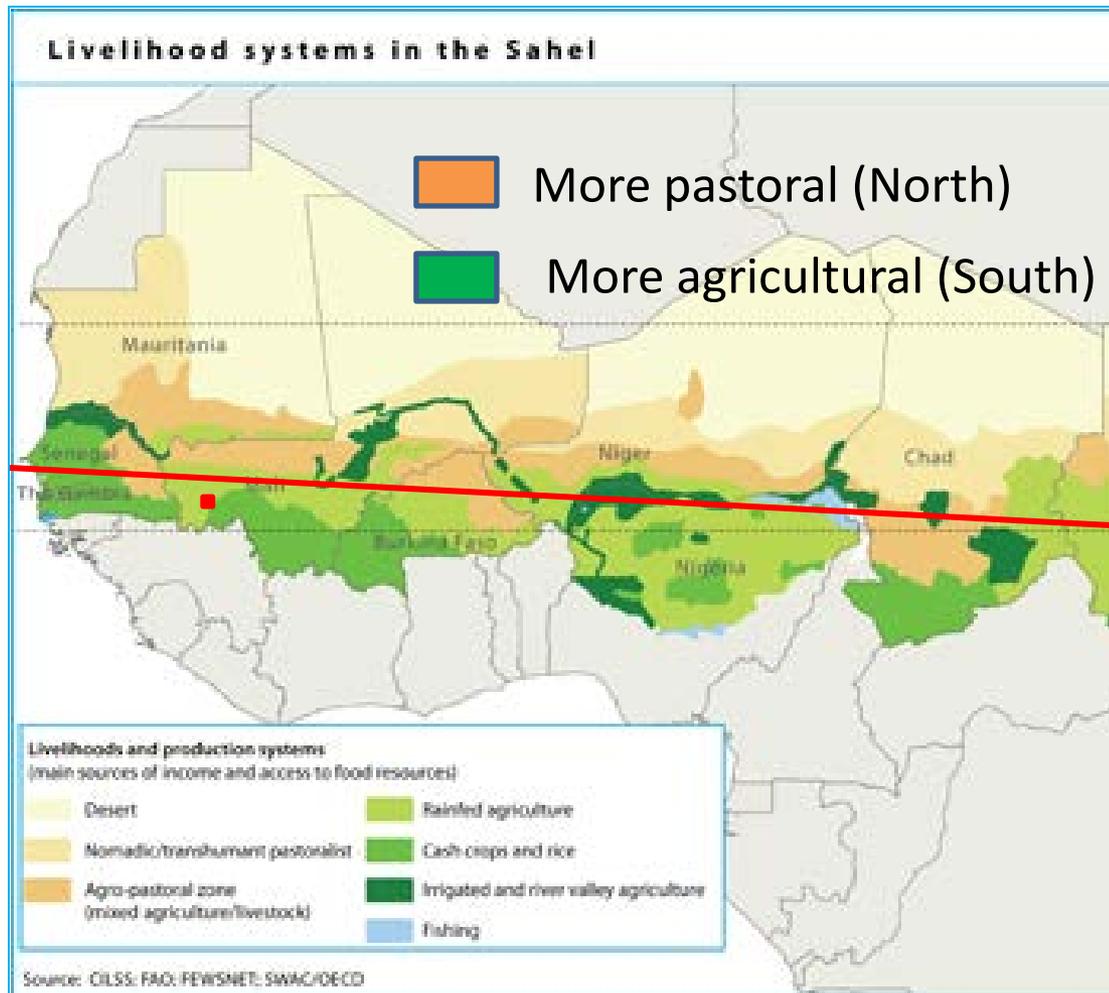
Annual grasses → Perennial grasses → Woodland/forest

