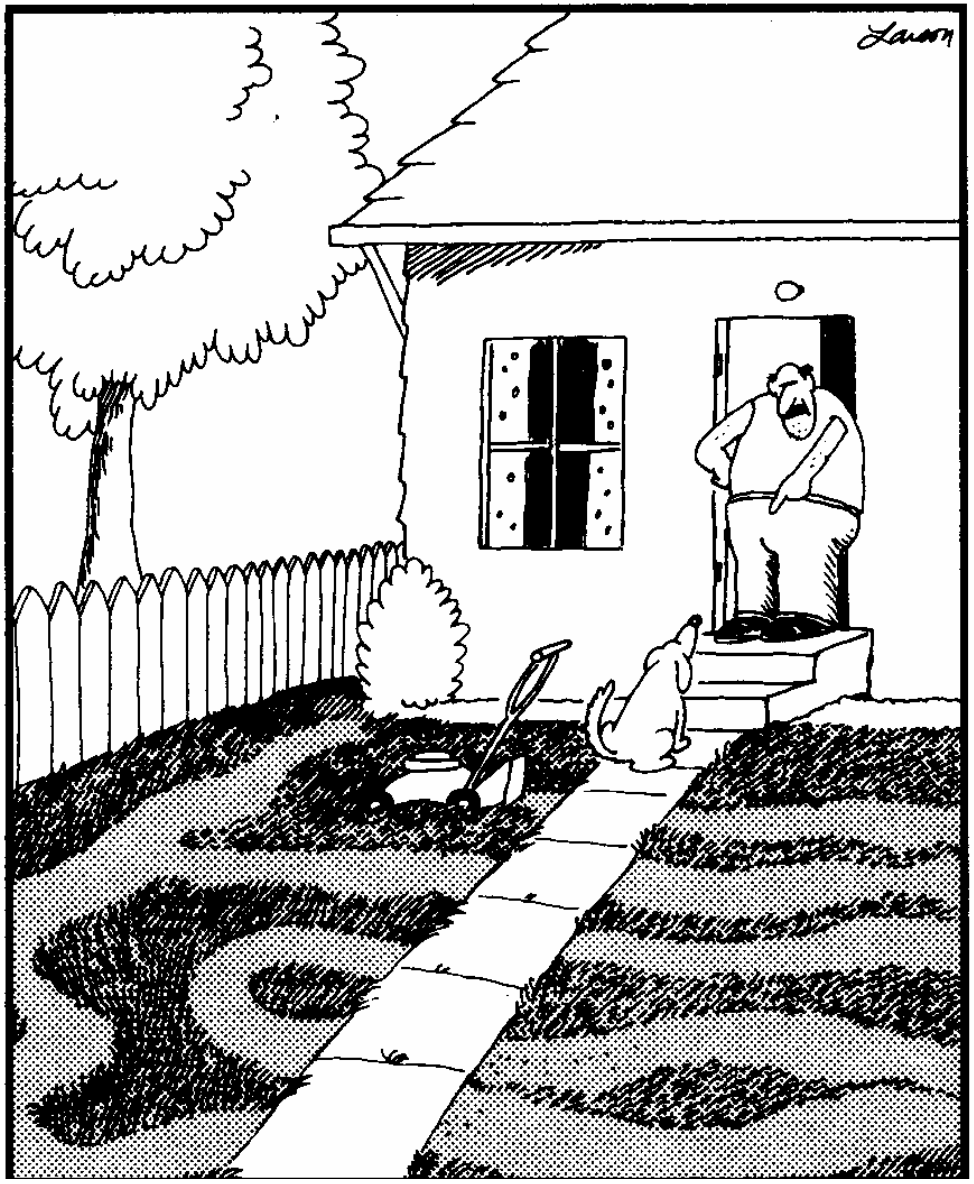
Potential consequences and tradeoffs of managing lands for livestock production and wildlife

Justin Derner and David Augustine

USDA United States Department of Agriculture
ARS Agricultural Research Service

Photo credit-Mike Danzenbaker



The Far Side®

Great heterogeneity management, Fido. But is that the right spatial scale?

Road Map

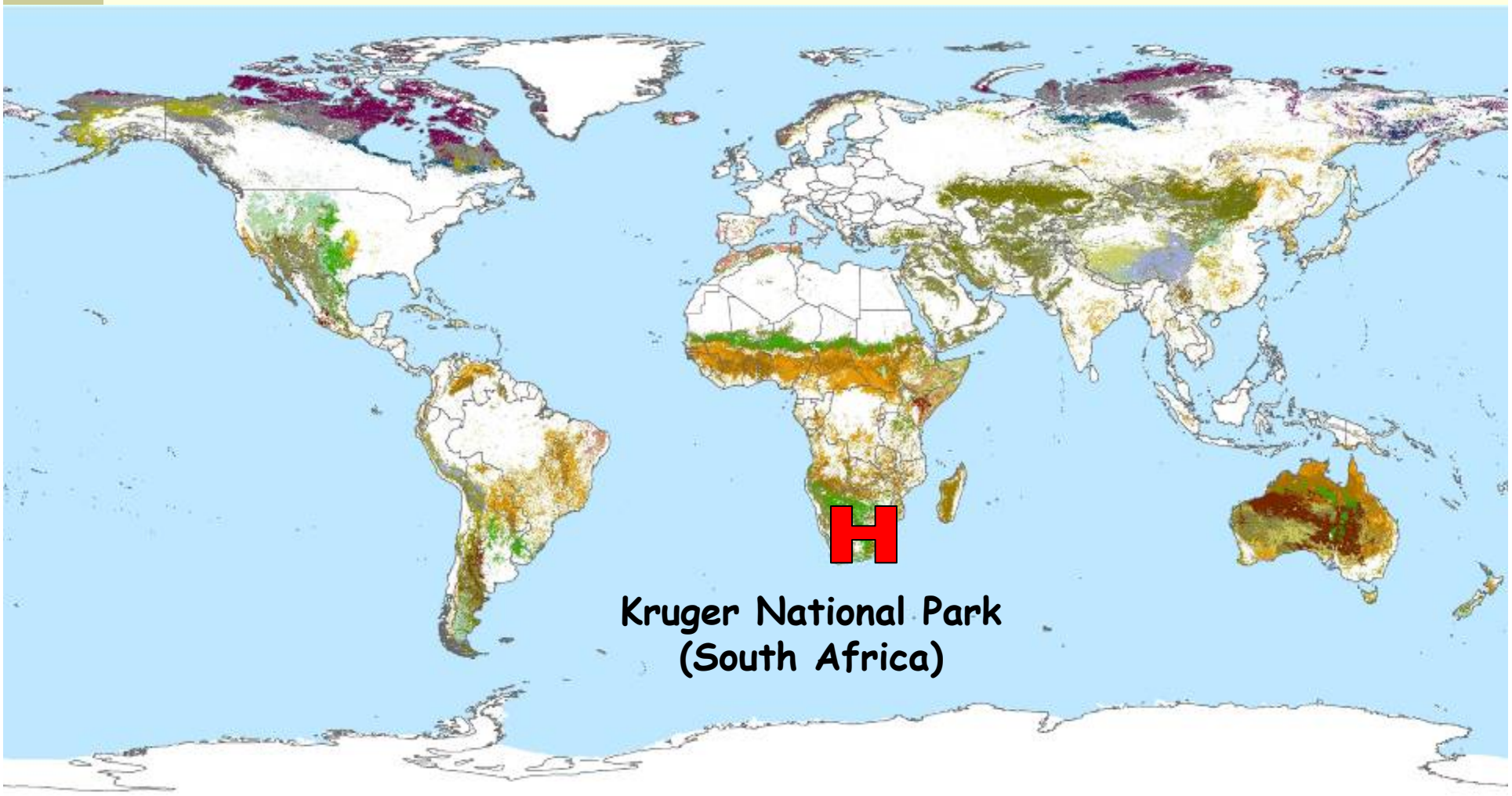
- World-wide perspective on "Why heterogeneity in rangelands"?
- Predictability and constancy vs. heterogeneity
- Examples of potential consequences and tradeoffs

Why heterogeneity in rangelands?

