# *Spatial and Temporal Variation of the Fire Regime in Mkuzi Game Reserve, KwaZulu-Natal*

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Conservation, Partnerships & Ecotourism

# Introduction

- Fire is a key determinant of savanna dynamics and is an important management tool in Mkuzi Game Reserve
- Objectives of using fire include:
  - ensuring fodder flow to large herbivores by removing moribund grass material
  - reducing woody plant encroachment
  - reducing the risk of accidental or arson fires that may threaten the survival of plant species or destroy the composition or structure of a priority vegetation community
  - maintaining or improving biological diversity by promoting vegetation heterogeneity (through applying point-source ignition burning)

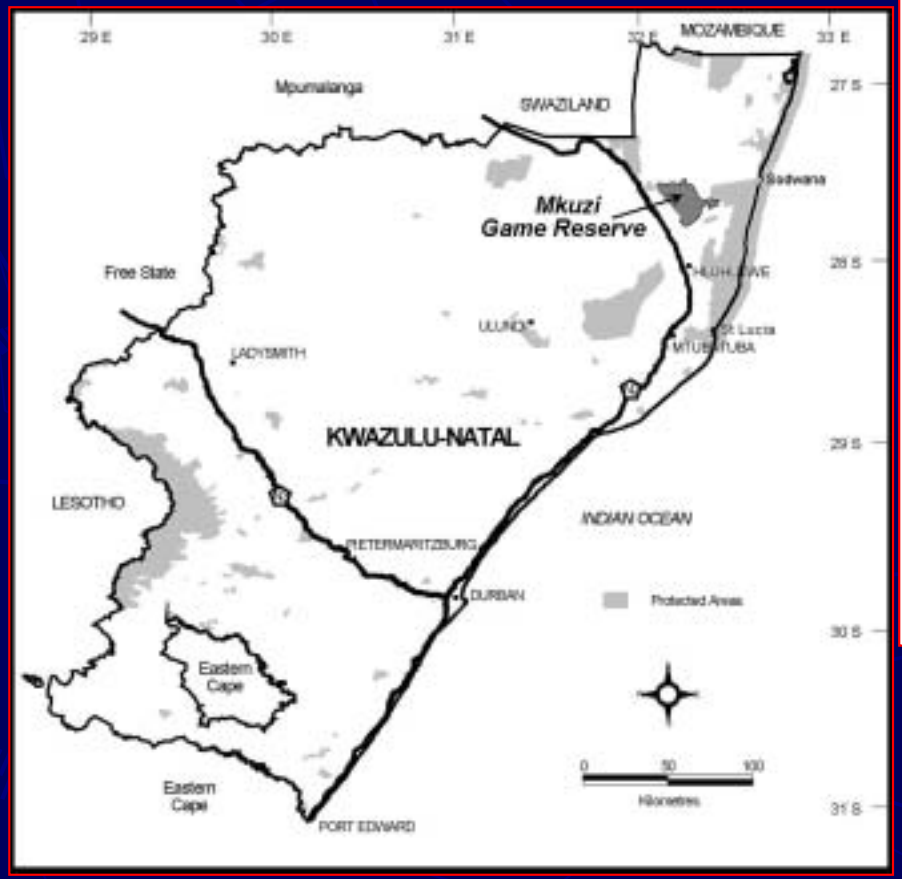
# Objectives

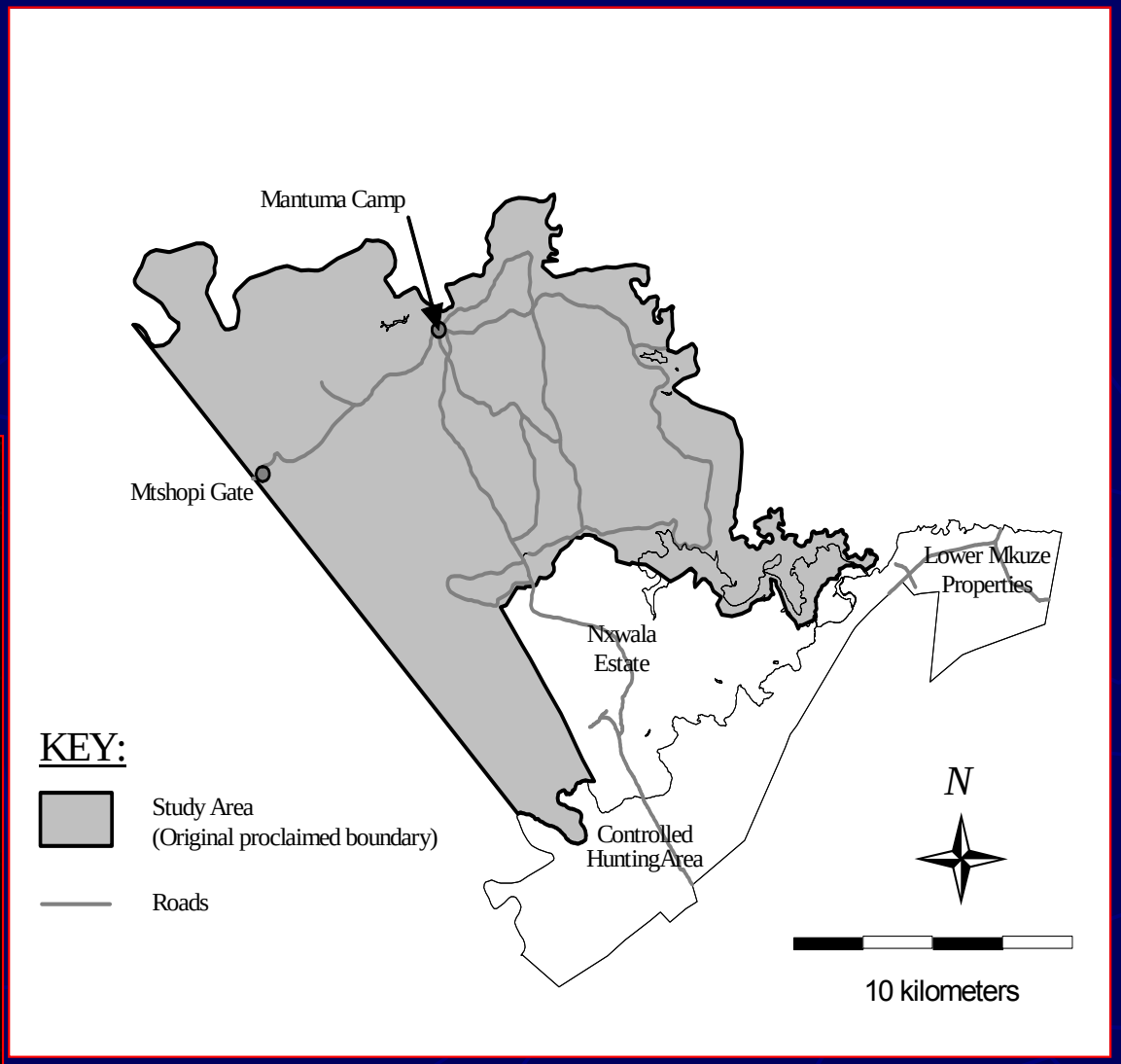
- Using Geographic Information Systems (GIS), describe the spatial and temporal variation in the fire regime of Mkuzi Game Reserve from 1963 to 1999.

- Determine the difference in fire patterns between the block burning and point source ignition (PSI) burning strategies

# The Study Area

- Semi-arid Savanna
- MAR of approx. 650 mm
- Wet season (all months with >50 mm rain) is from Oct to Mar