Pastoral → Agro-pastoral → Agricultural

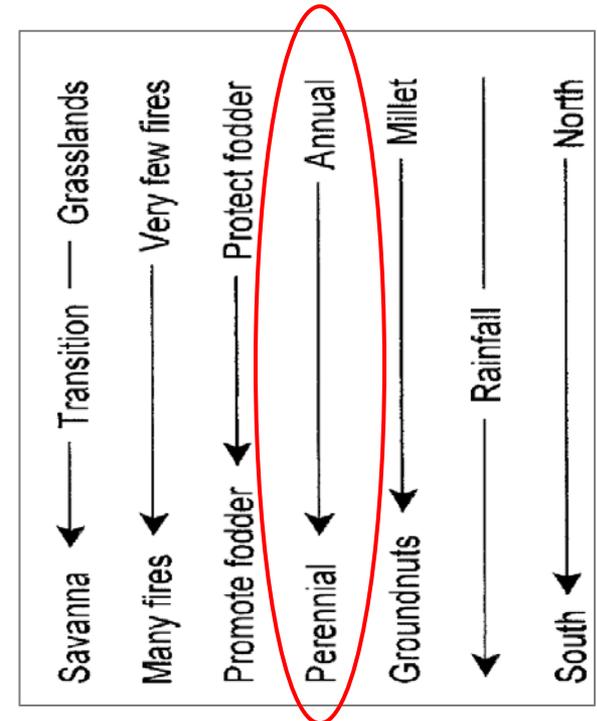
LESS FIRE

MORE FIRE

LESS FIRE

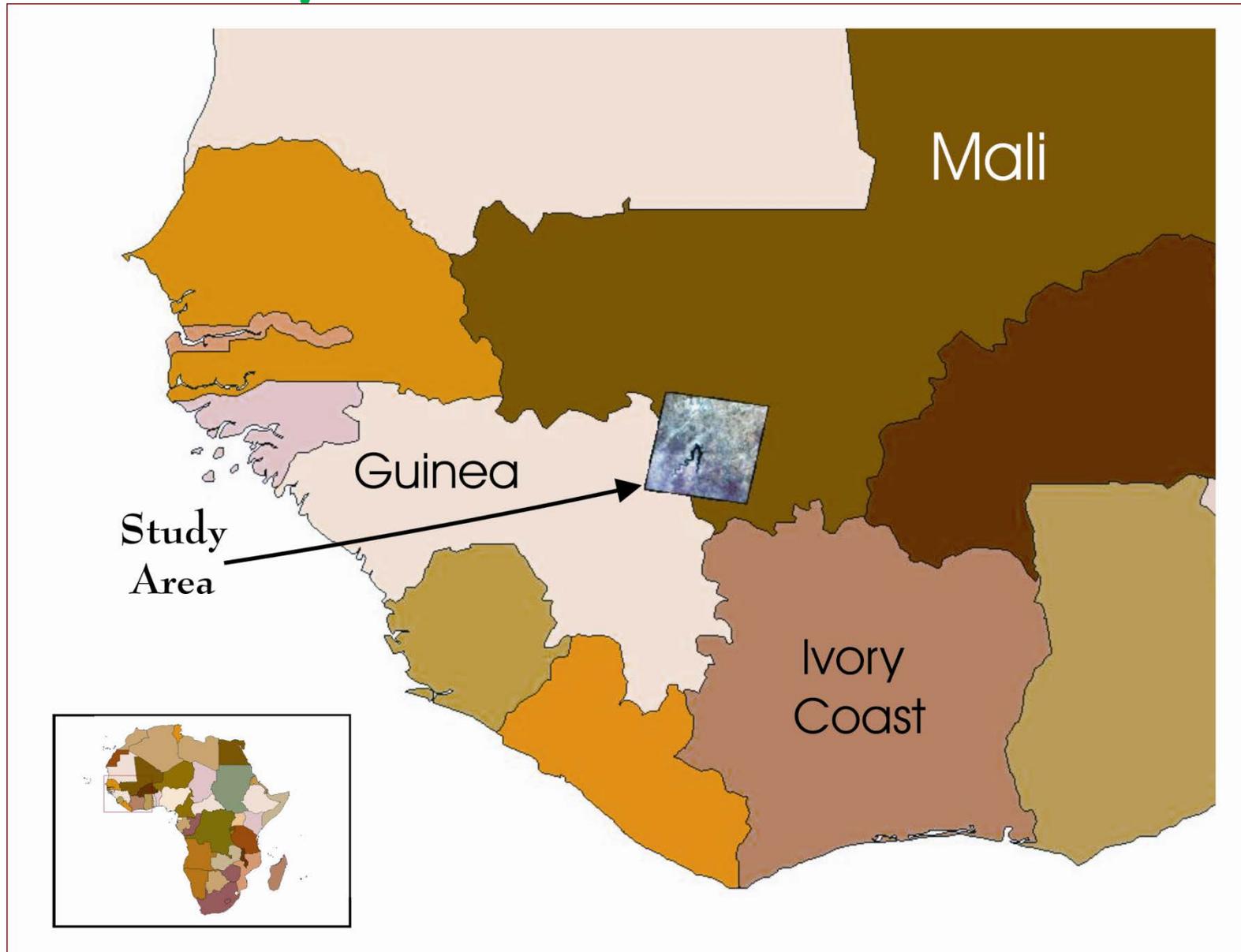


Broad Scale Factors

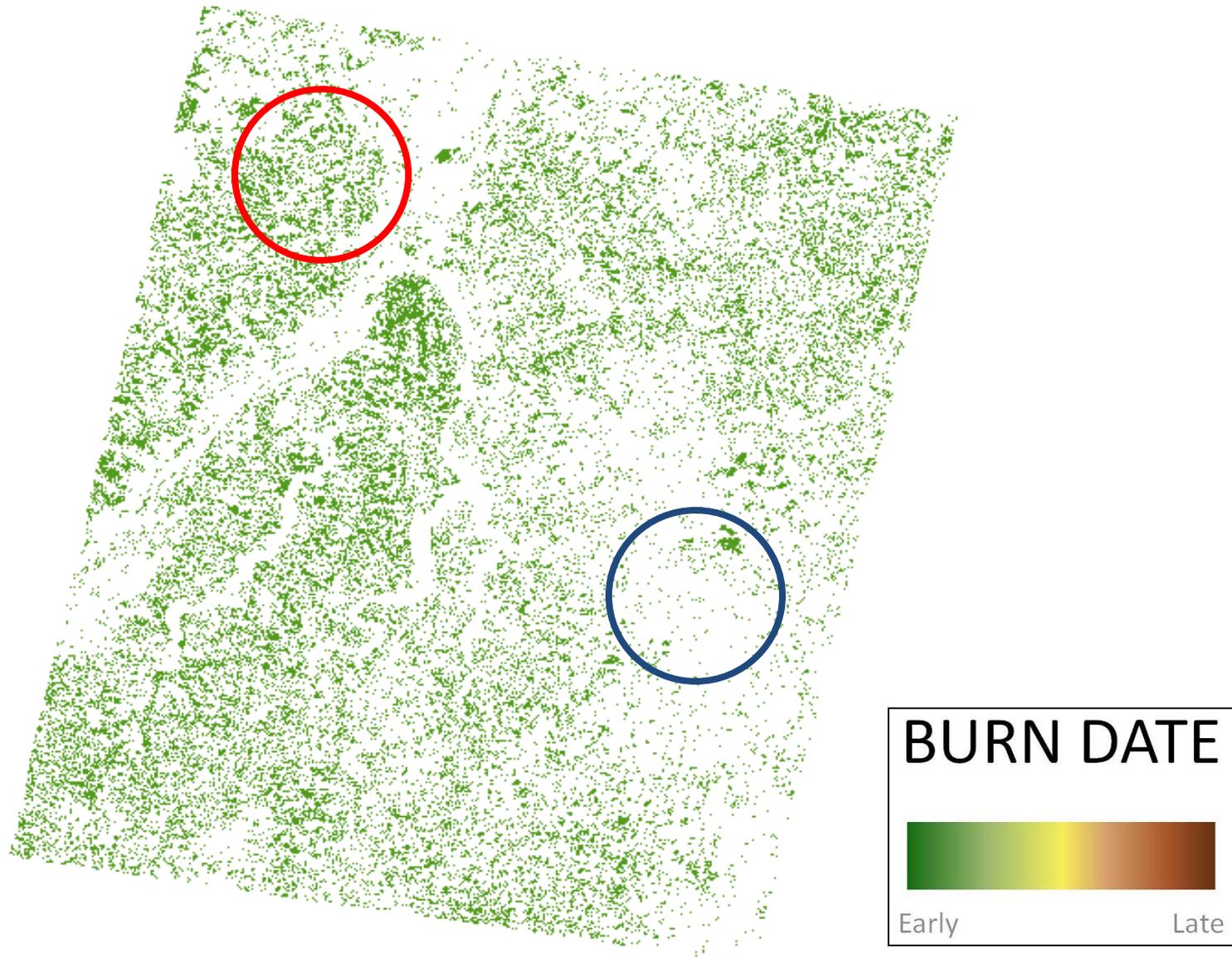


Source: Mbow et al 2000

Study Area for Fire Research