Heterogeneity

Basis for Conservation of Diversity at broad scales

World-wide examples of heterogeneity in rangelands



1992 AVHRR-NDVI Composite Data
Olson Global Ecosystems Classification

- Low Sparse Grassland
- Tall Grasses and Shrubs
- Upland Tundra
- Irrigated Grassland
- Semi-Desert
- Shrub Evergreen
- Shrub Deciduous
- Cool Grasses and Shrubs
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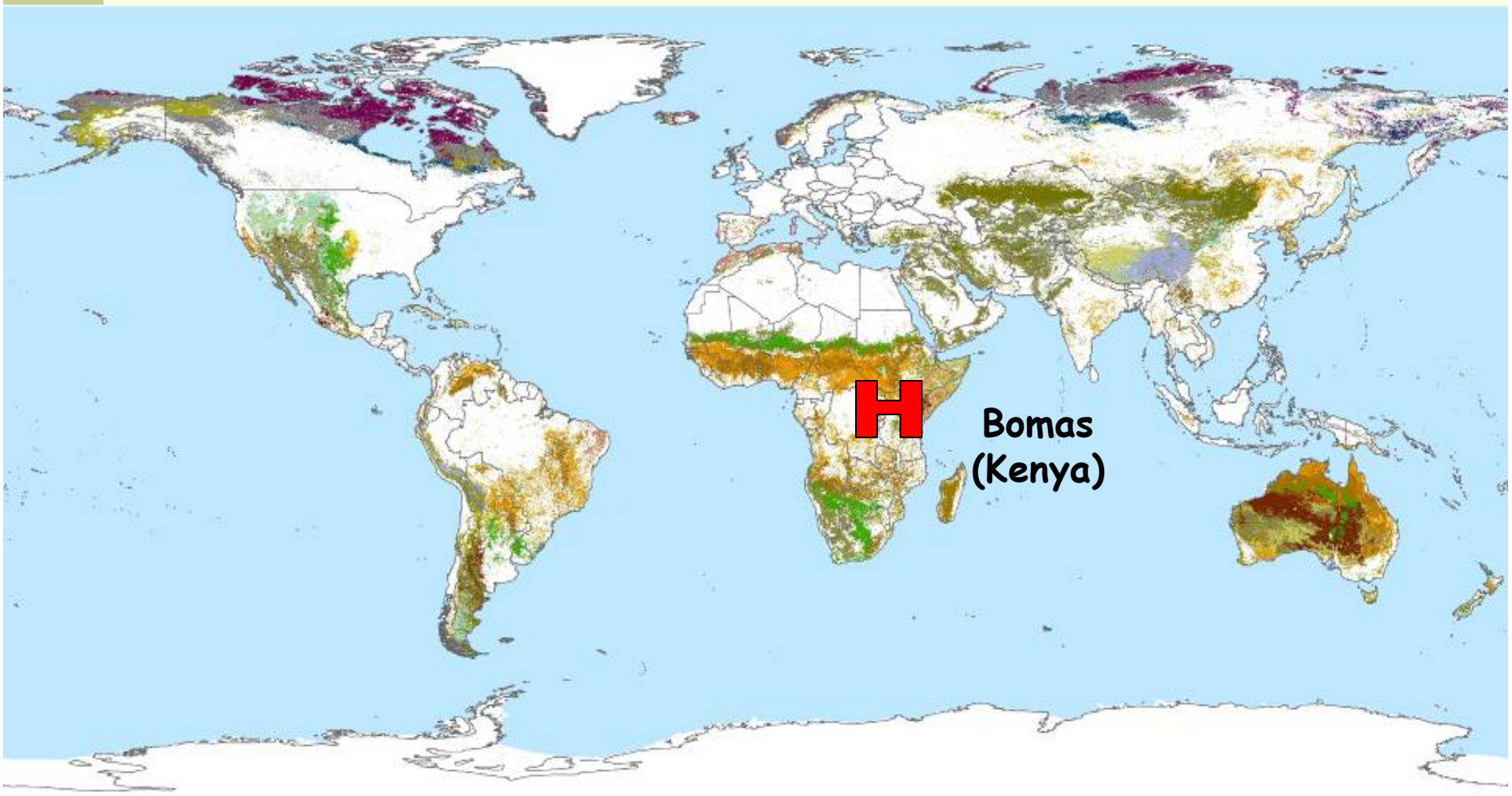
- Succulent and Thorn Scrub
- Heath Scrub
- Woody Savanna

N W E S

0 1,500 3,000 4,500 6,000 Kilometers

1-Kilometer Resolution



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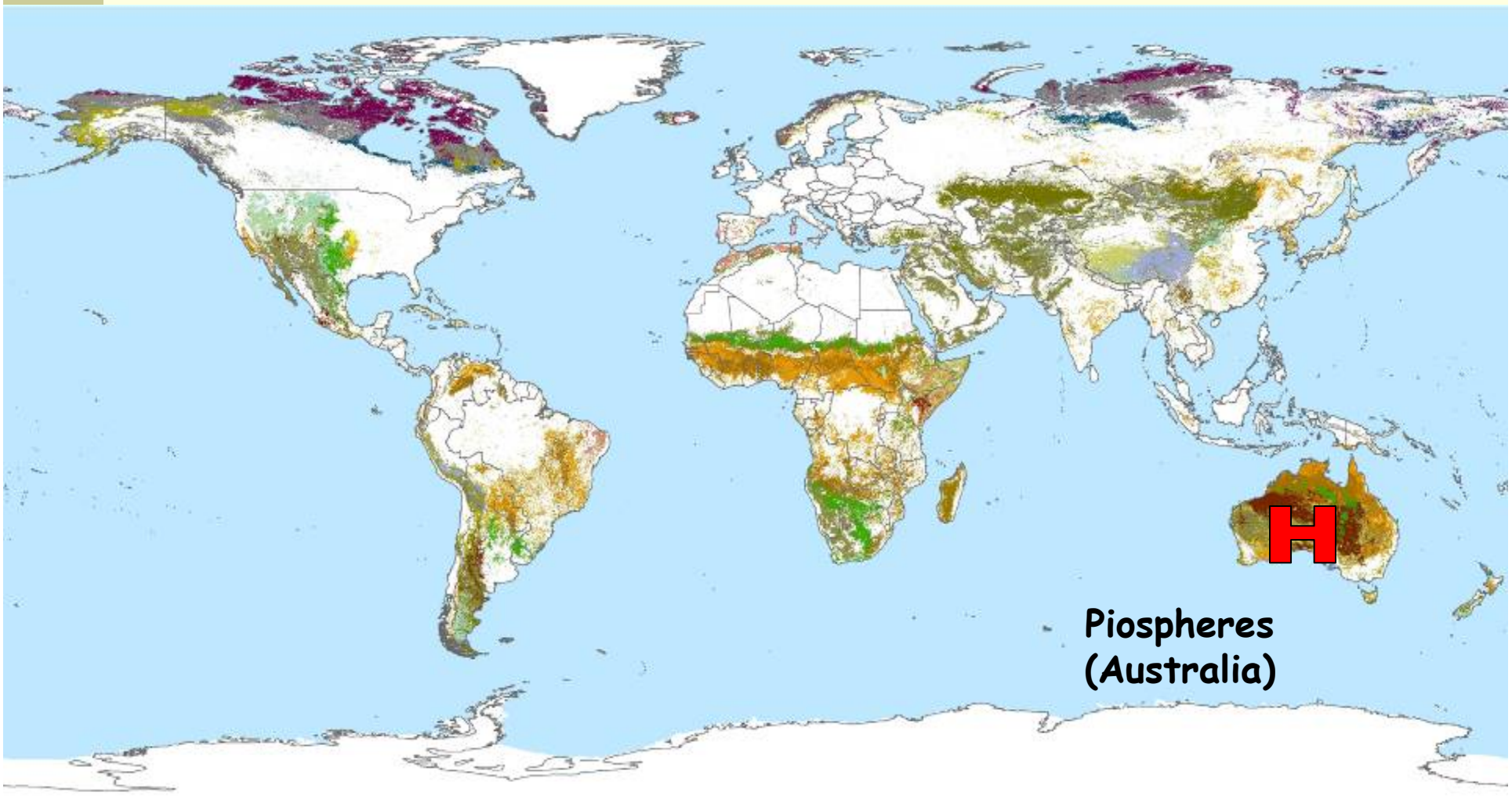