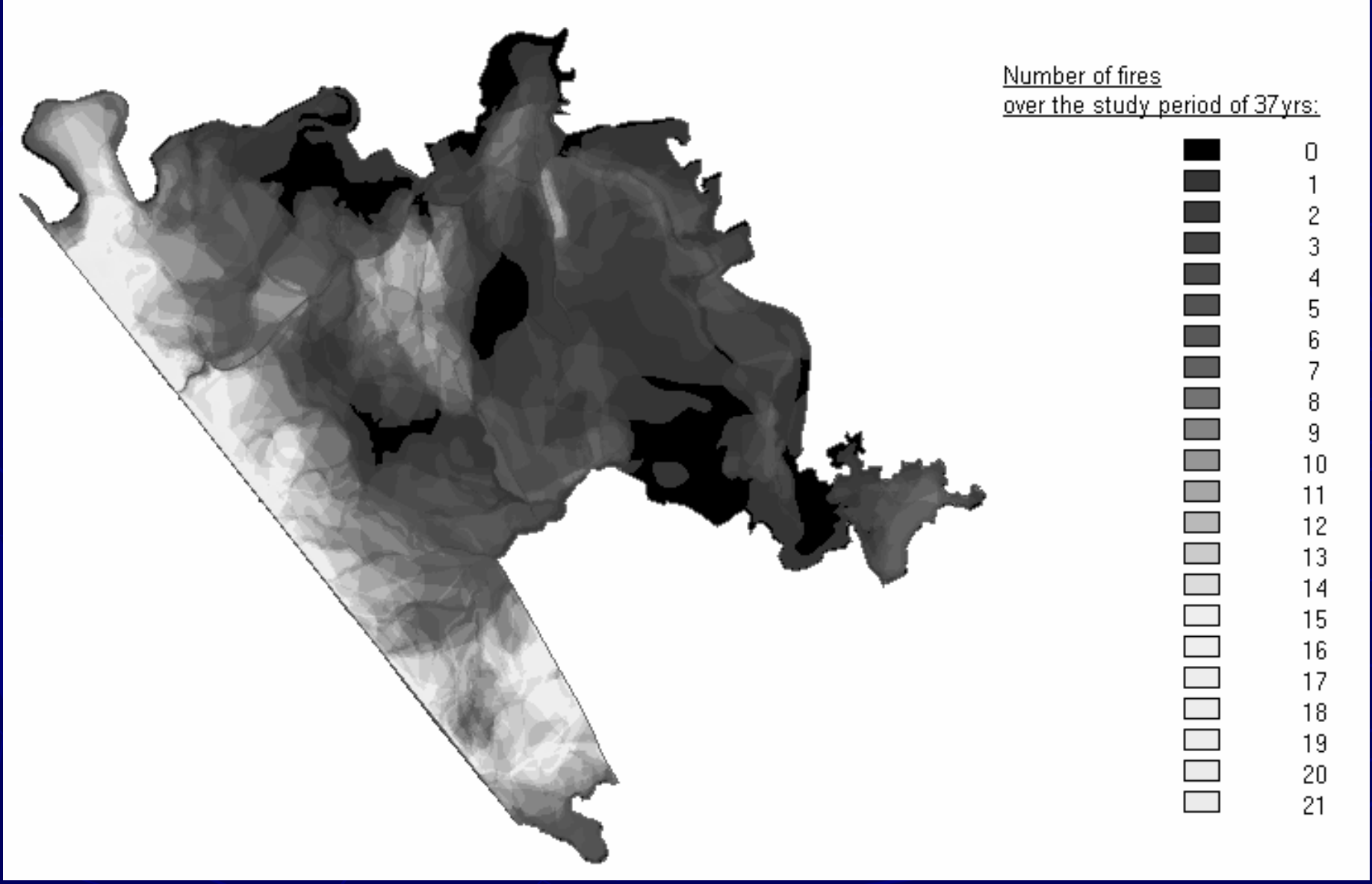


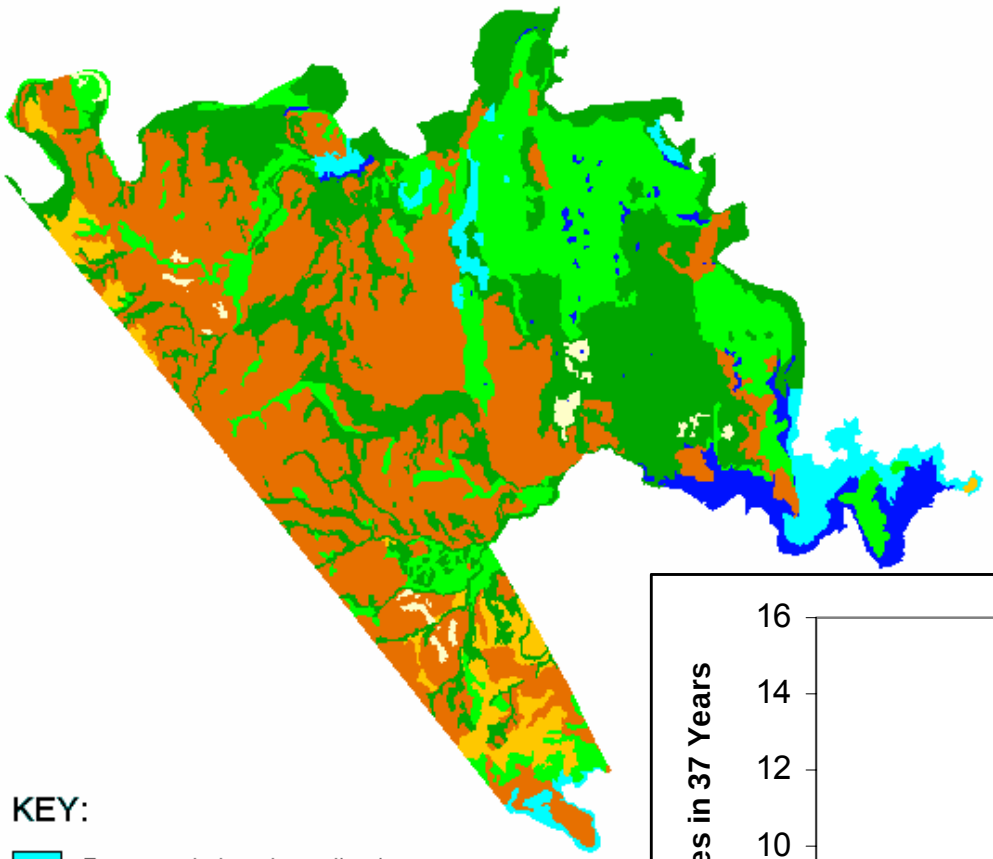

- Mean annual temperature: 23.2 $^{0}$C

# *Spatial Patterns of Fire*

# Fire Frequency Map

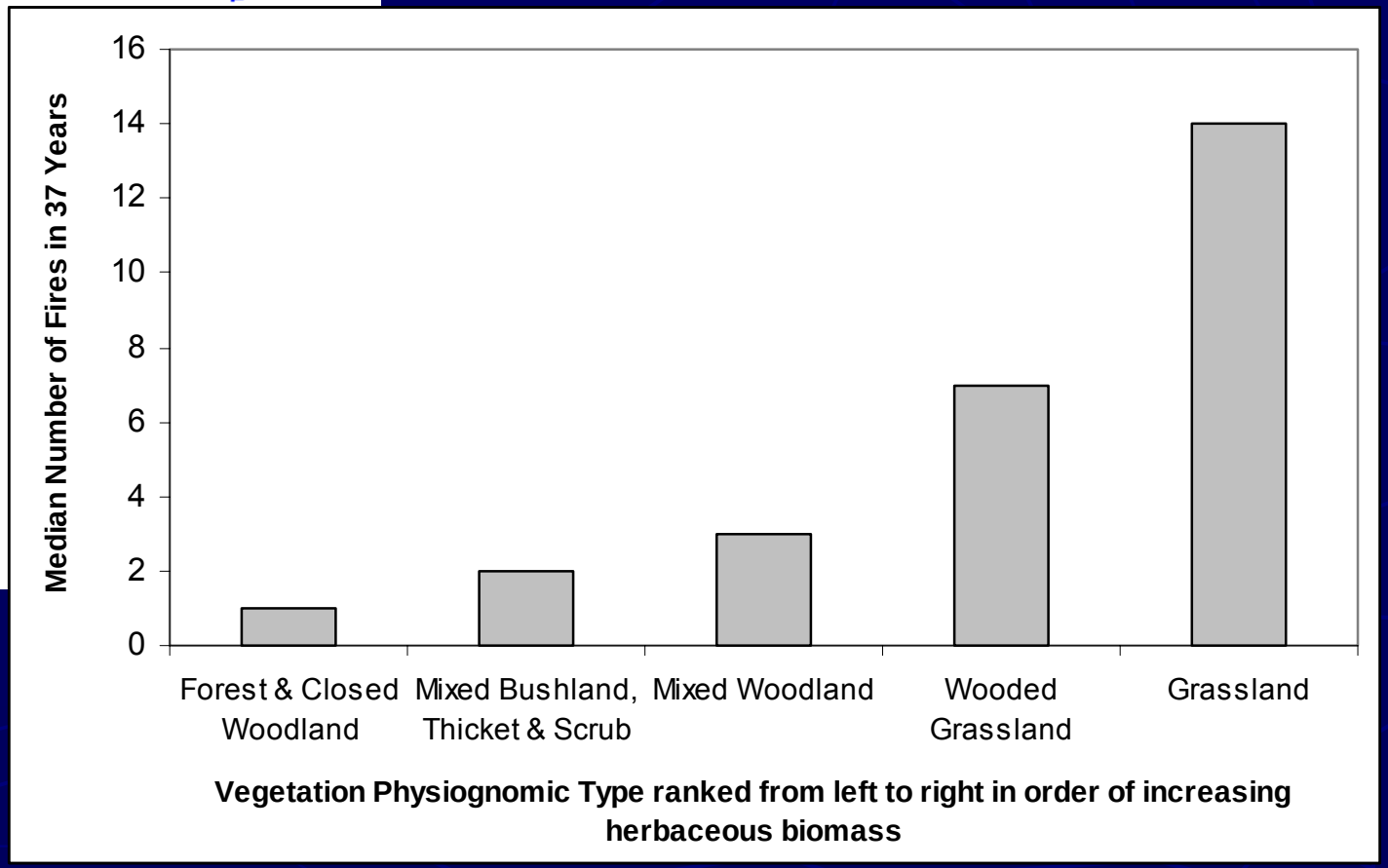