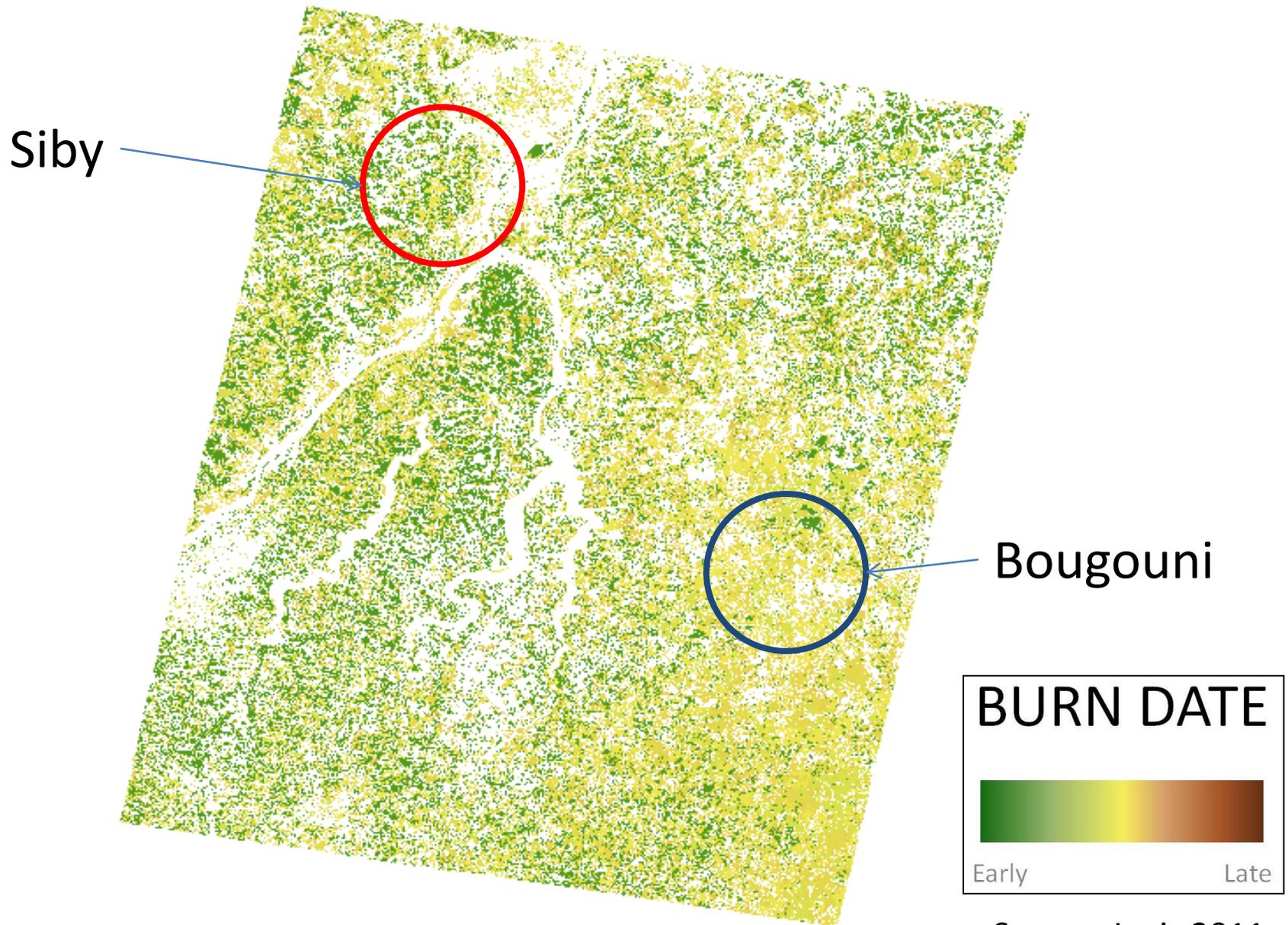


“Early” Savanna Fires, Nov 2006



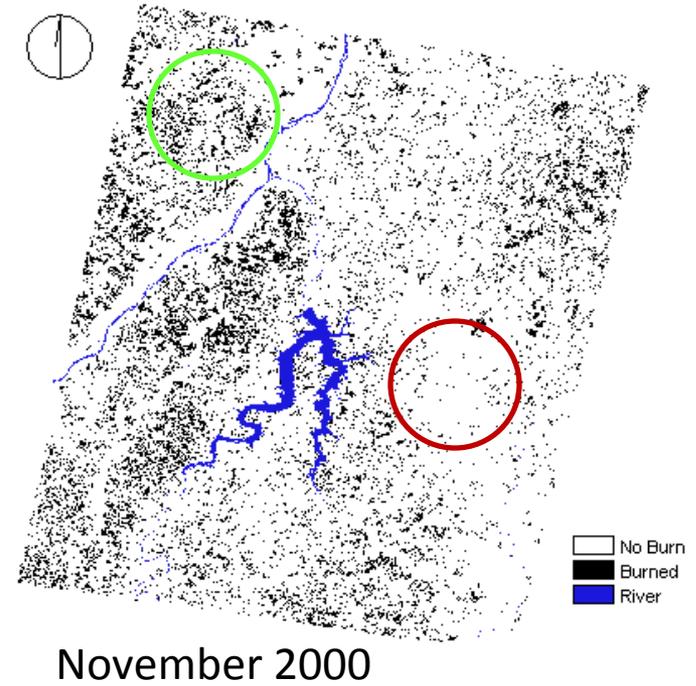
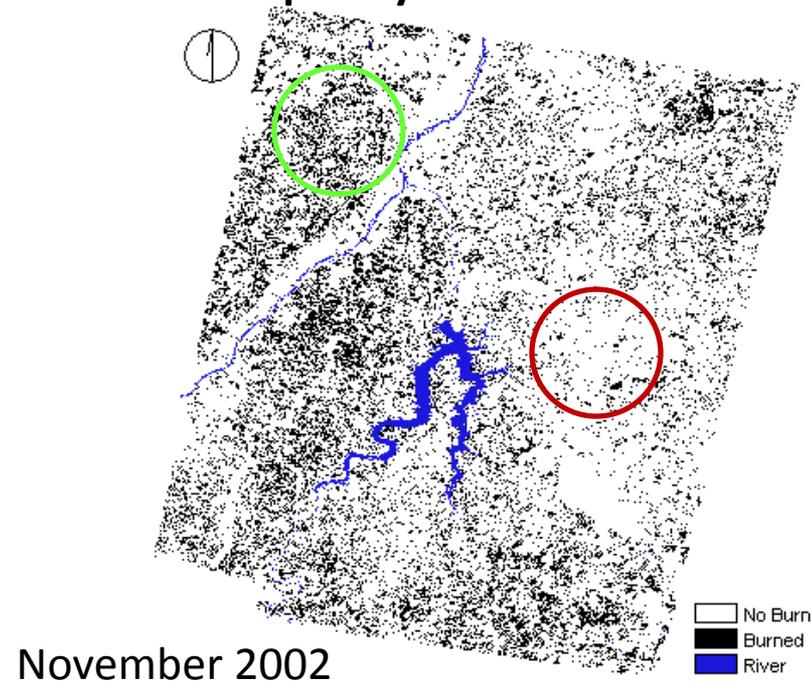
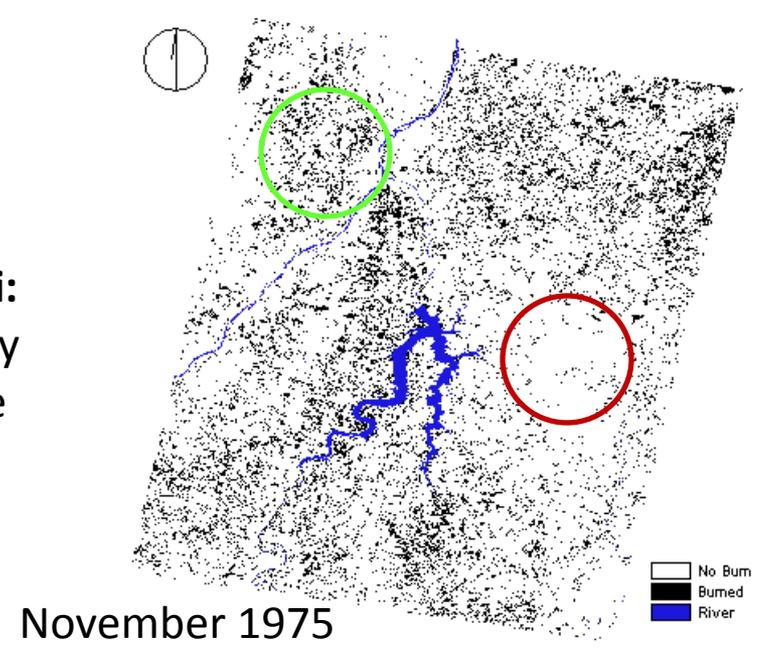
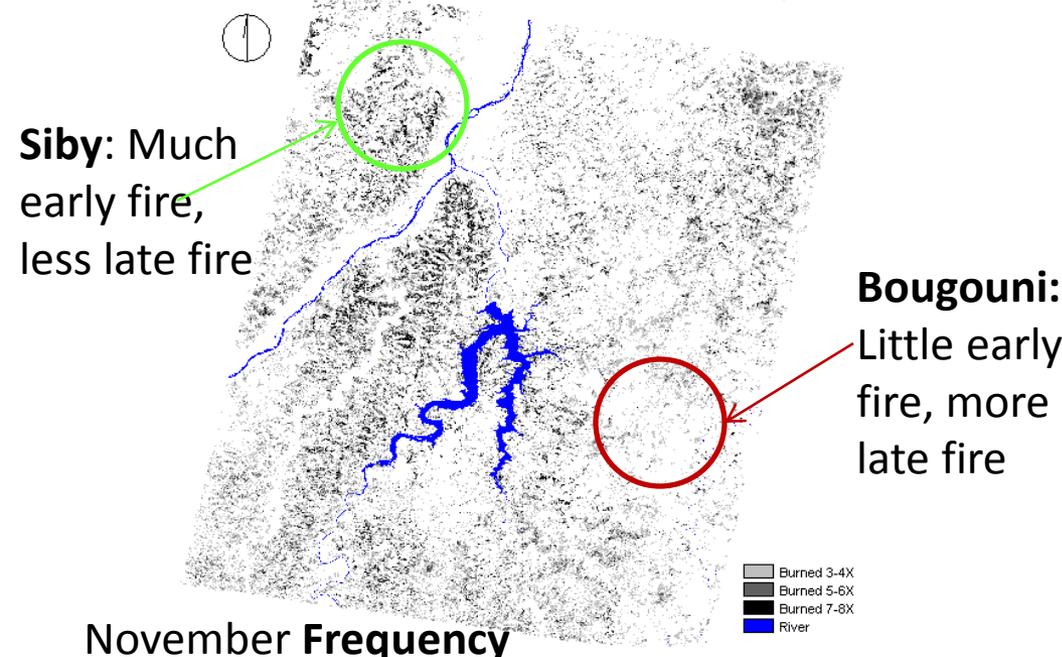
Source: Laris 2011