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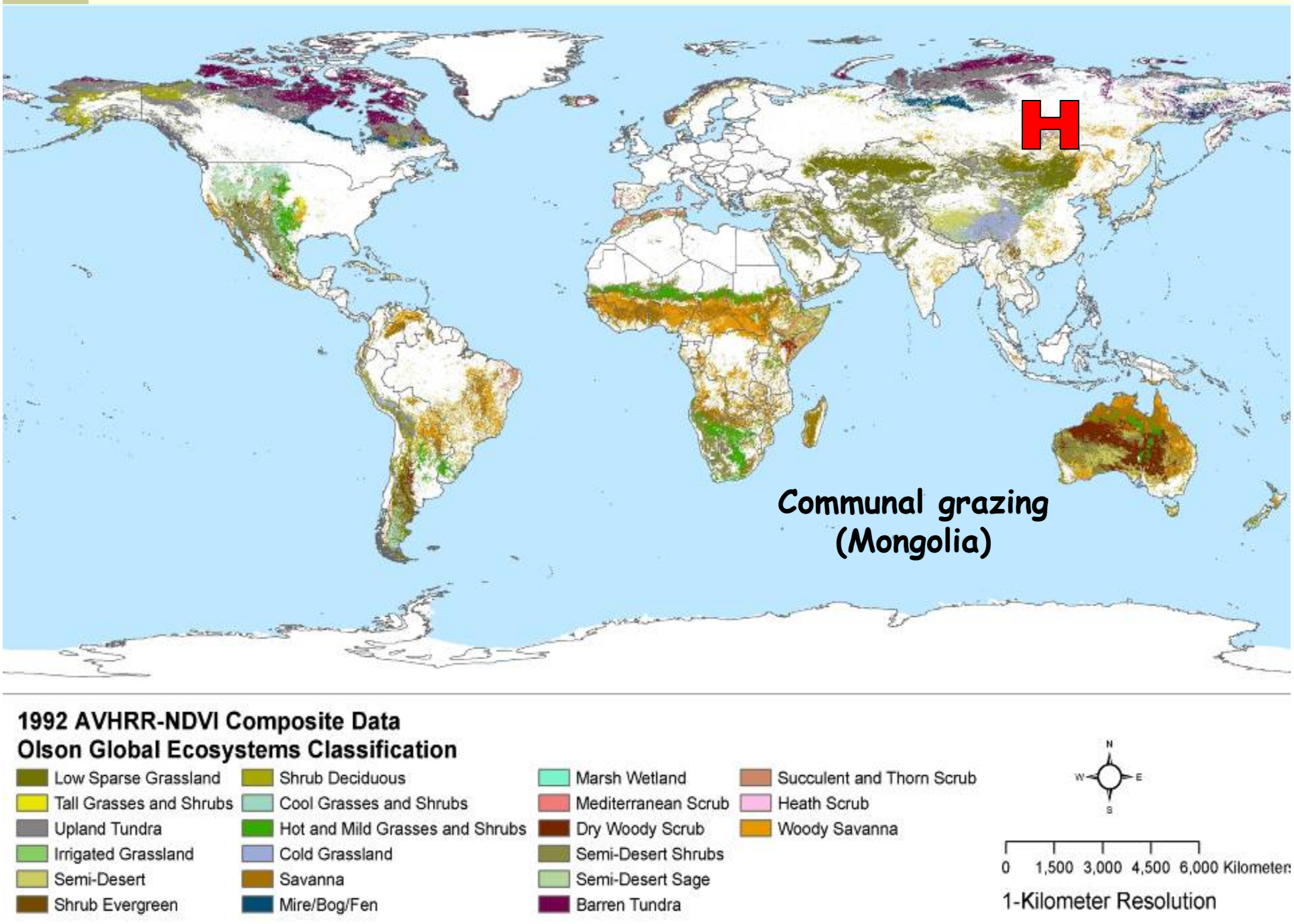
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Communal grazing
(Mongolia)
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