# Fire Frequency in Relation to Vegetation

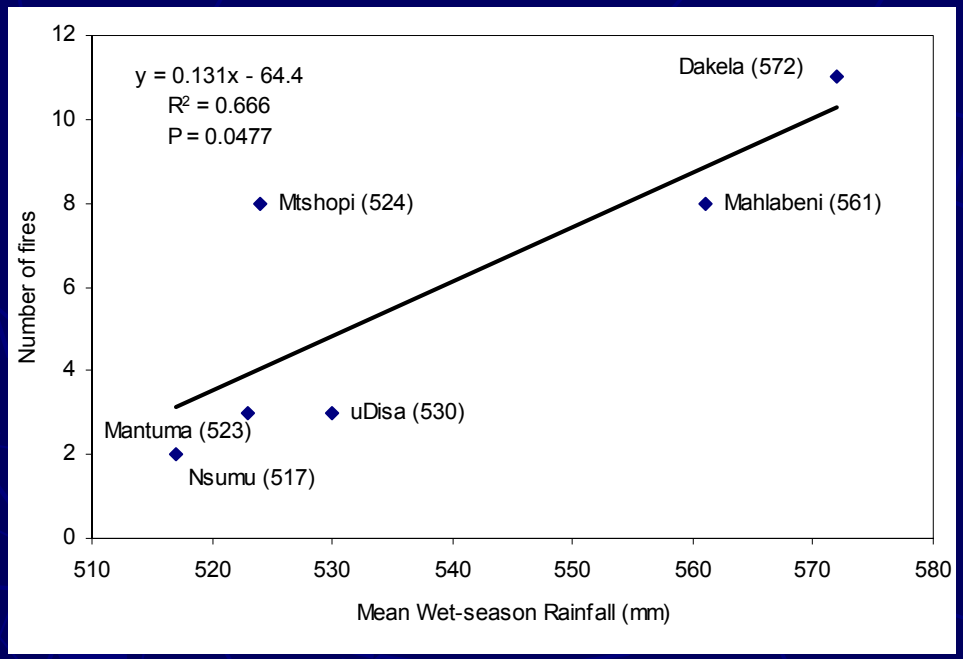


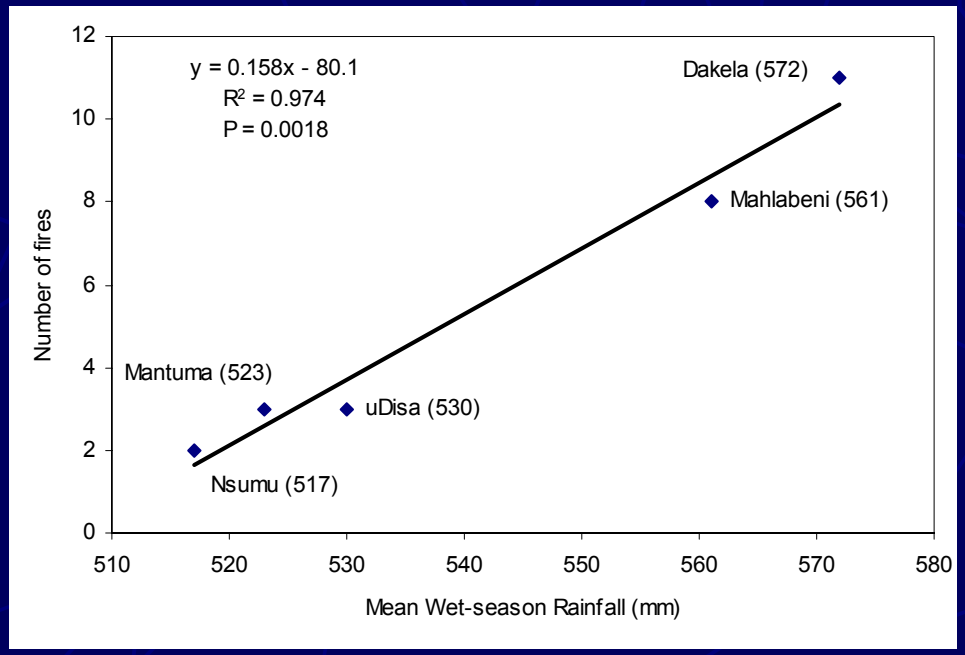
KEY:

- Forest and closed woodland
- Mixed Woodland
- Mixed Bushland
- Mixed thicket and scrub
- Wooded grassland
- Grassland
- Wetlands