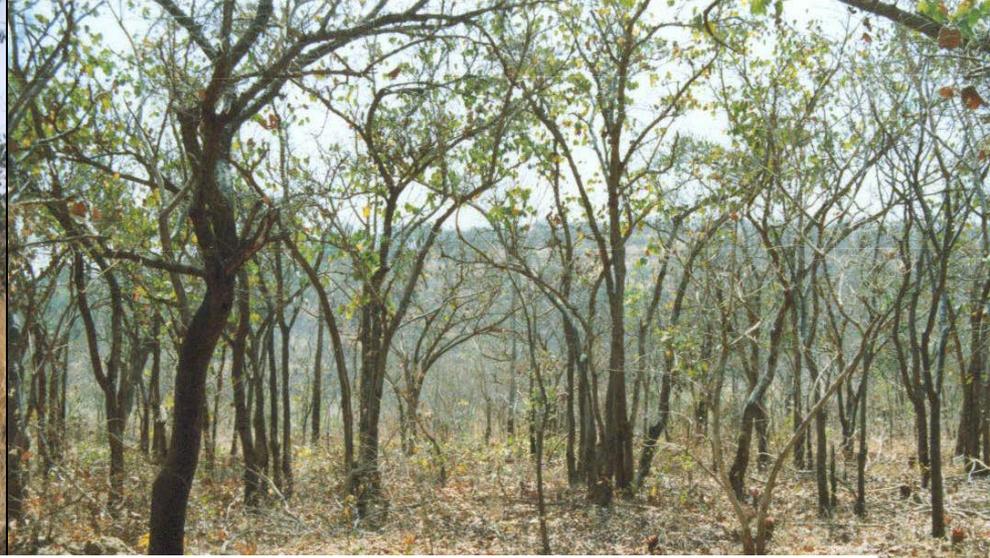
“Late” Savanna Fires, Feb 2007



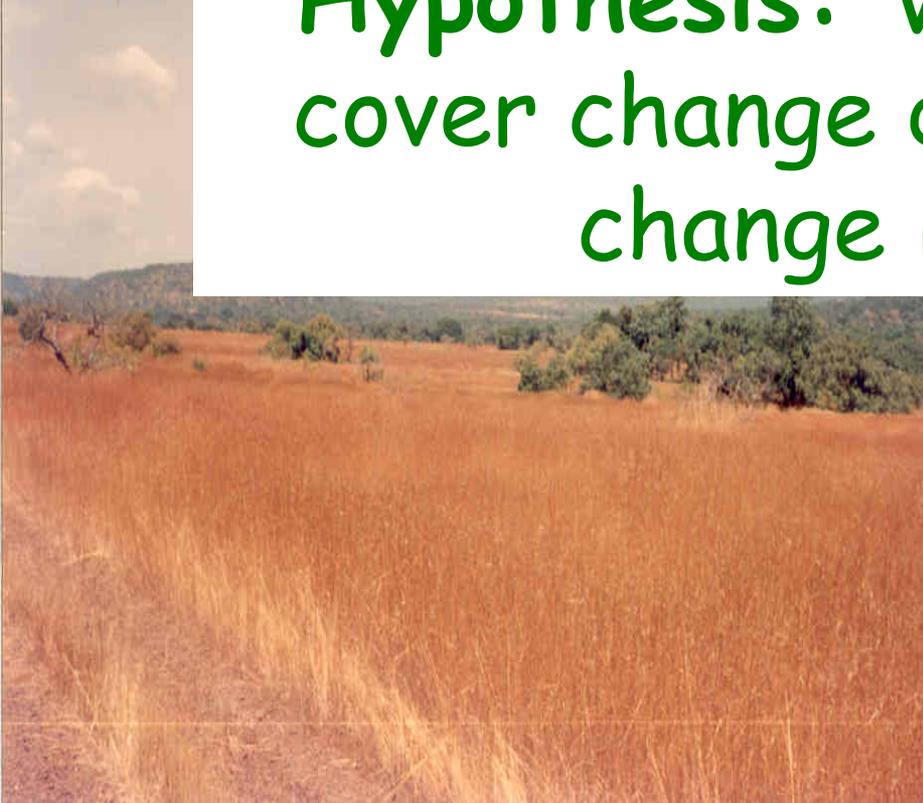
Source: Laris 2011

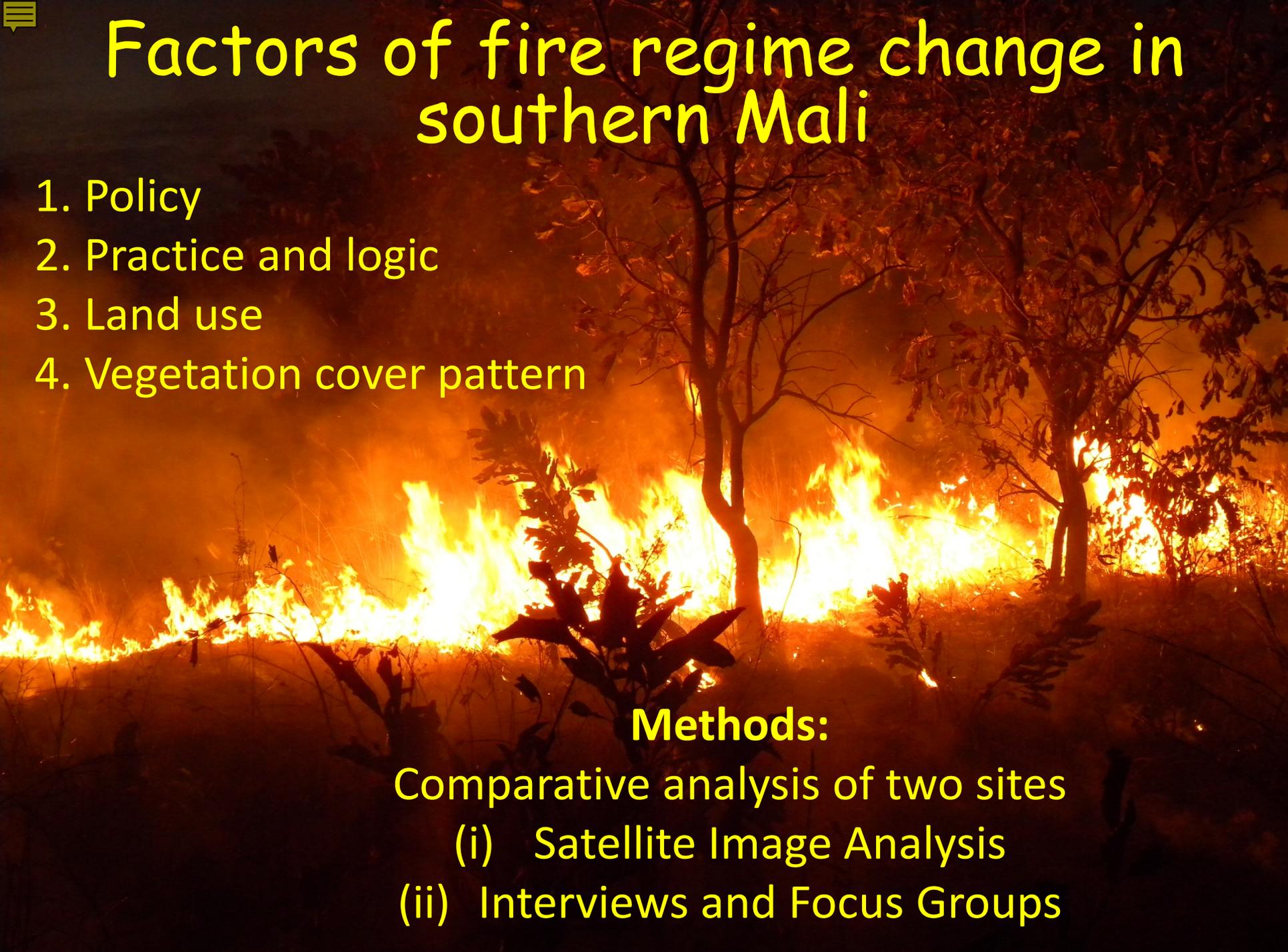
November burned area maps: 1975, 2000, 2002 and frequency





Hypothesis: Vegetation (*grass*) cover change drives fire regime change in savannas.





Factors of fire regime change in southern Mali

1. Policy
2. Practice and logic
3. Land use
4. Vegetation cover pattern

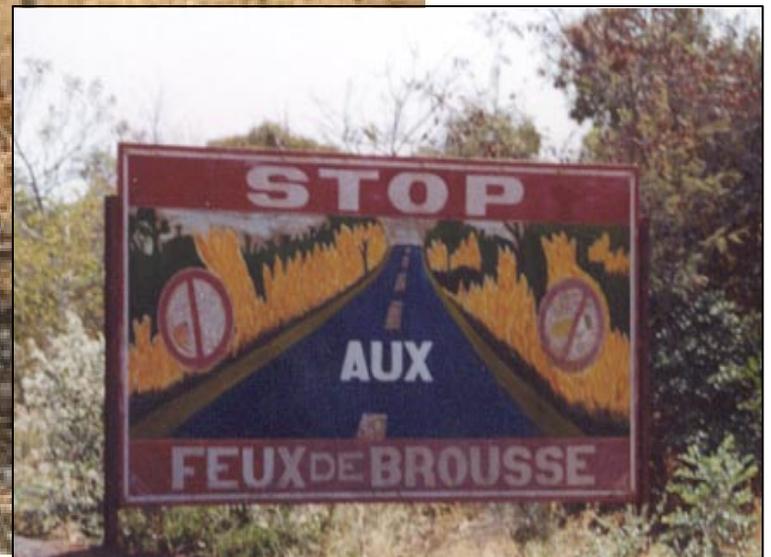
Methods:

Comparative analysis of two sites

- (i) Satellite Image Analysis
- (ii) Interviews and Focus Groups

Policy: Fire Suppression

When we tried that, the fire jumped the Niger River and burned all the way to la Guinea!