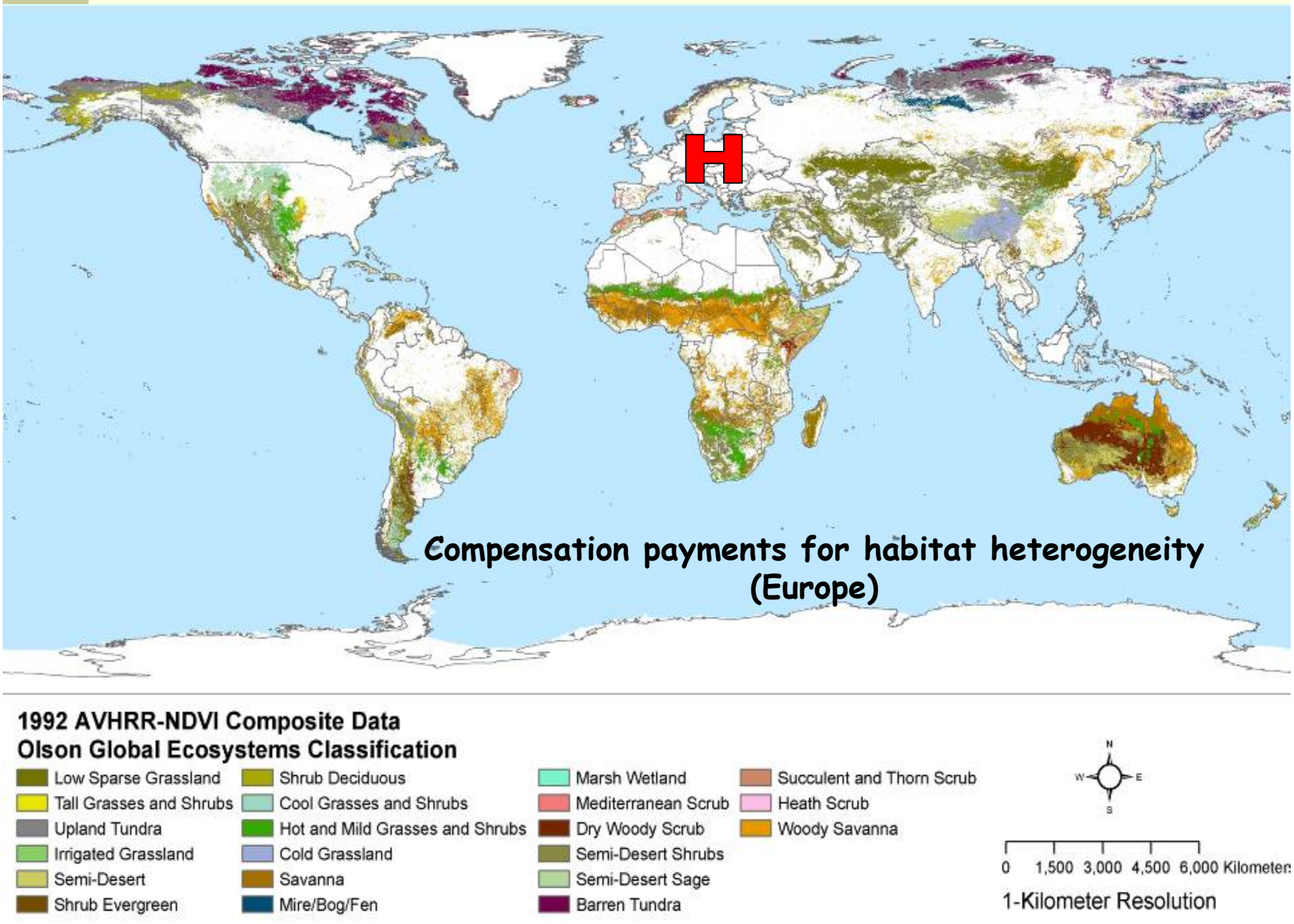
H
Compensation payments for habitat heterogeneity
(Europe)
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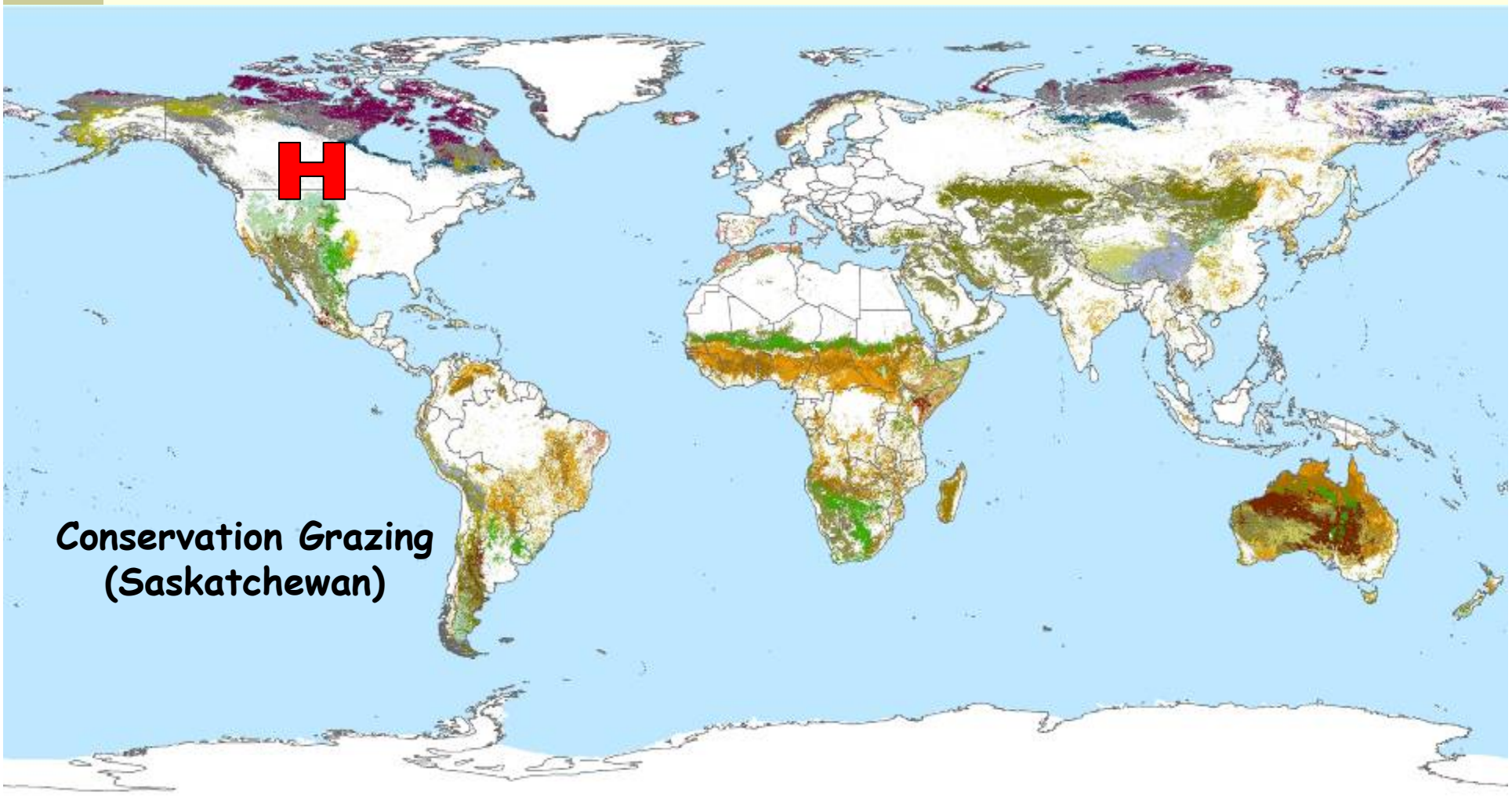