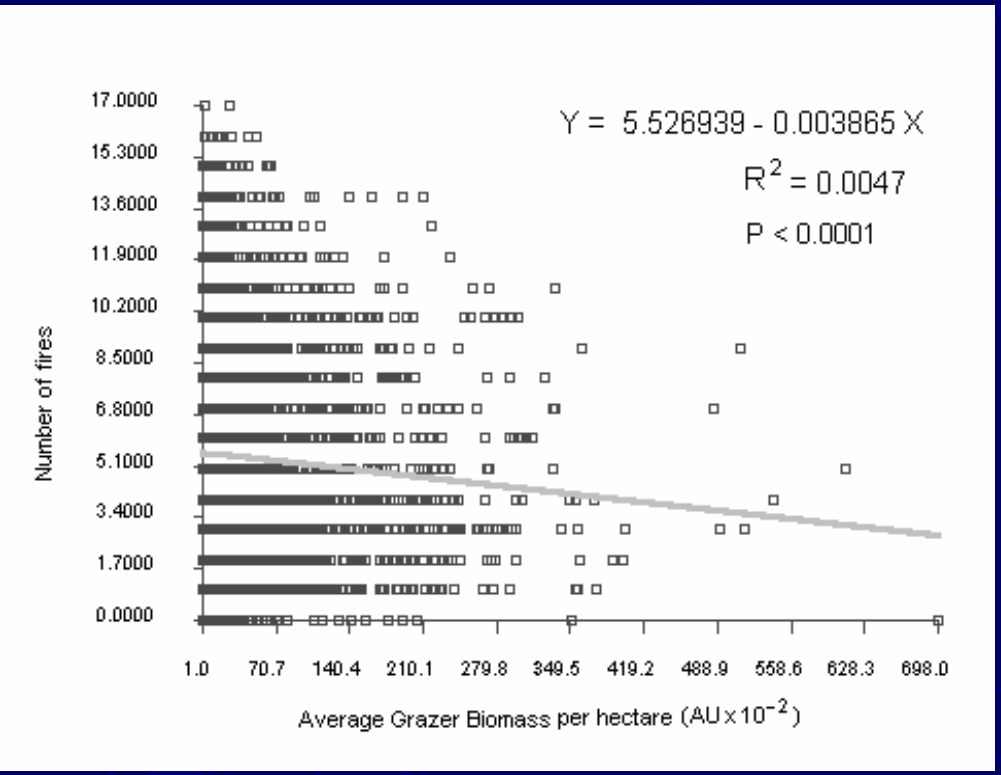


# Relationship between rainfall distribution and fire frequency

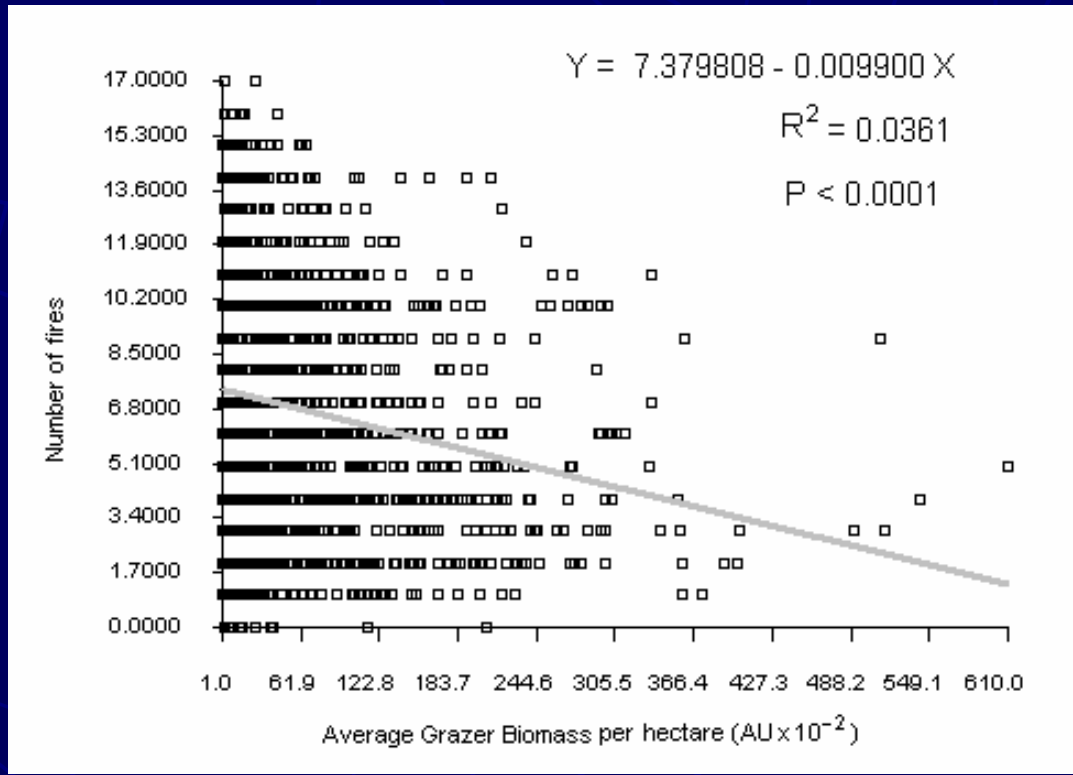


# Relationship between herbivore biomass and fire frequency

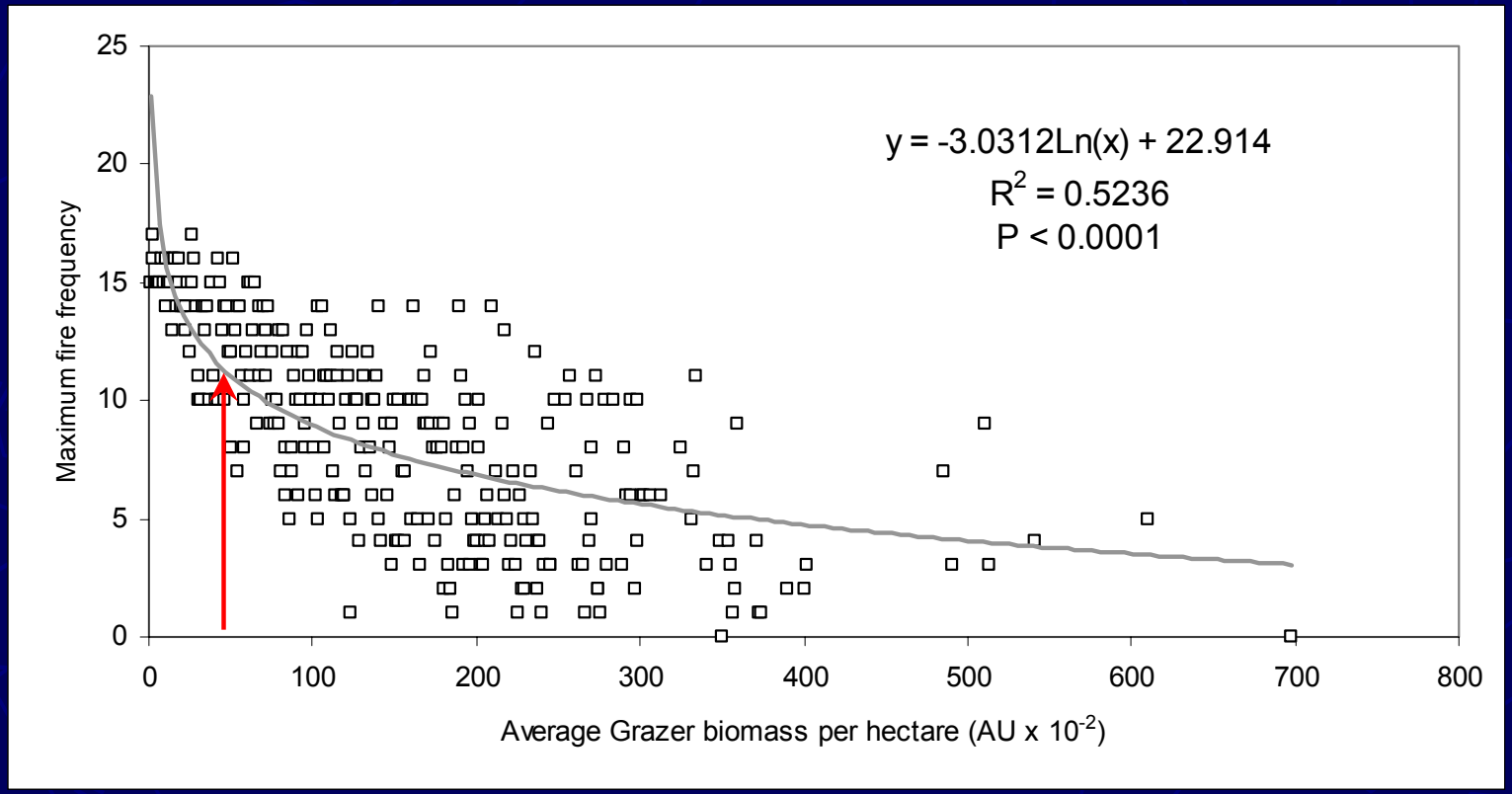



**All vegetation types**



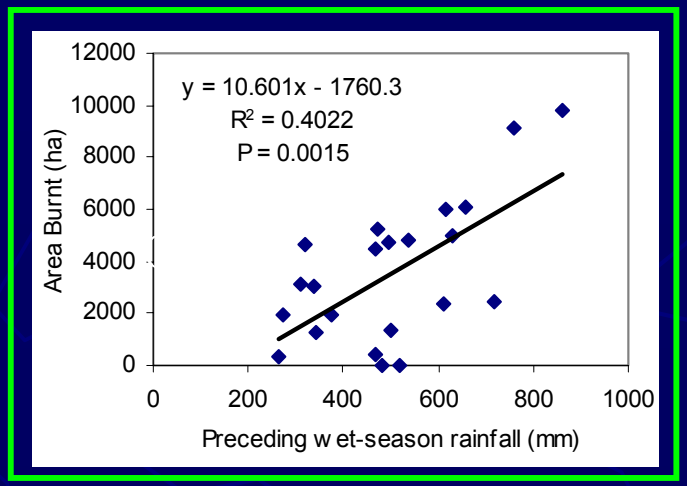

**Grassland & wooded grassland physiognomic types**

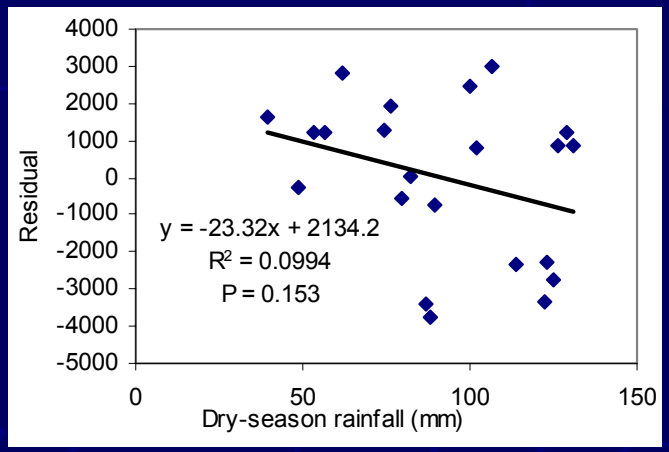
# Relationship between herbivore biomass and fire frequency