Practice and Logic



“Bin be and a jeni waati.”
Every grass has its
(appropriate) time to burn

Photo by
C. Strawn 2005



Un-Burned Patch

Burned Patch

Early-Burned Patch

Laris 2002

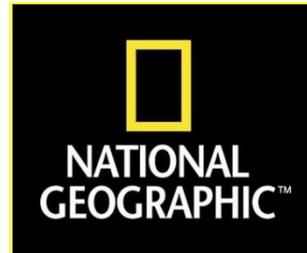


Video Clip

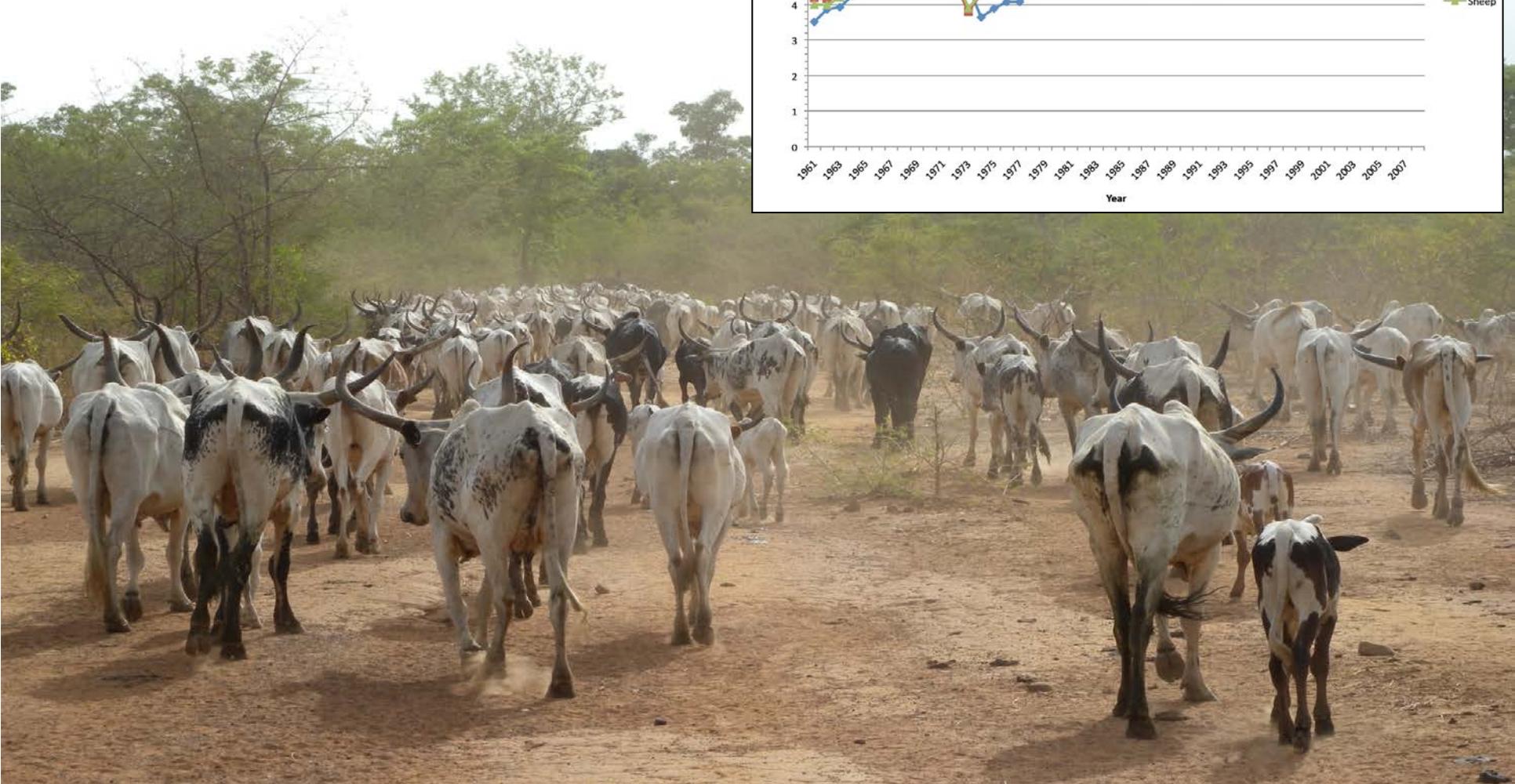
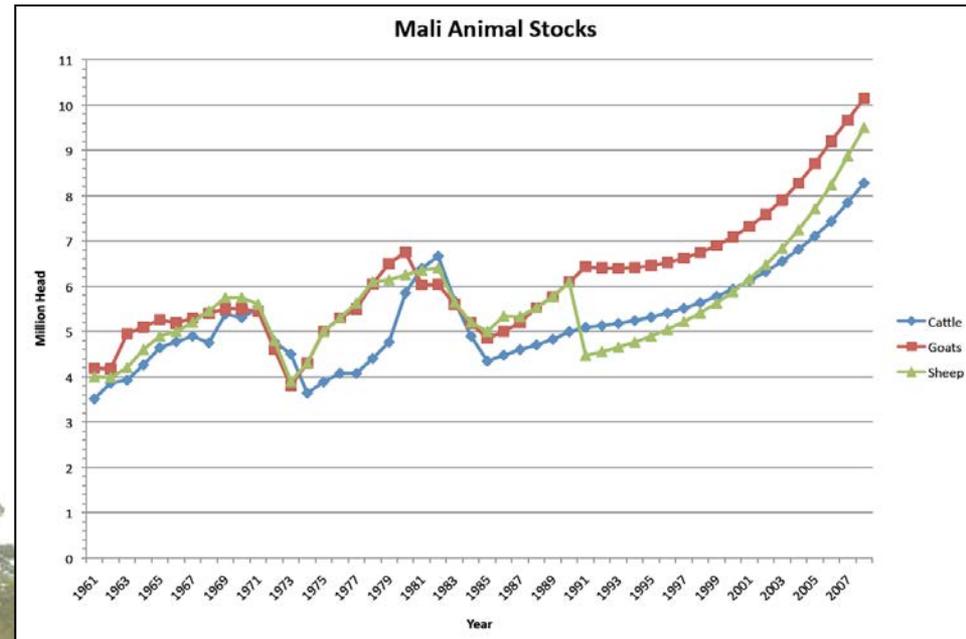
Early fire/

Hot fire

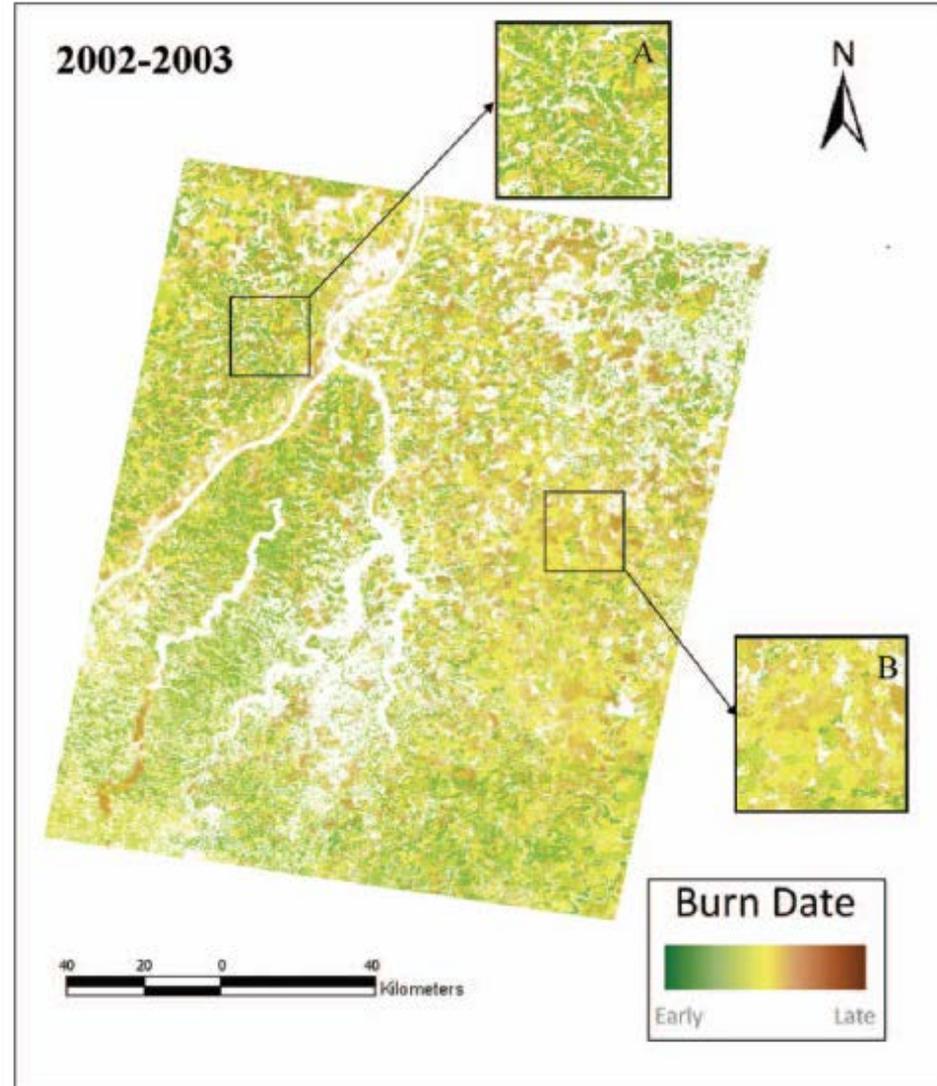
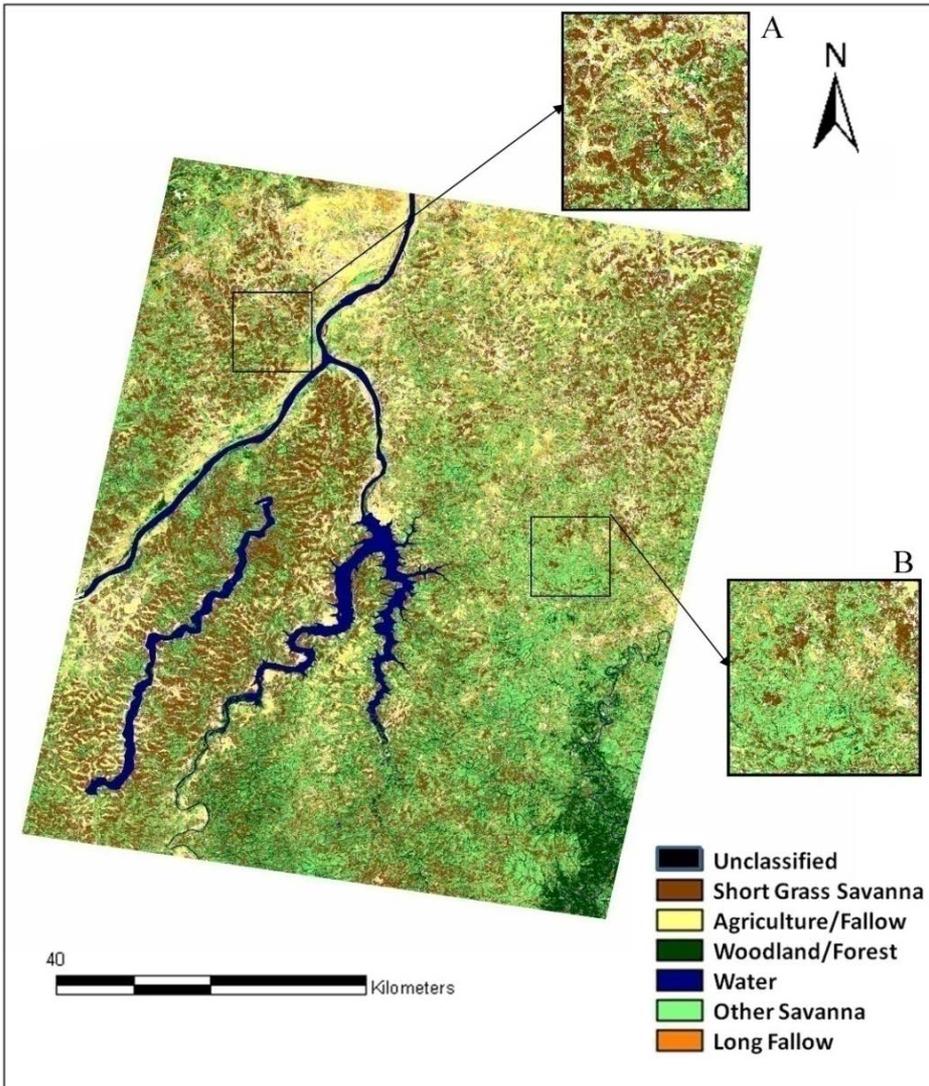
SPEAKERS!