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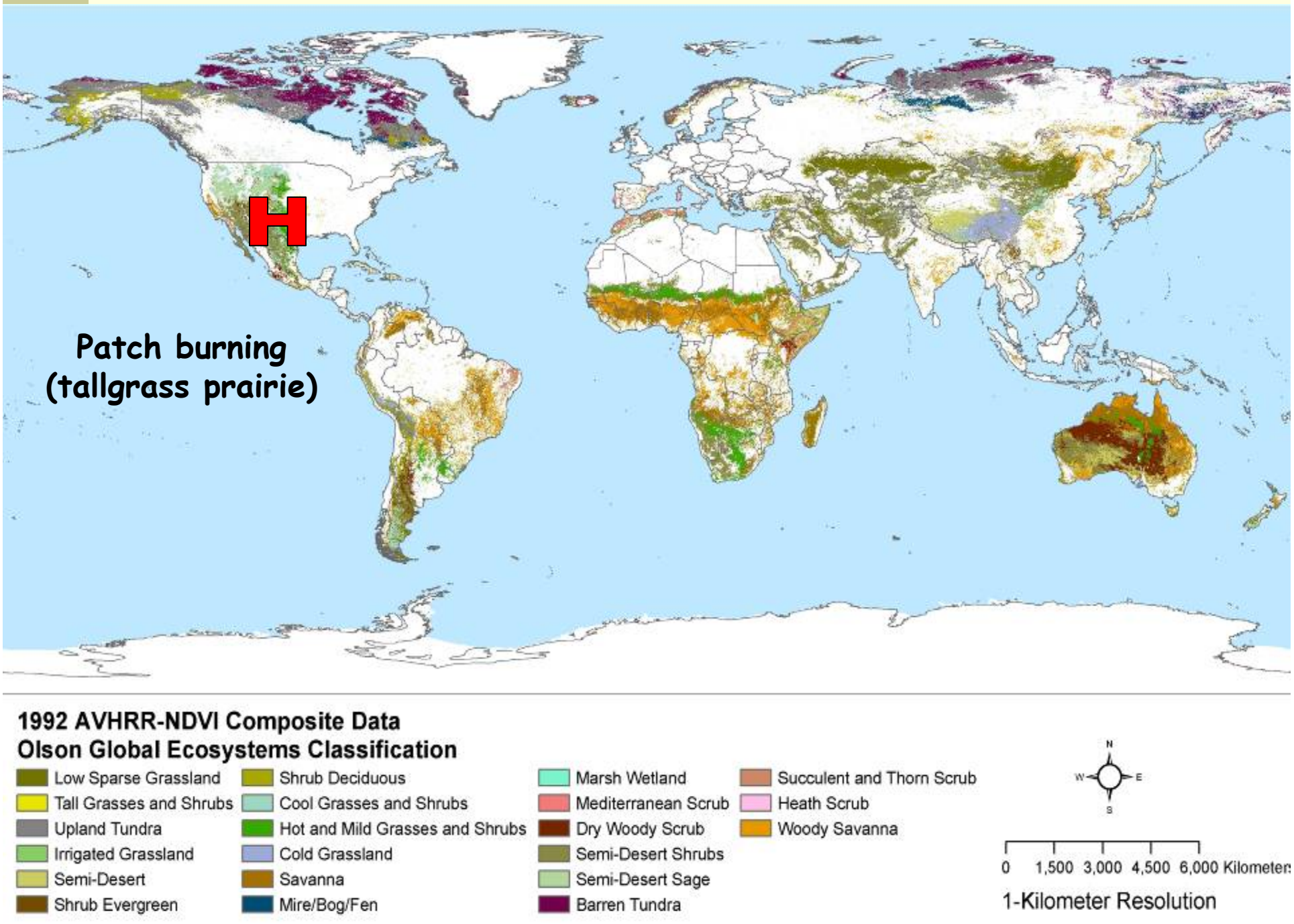
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Patch burning
(tallgrass prairie)
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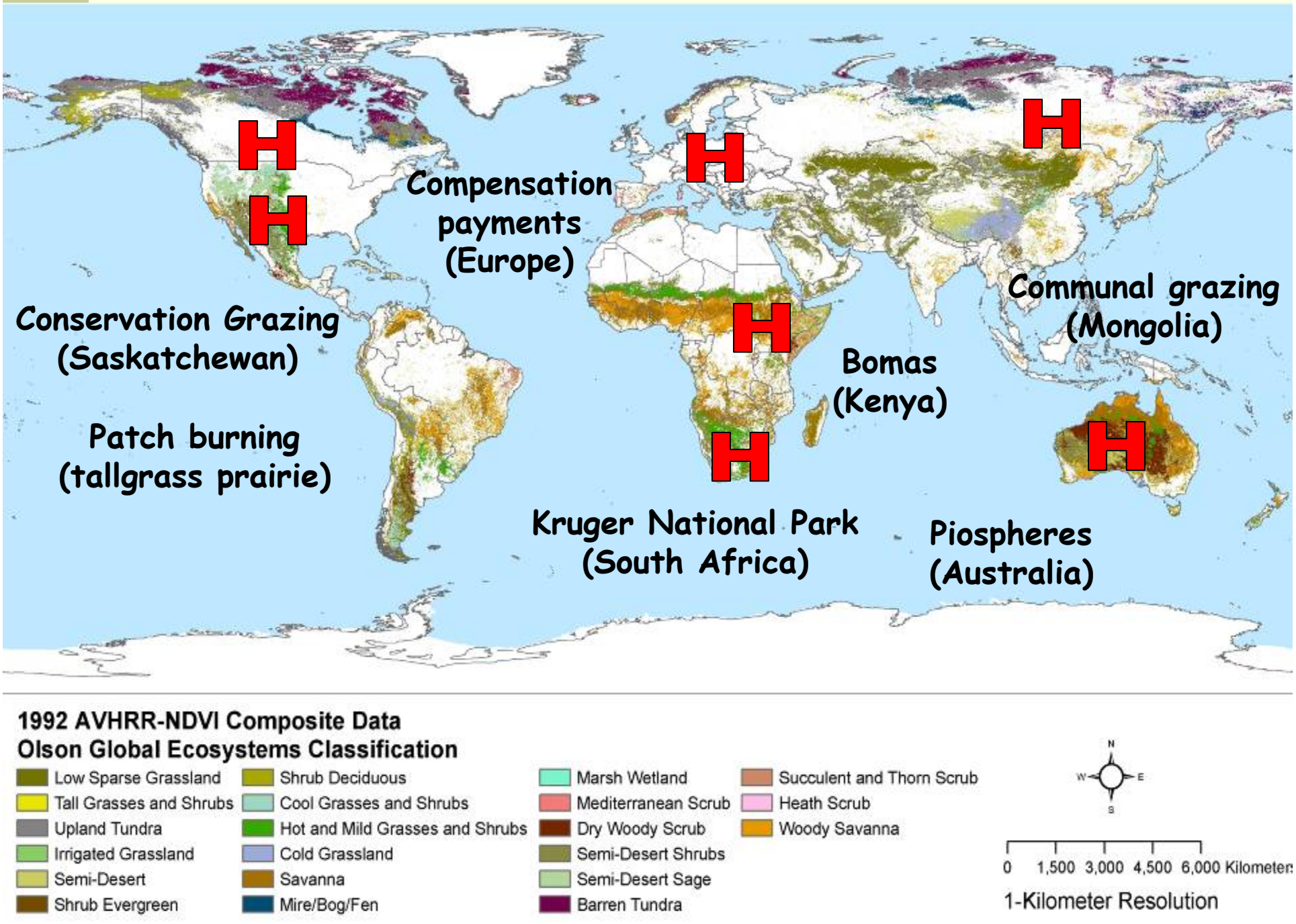
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Compensation payments (Europe)
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Communal grazing (Mongolia)
Conservation Grazing (Saskatchewan)
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Bomas (Kenya)
Patch burning (tallgrass prairie)
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Kruger National Park (South Africa)
Piospheres (Australia)
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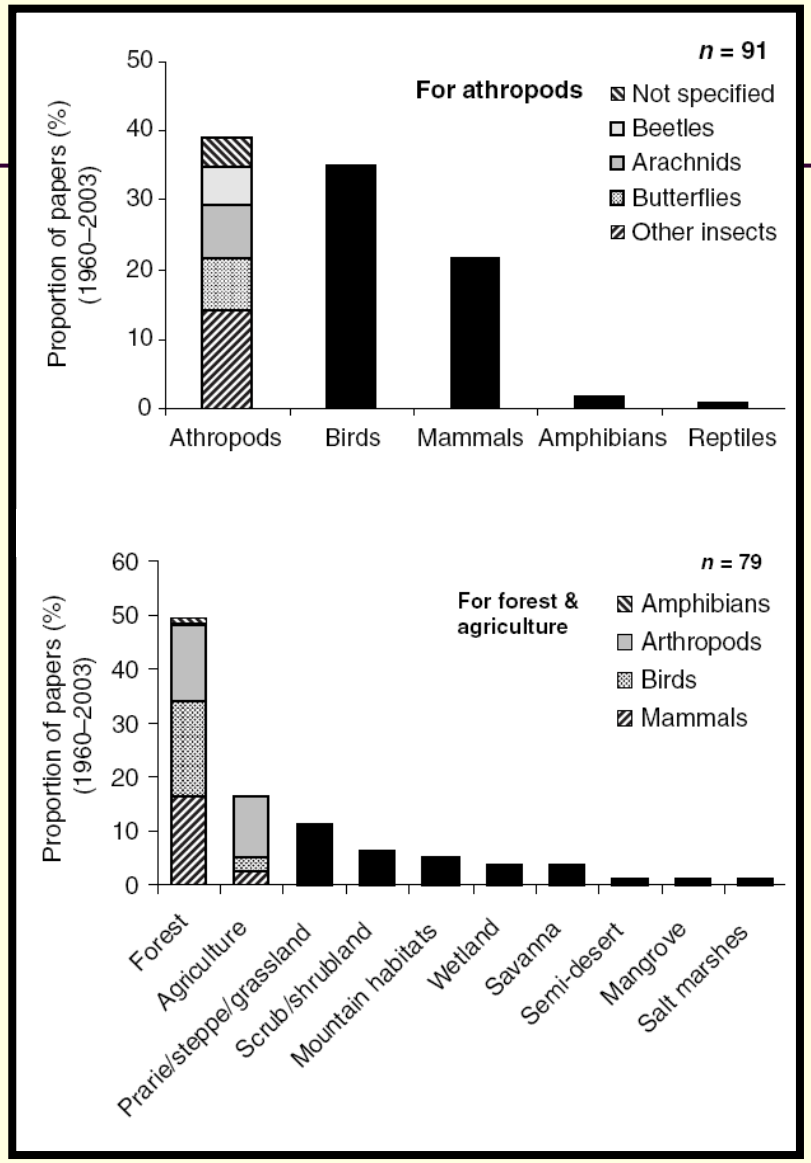