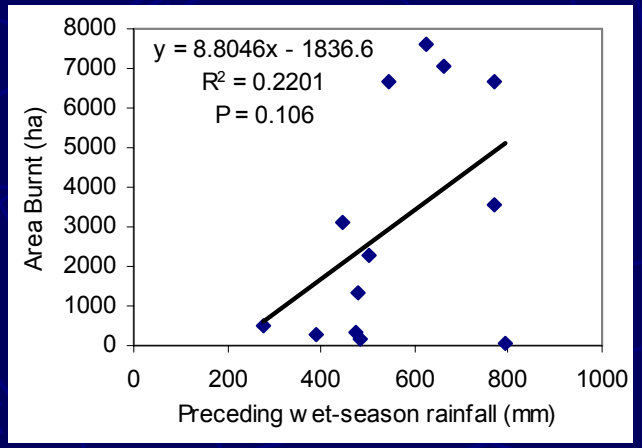
# *Temporal Patterns of Fire*

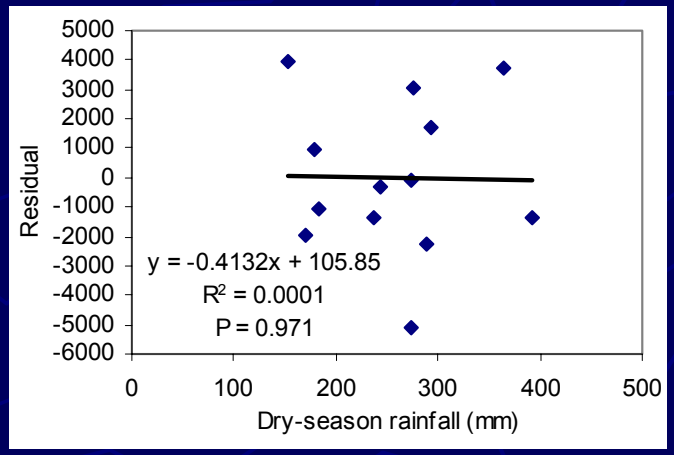
# Area burnt annually in relation to annual rainfall patterns