Land Use?



Vegetation Cover & Fire Regime

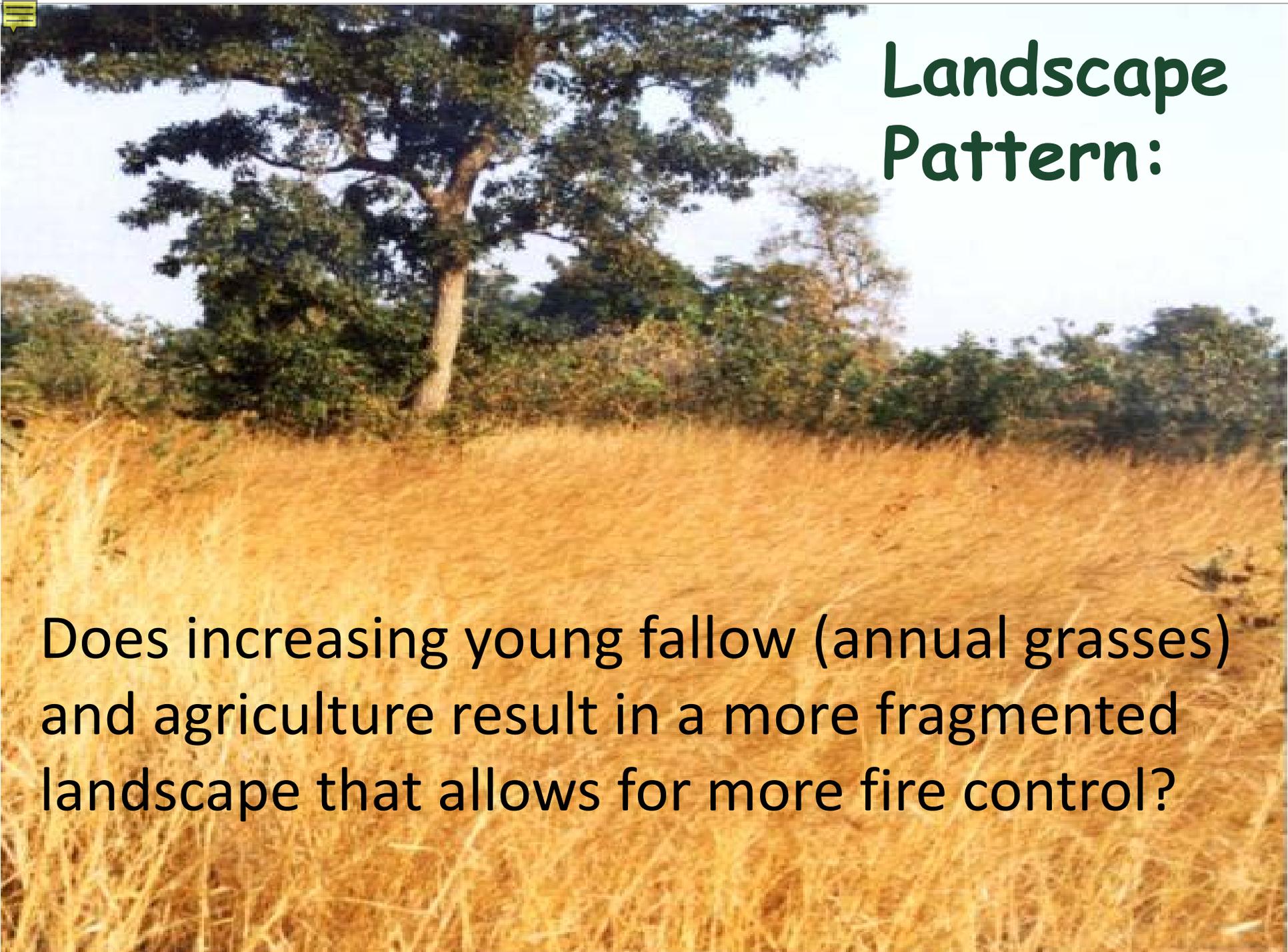


Survey and Imagery Results

Image Analysis Results

Survey Results

Average Burn Date	Area Burned (%)	Fire Type	Vegetation Type	Rural Calendar	Common Reasons To Burn
11/18/2002	17.56	Very early	Short Grass Savanna	Peanut Harvest	Protect against late fires, separate landscape to clear paths and form firebreaks , prepare hunting grounds, protect trees, regenerate pasture, eliminate pests
12/12/2002	8.09	Early	Short Grass Savanna & Fallow	Millet Harvest	
12/28/2002	15.8	Early	Fallow Lands	Harvest End	
1/21/2003	10.54	Late	Woodland/Forest	Cool Season	Hunt, clear grasses and pests to promote wood cutting or gathering, accidents, unknown
2/22/2003	4.91	Late	Woodland/Forest	Hot Season	Hunt, field preparation, accidents, unknown cause

A photograph of a savanna landscape. In the foreground, there is a field of tall, dry, golden-brown grasses. In the middle ground, a large, mature tree with a thick trunk and a dense canopy of green leaves stands prominently. The background shows a line of smaller trees and shrubs under a clear sky.

Landscape Pattern:

Does increasing young fallow (annual grasses) and agriculture result in a more fragmented landscape that allows for more fire control?