World-wide review: 85% of published studies (wide range of taxa; wide range of ecosystems) found a positive correlation between biodiversity and habitat heterogeneity

Tews et al. 2004. *Journal of Biogeography* 31:71-92

Fragmentation vs. heterogeneity

Fragmentation

Heterogeneity

Fragmentation and heterogeneity

- Fragmentation
  - results from the introduction of land uses, structures or disturbances that are novel to the ecosystem

- Heterogeneity
  - management practices guided by an understanding of historical ecosystem drivers are used to induce spatial & temporal variation in vegetation structure/states

Predictability and constancy vs. heterogeneity

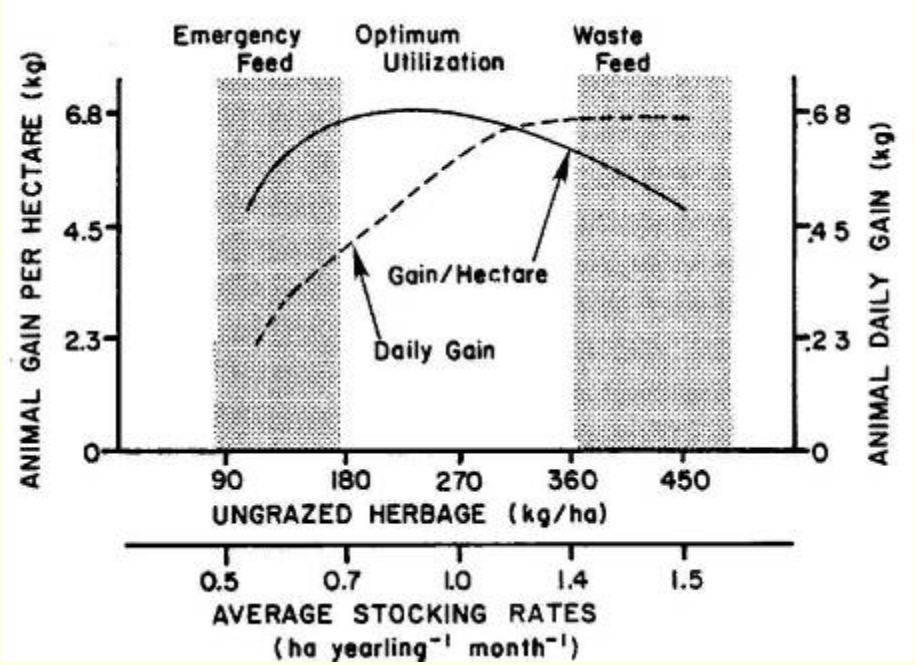
Human-induced management

- Predictability
  - Uniformity
- Constancy
  - Risk-averse

- Often encourages "management to the middle" approaches
- Often discourages "heterogeneity-based management"

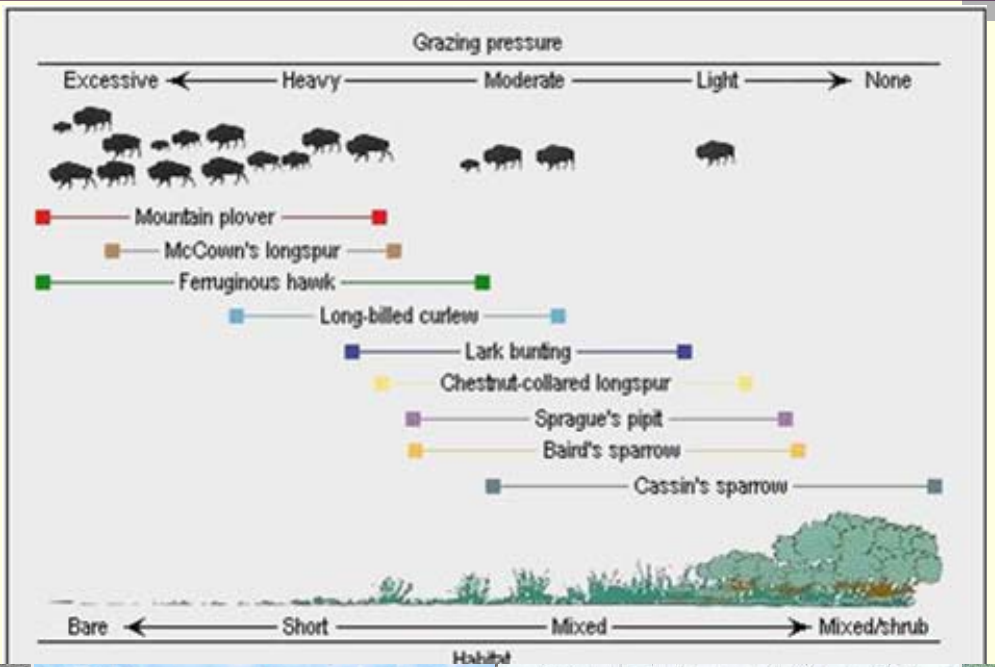
Predictability and constancy

- Emphasis on increased animal performance through homogeneous utilization of vegetation via moderate stocking rates



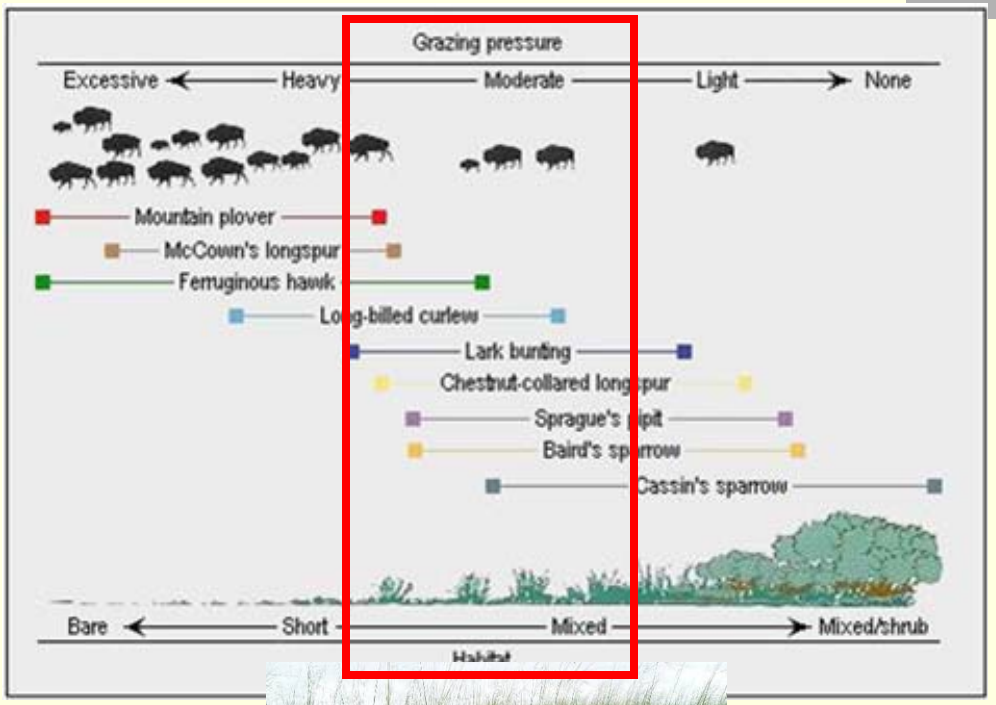
Bement 1969.
***Journal of Range Management* 22:83-86**