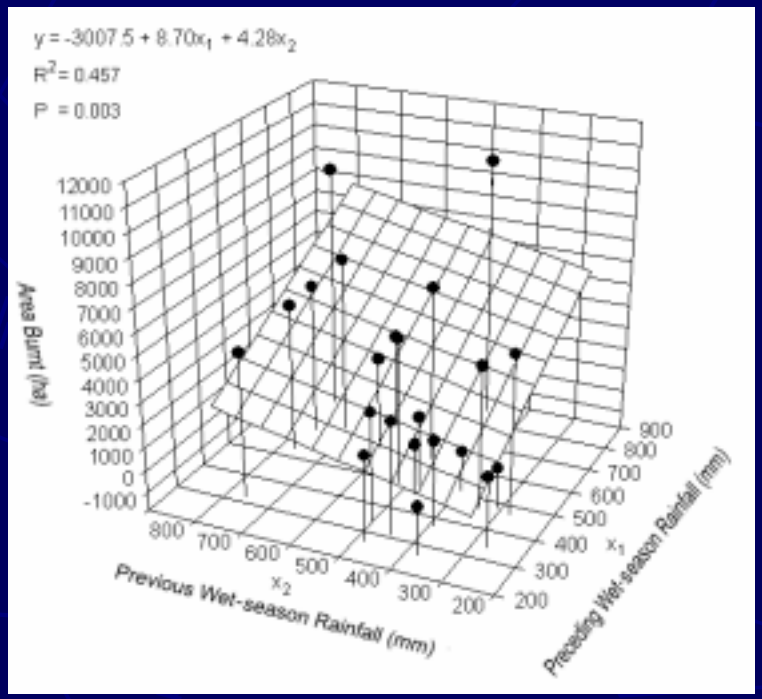

Dryer dry seasons



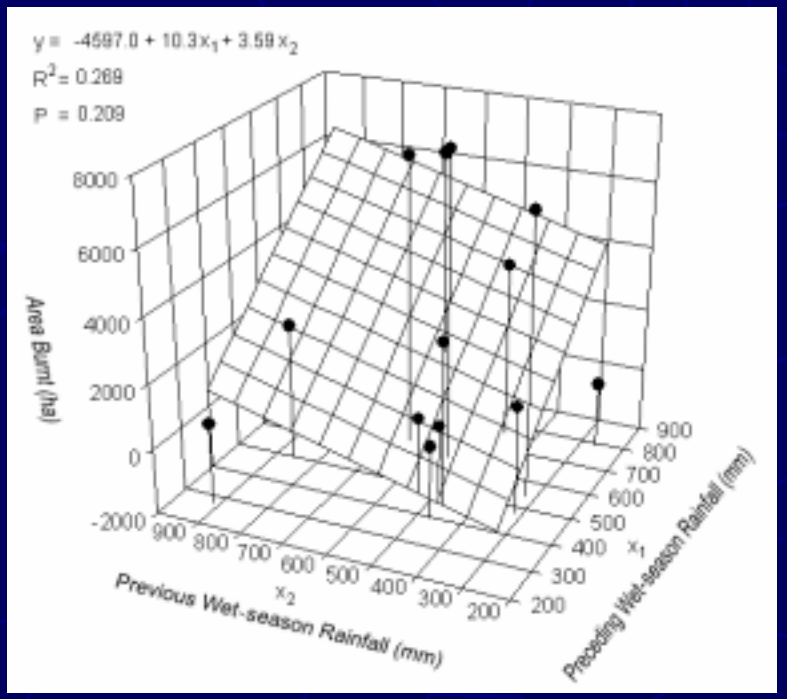




Wetter Dry Seasons

# Area burnt annually in relation to annual rainfall patterns

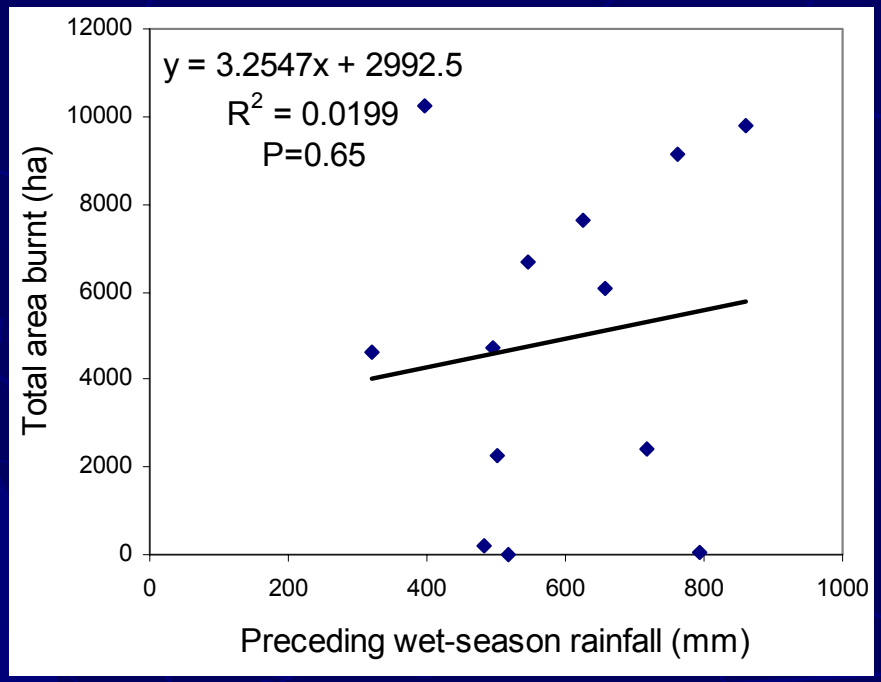


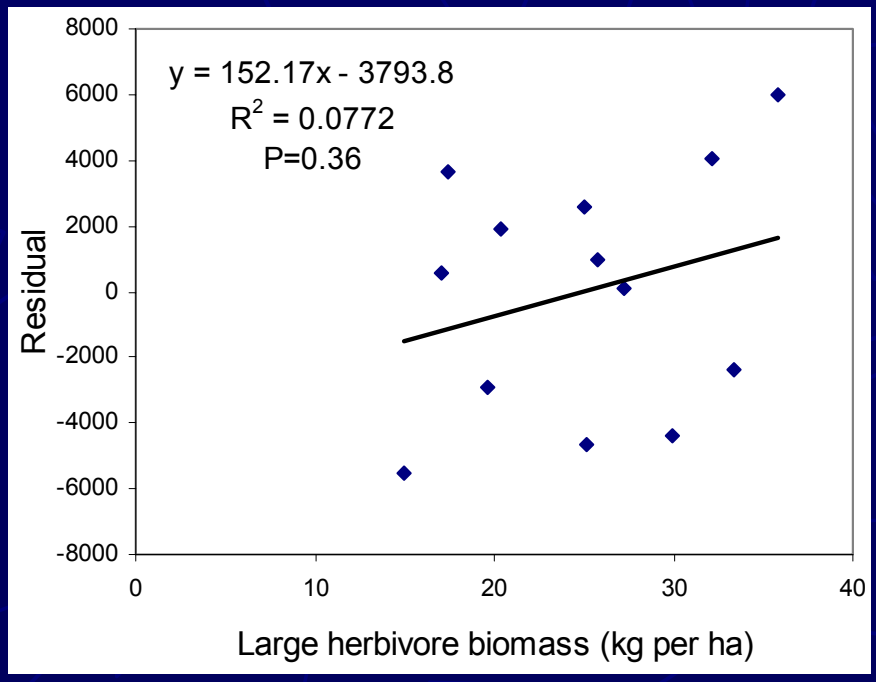

**Dryer Dry Seasons**




**Wetter Dry Seasons**

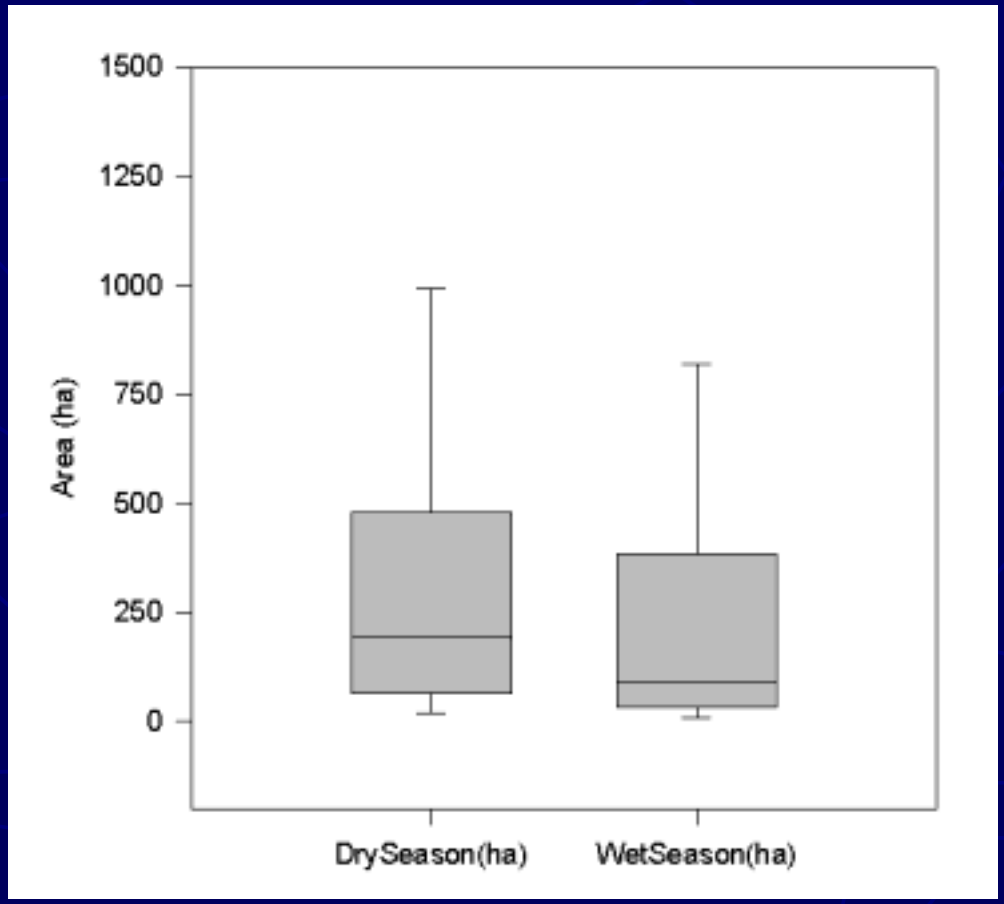
# Area burnt annually in relation to large herbivore biomass (grazers)



# Area burnt in relation to season of burn

**Comparison of individual burn sizes**



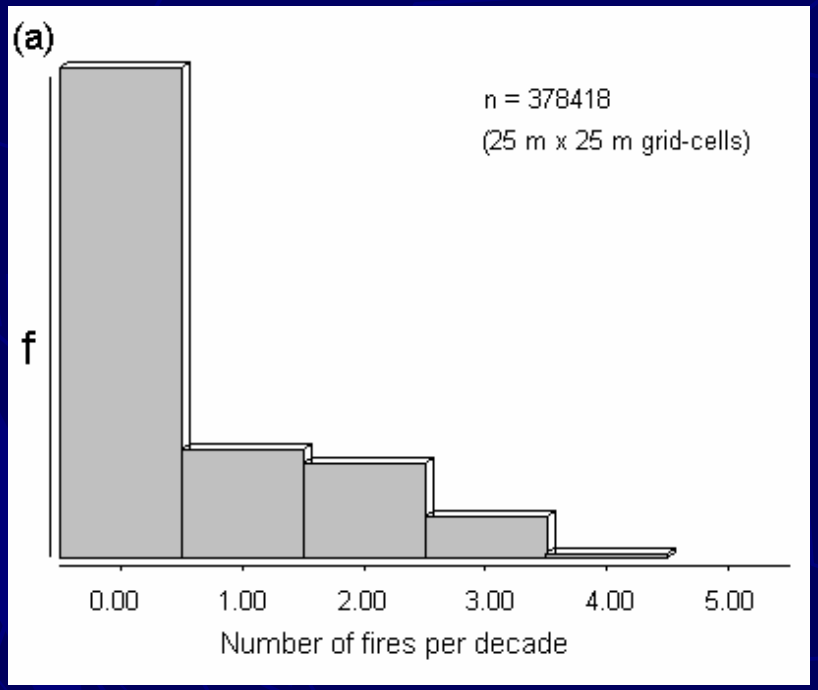

median=194.1ha median=89.4ha

P<0.04

# *Block Burning vs Point Source Ignition Burning*

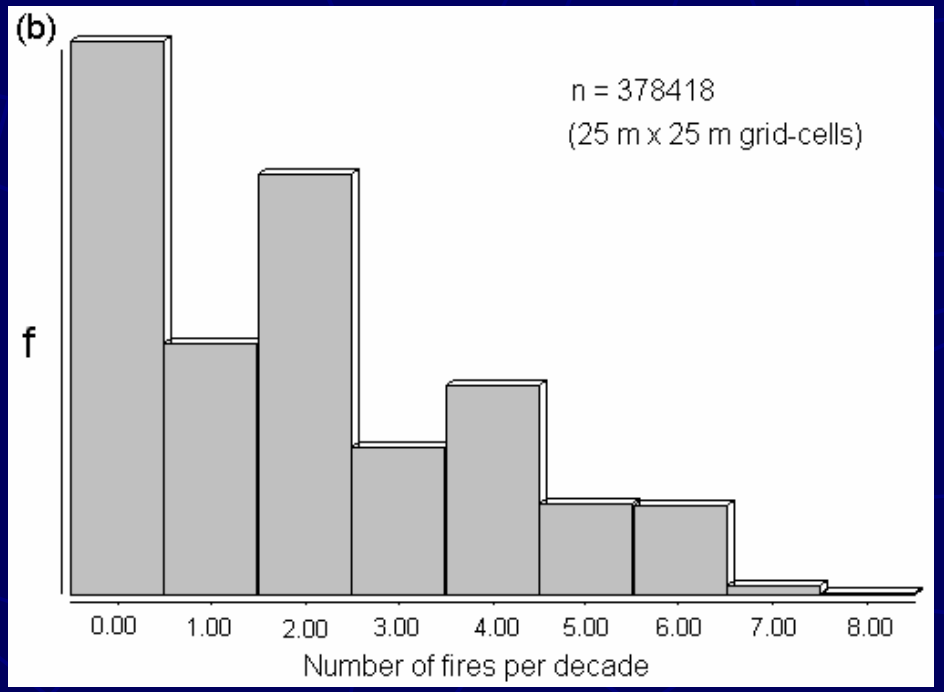
# Difference in fire frequency between Block & PSI burning strategies