Land in agriculture near Bougouni

Bougouni Area Agriculture 1975

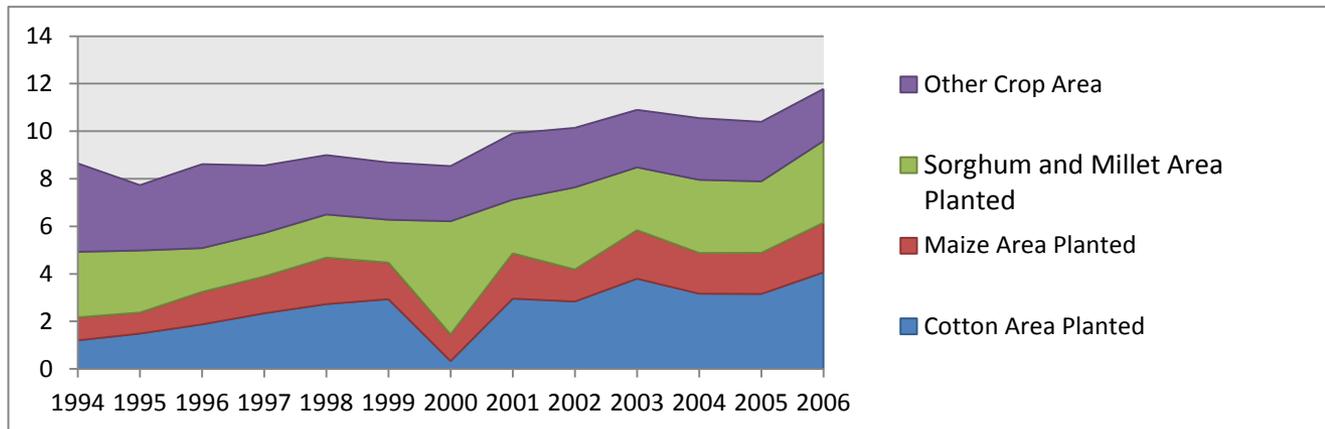
Bougouni Agriculture 1988

Bougouni Area Agriculture 2006

1975

1986

2006

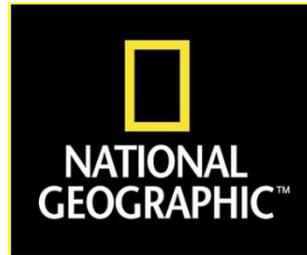


Source: Laris and Foltz 2011



Video Clip

Farmer reaction to fire



Koori be jeni i na fo essanci!

Cotton burns like gasoline!

--Bougouni Farmer 2011





Summary of Key Findings

- **Policy**

- Suppression policy did not result in fewer fires and the immediate (short term) impact was a shift to later, more contiguous fires.
- Longer term impact has been a hesitancy to set early fires and a lack of organized burning (a change in practice), and a **fear** of setting fires.

- **Practice and logic of burning**

- The common practice remains to set fires to dryer uplands early to fragment the landscape but,
- there is less early burning of fallow lands in part due to fear of damage to cash crops and in part due to lack of organization and common practice



Summary of Key Findings

- **Land Use**

- Differences in land use do not explain the variation between the two study areas shown; however,
- changes in land use have impacted practices of burning as a result of increased cash cropping.

- **Vegetation Cover Pattern**

- Vegetation cover is the main determinant of fire regime and explains the key differences in spatio-temporal patterns observed, but
- vegetation cover is also function of land use which will change over time perhaps reaching a threshold when agricultural pattern impacts fire.



Conclusions and Applications

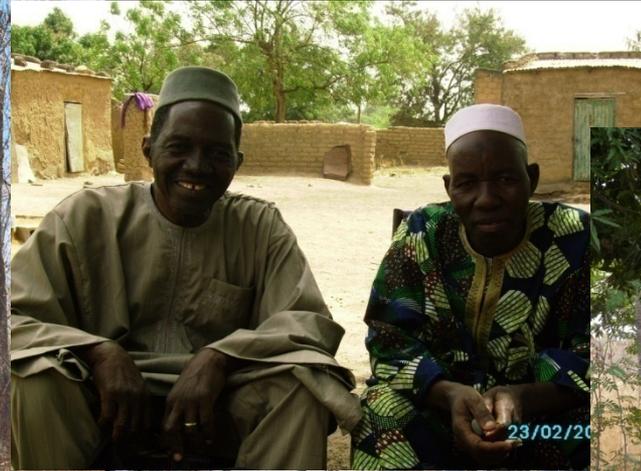
- Fire regimes are linked to vegetation patterns which are a function of natural patterns and land use. As land use intensifies, fire patterns should eventually change.
- Fire policy legacy and a shift to cash crops has had an impact on the burning regime in some areas (perhaps countering the above).
- A need to work with organizations in village clusters to develop and map desired early burning strategies
 - The lack of early fire is a problem resulting in too much uncontrolled late-season fire
 - A fear of setting fire on fallow lands
 - Agreement that organized burning (at the level of the village clusters) would help them manage fire

Fire is a good slave but a bad master!



Photo by Cullen S

Thanks to all of those people in Mali and elsewhere who made the research possible



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Changing Agricultural System



Less hand farming



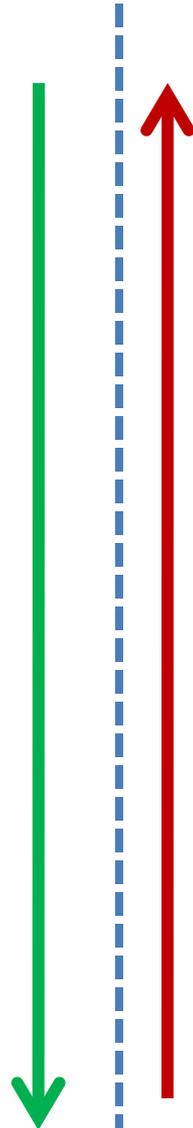
More permanent cropping with maize and cotton



Shorter fallow periods and less rotation



More use of plows, fertilizers and herbicides



Tall Perennial Grasses



How and why do fire regimes change in Southern California?

Biophysical Causes

Human Causes

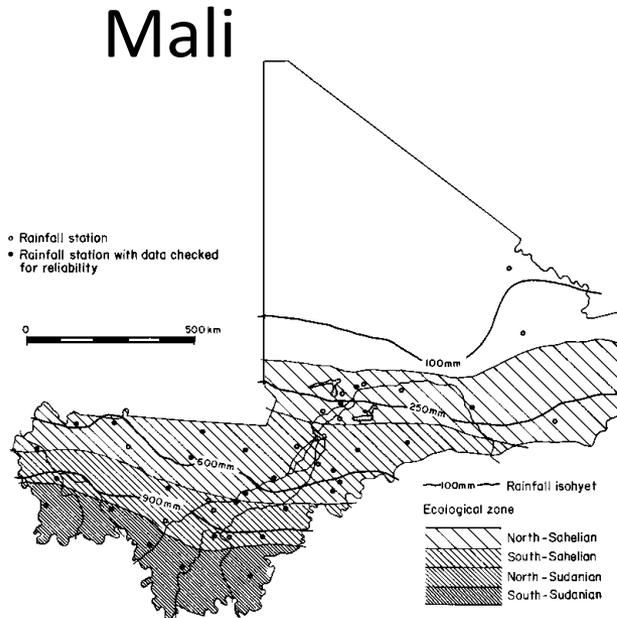


- Climate/weather
- Landscape Pattern Change

- Population Density Change
- Policy Change



Savanna Belts



(West Africa)