Heterogeneity

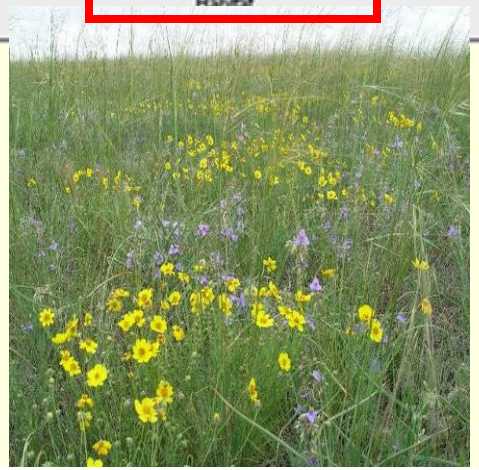


(Knopf 1996)

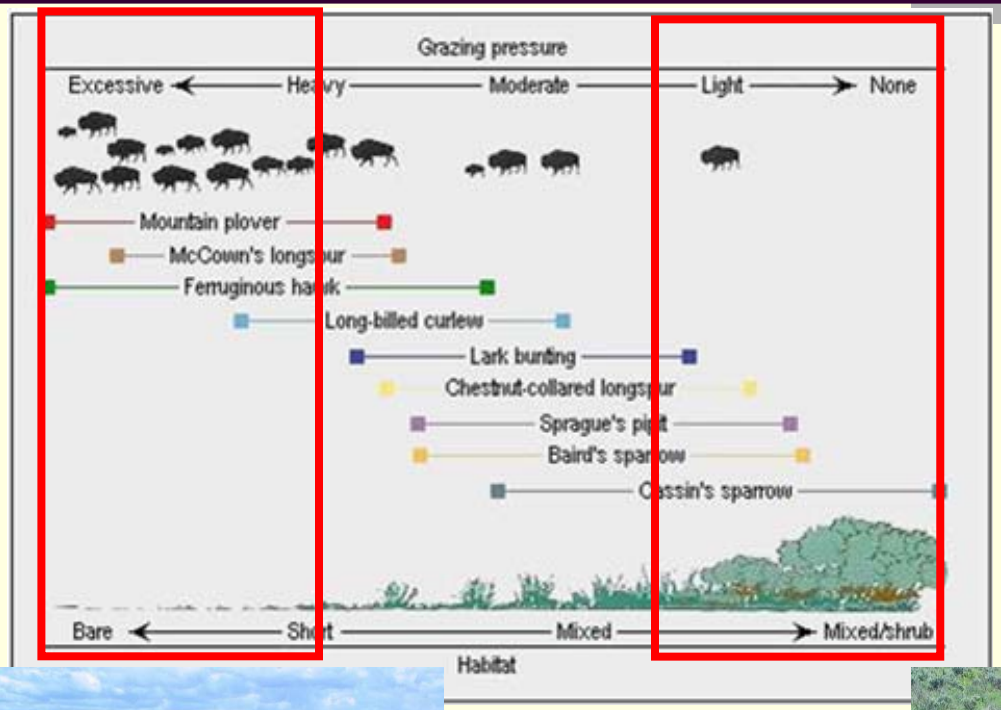
Management to the middle



(Knopf 1996)



Under-represented habitats



(Knopf 1996)

Examples of potential consequences and tradeoffs

Consequences and tradeoffs

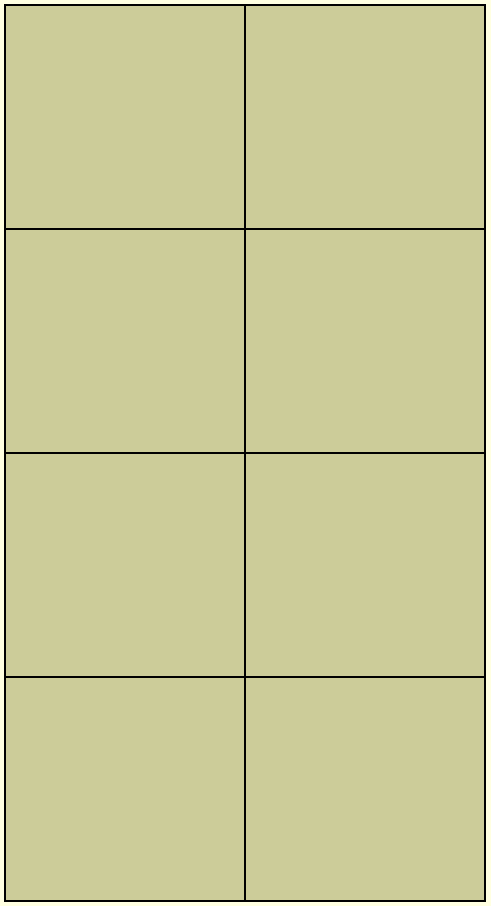
- Comparison of costs between "management to middle" and "heterogeneity-based management"
- Assumption of increased risks with "heterogeneity-based management"
  - Reduction in predictability and constancy?
- Assumption that "heterogeneity-based management" provides more flexibility (i.e., adaptive management)
  - Greater drought mitigation possibilities?

Example – Current management

- Ranch in SE WY
- Northern mixed-grass prairie
- 8 same-sized pastures (each 320 acres)
- All pastures currently moderately stocked
  - (7.6 acres/yearling/5 month summer grazing)
- Livestock gain data (yearlings)
  - Light stocking (-40%): 2.18 lbs/hd/day
  - Moderate stocking: 2.08 lbs/hd/day
  - Heavy stocking (+40%): 1.82 lbs/hd/day
    - Derner et al. 2008. *Livestock Science* 117:60-69

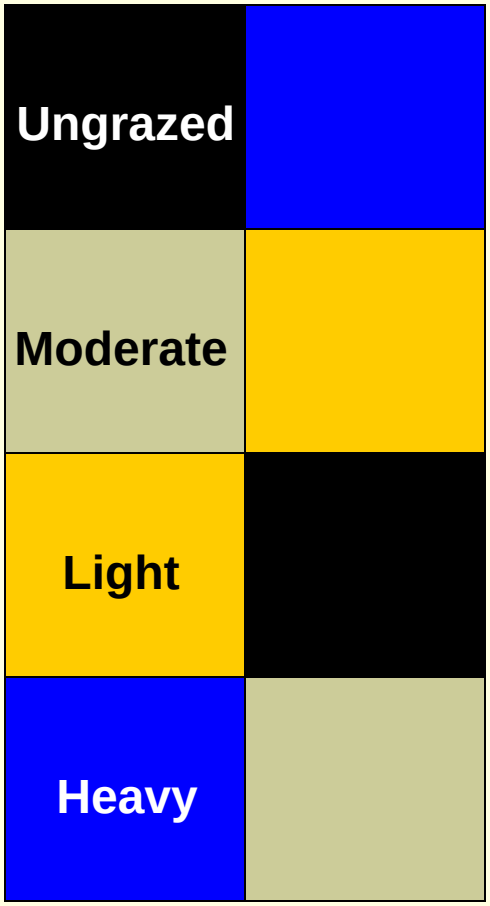
Example – Current Management

- 336 total yearlings
  - 42 per pasture
- 104,832 pounds of gain
- Assumption of $1 per pound of gain
- Thus, $104,832 gross income