**Block burning (1963-1984)**



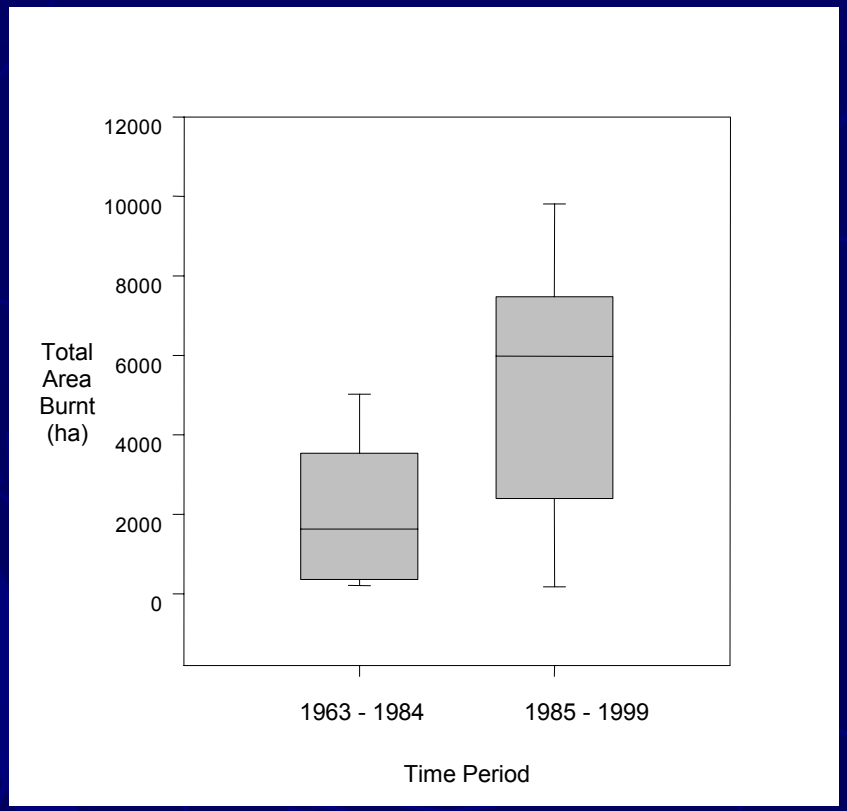

Median = 0.5

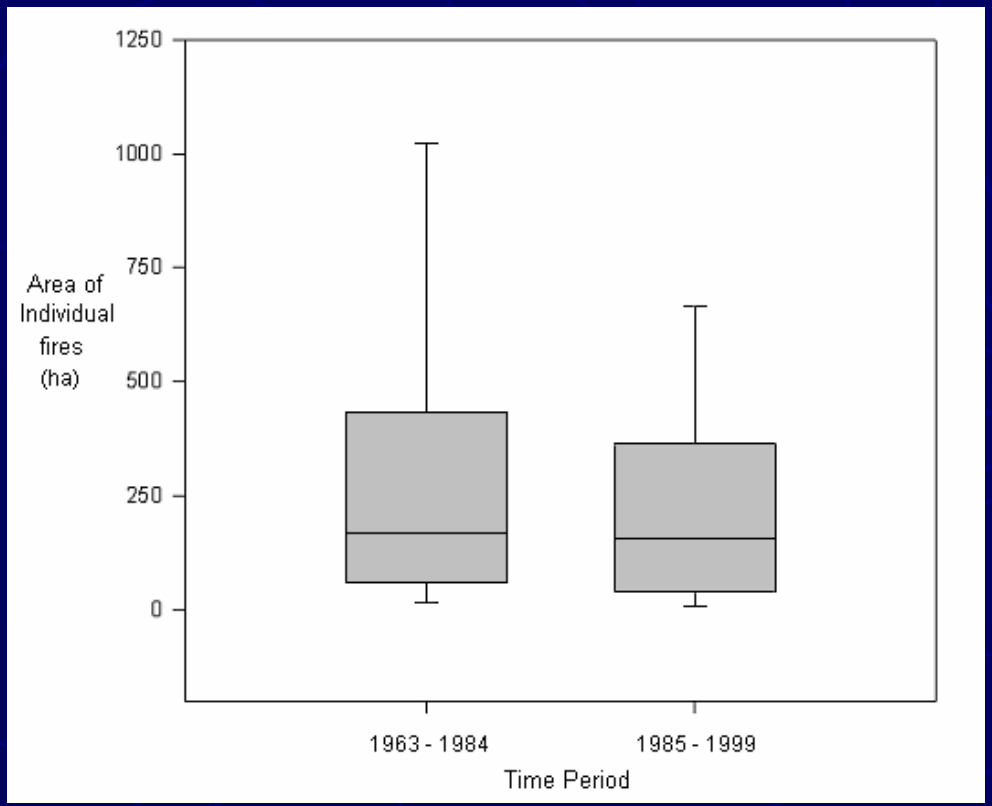
**Point source ignition (PSI) burning (1985 to 1999)**