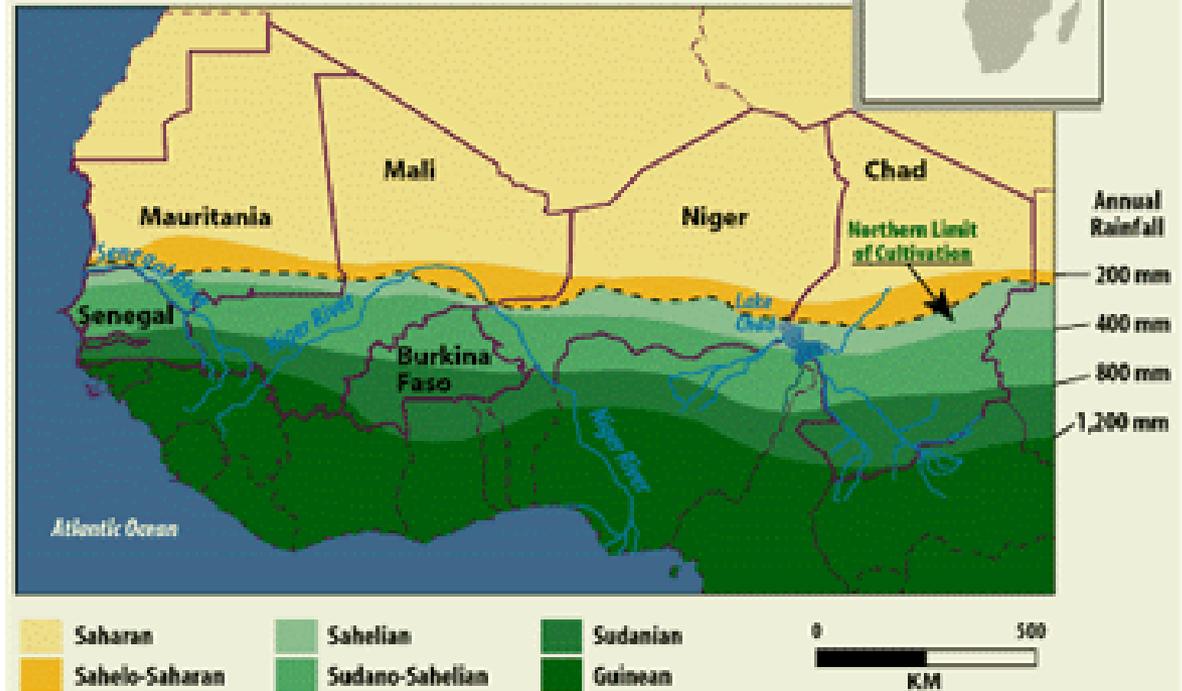


Figure 1

Source: FEWS
FEWS, June 1997

Sahara < 200 mm

Sahel 200 – 400 mm

Sudano-Sahelian 400 – 800 mm

Sudanian 800 – 1200 mm

Guinean > 1200 mm



Disturbance Regimes

Fire Regime—

The frequency,
intensity (timing),
type and pattern of
fire



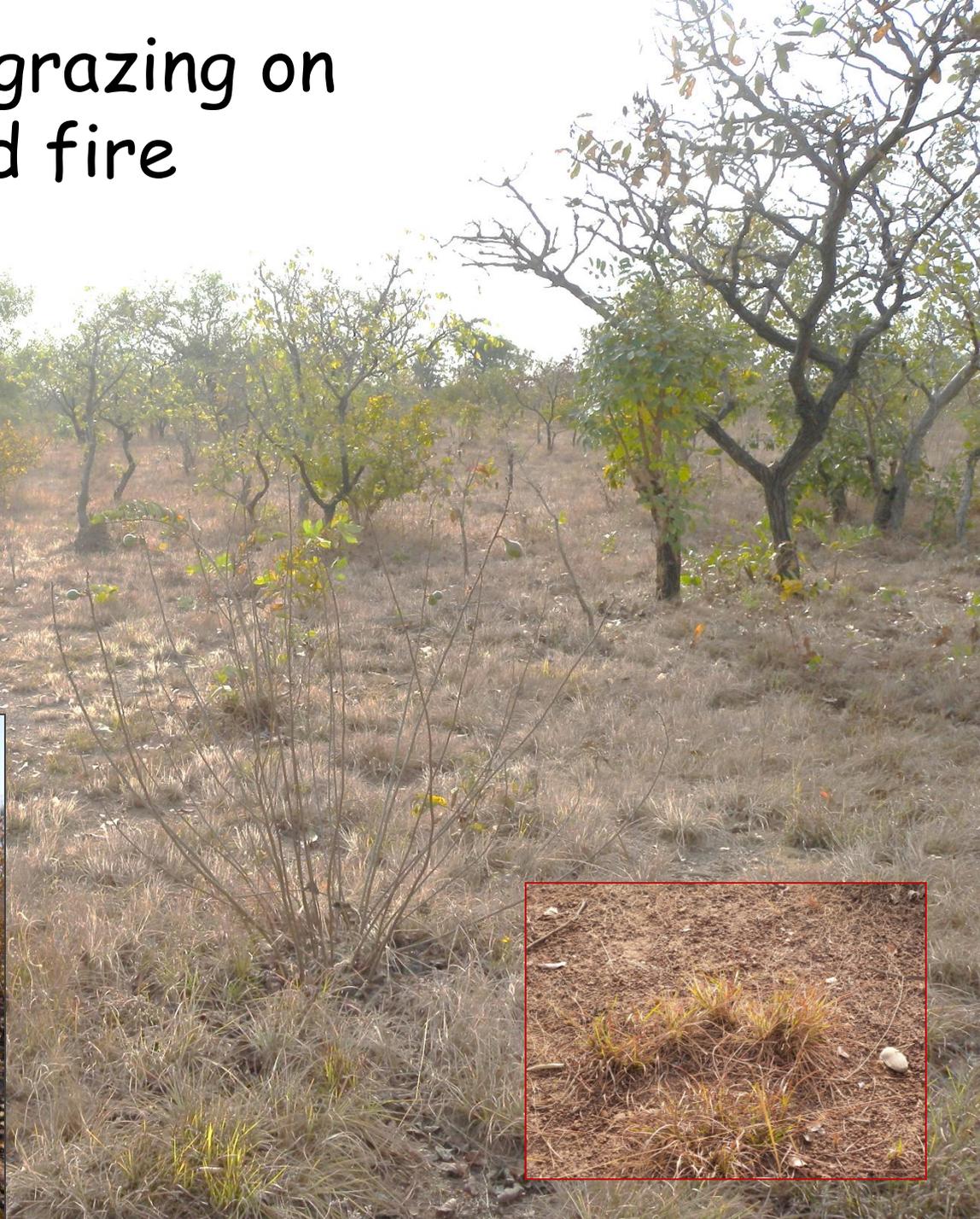
A “Humanized” Burning Regime

Q: Why do people burn when and where they do?



Landsat ETM image, 2002

Impact of grazing on grasses and fire





How and why do fire regimes change?

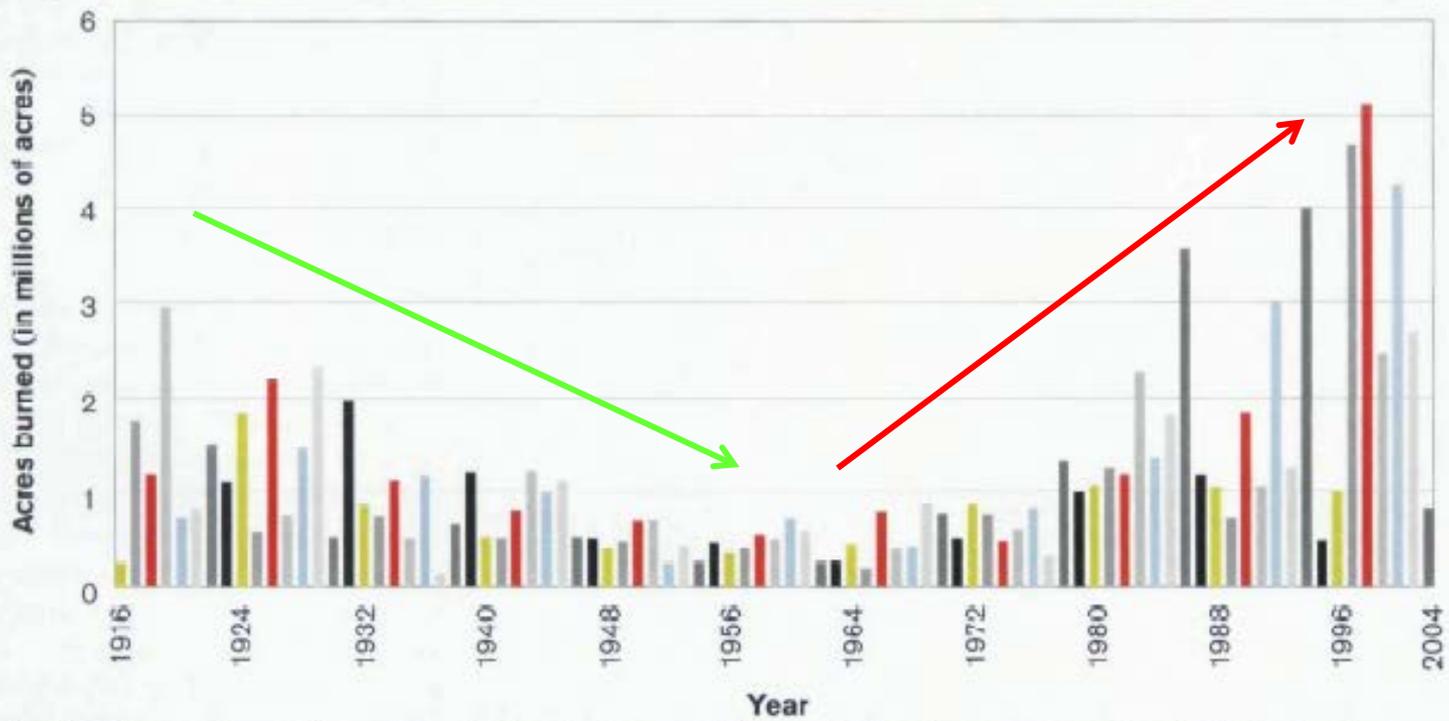
Biophysical Causes

Human Causes

Climate/weather

Policy Change

Figure 1. Acres lost to wildfire in the western United States, 1916-2004



NOTE: The area burned in western wildfires has increased in recent decades as suppression efforts become less effective. The values above are sums of totals from the 11 states west of Colorado's eastern boundary.

SOURCE: Data for 1916 through 2004 were compiled from a variety of sources by Anthony L. Westerling of the Climate Research Division of Scripps Institution of Oceanography (University of California-San Diego) and used by permission.