Median = 2.0

# Difference in burn size between Block & PSI burning strategies



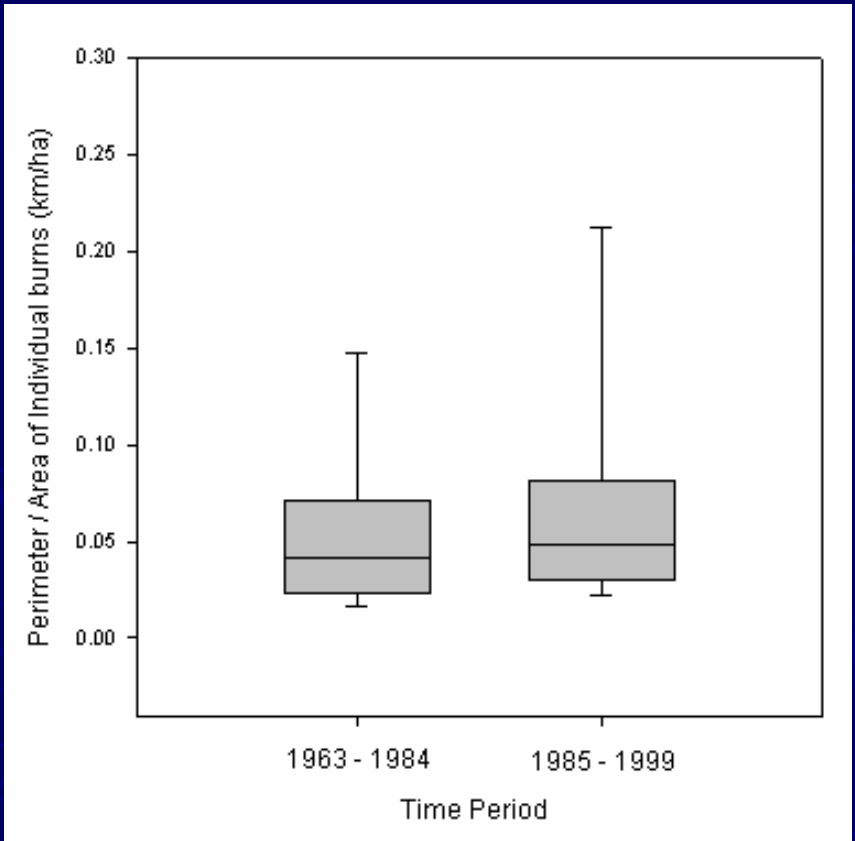

Median: 1 629 ha 5 976 ha

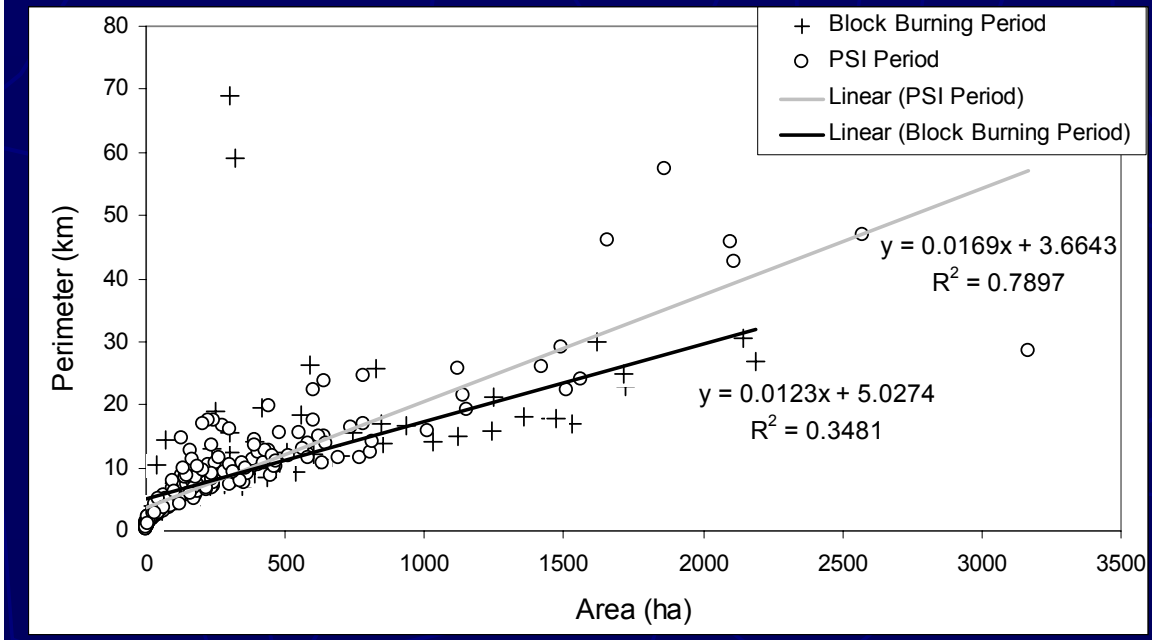
P<0.008

Median: 166 ha 155 ha

P>0.13

# Difference in geometric character of burns between Block & PSI burning strategies



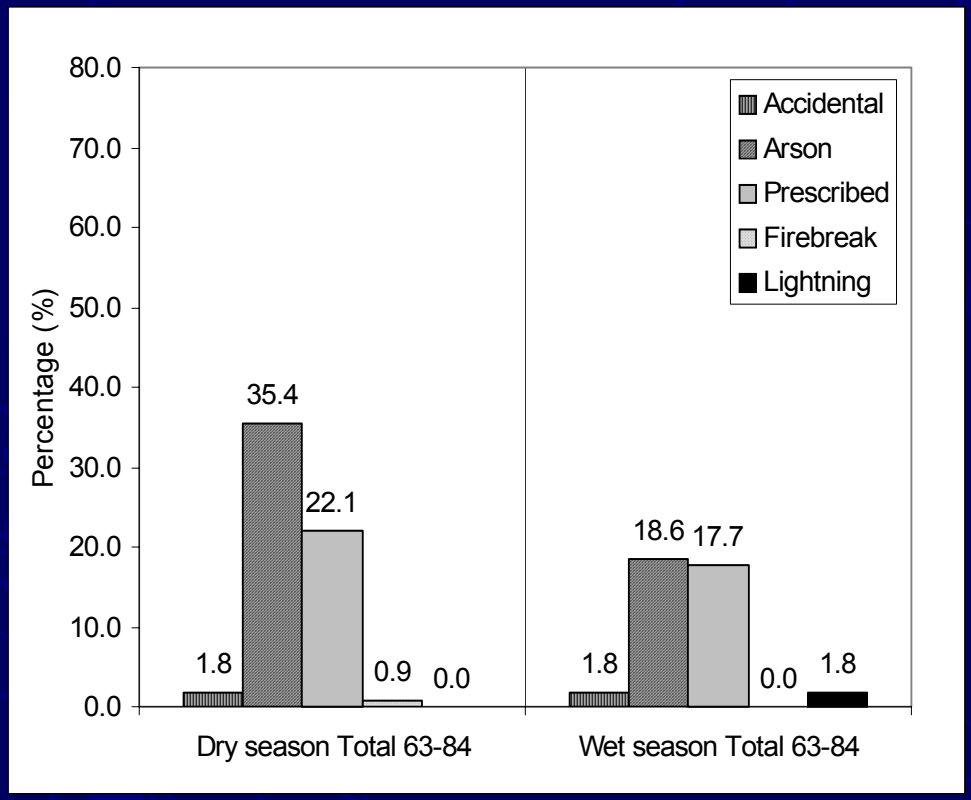




Median: 0.0415 km/ha 0.0480 km/ha

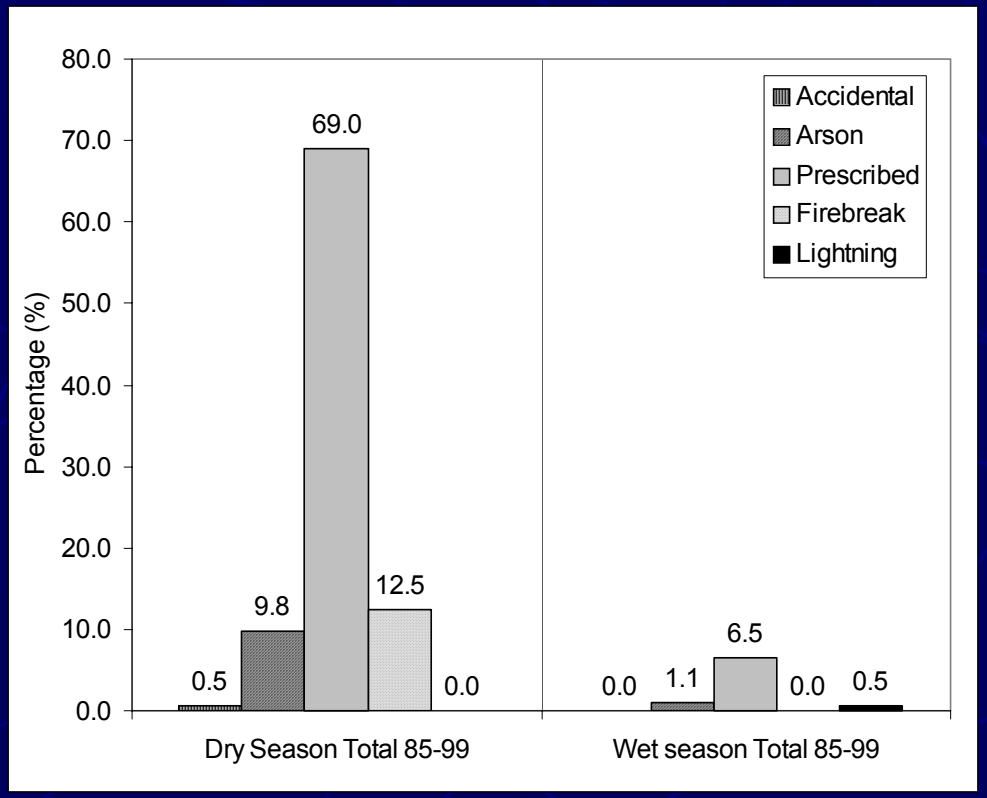
P<0.03

# Difference in seasonal distribution of burns between Block & PSI burning strategies

**Block Burning**




**Point Source Ignition Burning**



# Difference in burn intensity patterns between Block & PSI burning strategies

| Period | Intense | Clean | Patchy | Very Patchy | Total |
|---|---|---|---|---|---|
| Block Burning: 63 - 84 | 3 | 17 | 10 | 2 | 32 |
| Percentage | 9.38 | 53.13 | 31.25 | 6.25 | 100 |
| PSI: 85 – 99 | 39 | 58 | 52 | 6 | 155 |
| Percentage | 25.16 | 37.42 | 33.55 | 3.87 | 100 |

- No association between burning strategy and fire intensity, i.e. burning strategy did not influence the intensity of burns
- In each intensity class, proportions were not significantly different between Block & PSI burning

# Difference in importance of various barrier types between Block & PSI burning strategies

- Rank order of importance of barrier types:
  - **Block burning** - rivers and riverine vegetation > firebreaks and fencelines > roads and tracks (other vegetation, wetlands, other fires, and transects each contributed <5%)
  - **PSI period** - roads and tracks > rivers and riverine vegetation > other vegetation (transects, firebreaks and fencelines, wetlands, and other fires each contributed <5%)
- The contribution to barriers, with a change from block to PSI burning:
  - Increased for transects, roads and tracks, and other vegetation
  - Decreased for rivers and riverine vegetation
  - Remained unchanged for fire breaks and fencelines, wetlands, and other fires
- However, neither the combined contribution of management barriers nor of natural barriers changed !!!

# Conclusions

- Relationships known from a plot scale held true at a landscape scale,
  - where the amount and condition of herbaceous fuel were the key factors that affected fire patterns.

- Block vs PSI Burning – Fire patterns show that objectives of PSI burning have only partly been achieved.

# Recommendations and Implications for Management

- Effort to implement prescribed burns must be maintained and arson/accidental fires should be treated as per the reserve management plan.
- Preceding wet season rainfall, herbivore population estimates & available herbaceous fuel (formal assessment of fuel load) must be taken into account when formulating annual burning plans
- PSI Implementation:
  - Apply more early dry season burns
  - Re-ignite fires on opposite side of artificial barriers such as roads & tracks when fires have burnt out against them
  - Refrain from igniting fires directly alongside roads and tracks
- Continue monitoring of fires, but methods could be improved e.g. use satellite imagery to determine extent & severity of fires

# Acknowledgements


- Ezemvelo KZN Wildlife
- Prof Tim O' Connor
- Dr Peter Goodman
- Management and Scientific Support Staff of Mkuzi Game Reserve


THANK YOU!