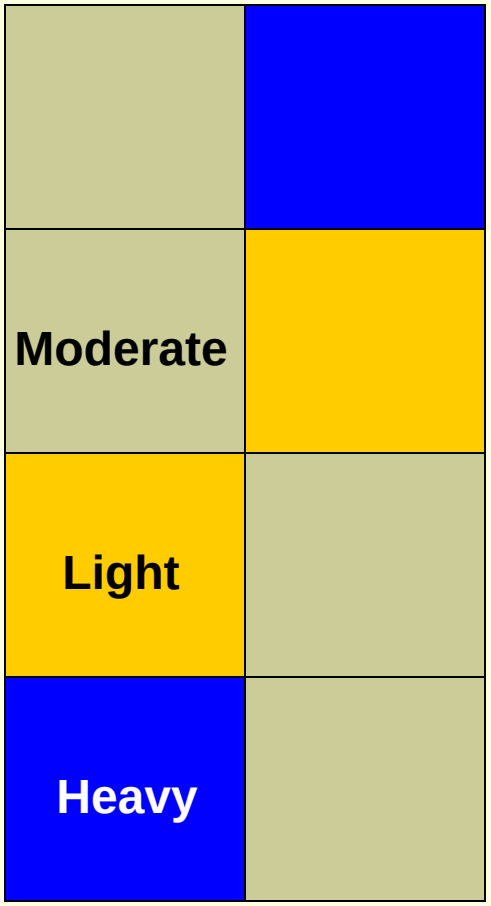
Example – Alternative 1

- ¼ of pastures each grazed light, moderate, heavy or none
- 250 total yearlings (-86)
  - Light: 50
  - Moderate: 84
  - Heavy: 116
- 74,226 pounds of gain
  - (-30,606)
- $74,226 gross income



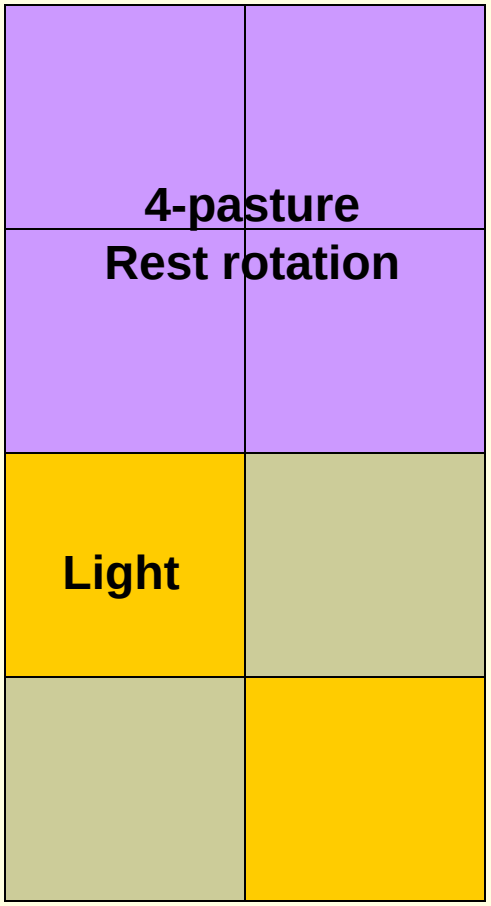
Example – Alternative 2

- 2 pastures each grazed light and heavy, 4 moderate
- 334 total yearlings (-2)
  - Light: 50
  - Moderate: 168
  - Heavy: 116
- 100,434 pounds of gain
  - (-4,398)
- $100,434 gross income

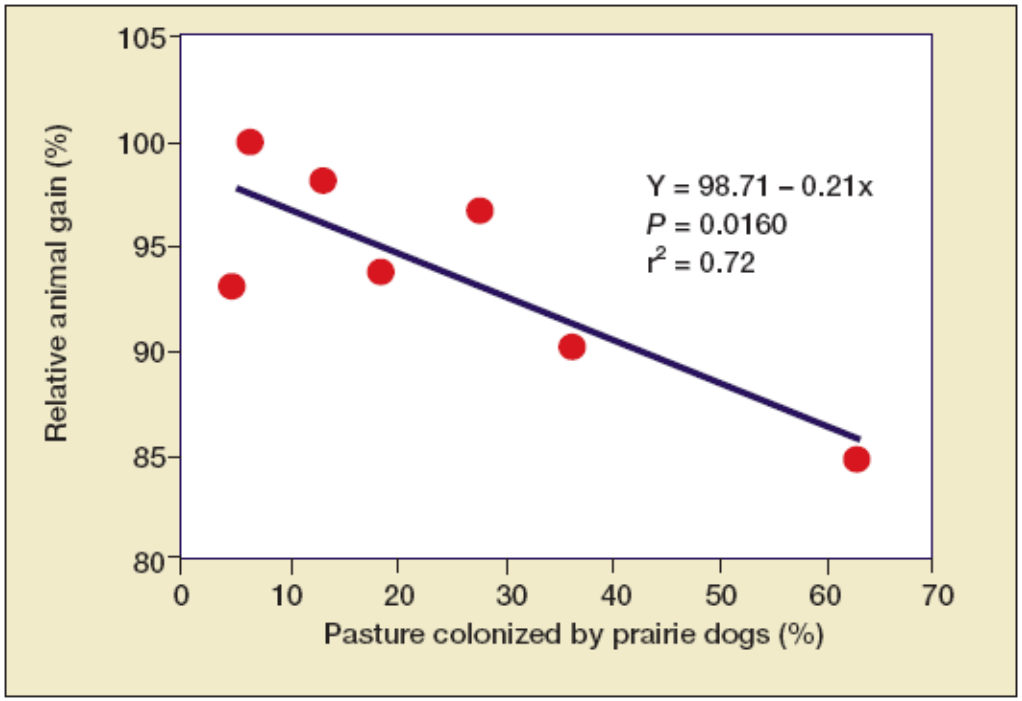


Example – Alternative 3

- 1, 4-pasture rest-rotation with overall moderate stocking
  - 1 pasture rested each year, other 3 absorb increased stocking rate
- 2 pastures each of light and moderate
- 302 total yearlings (-34)
  - Light: 50
  - Moderate: 84
  - Rotation: 168
- 88,422 pounds of gain
  - (-16,410)
- $88,422 gross income



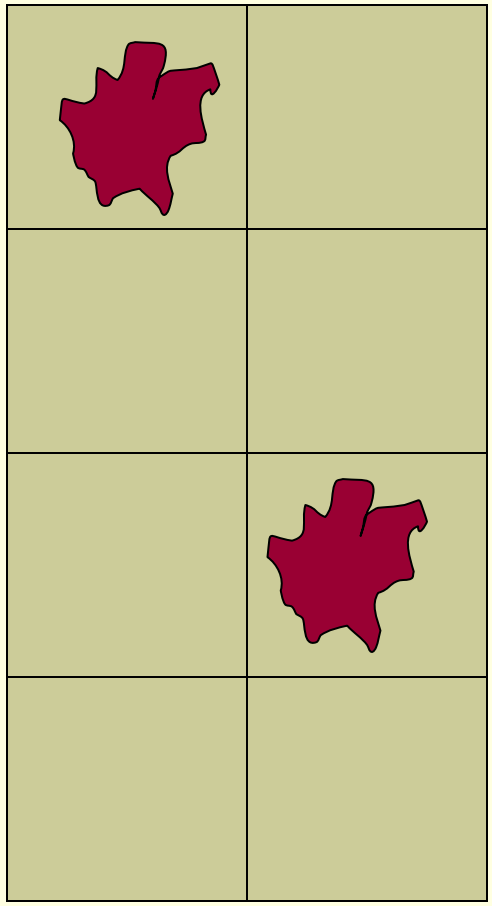
Prairie dogs and grazing



Derner et al. 2006.
Frontiers in Ecology and the Environment
4:459-464

Example – Alternative 4

- All pastures currently moderately stocked
- 2 pastures have prairie dog colonies occupying 40% of pasture
- 336 total yearlings (0)
- 101,729 pounds of gain
  - (-3,103)
- $101,729 gross income



Example	Gross income from livestock	Wildlife benefits	Drought mitigation
Current	$104,832	neutral	neutral
2 light, mod, heavy and no grazing	$74,226	Large increase in vegetation structure	2 pastures not grazed ("grassbank")
2 light and heavy, 4 mod	$100,434	Moderate increase in vegetation structure	2 lightly grazed pastures
Rest-rotation, 2 light, 2 moderate	$88,422	Moderate increase in vegetation structure and movement of rested pasture on landscape	1 pasture not grazed ("grassbank")
Prairie dogs	$101,729	Increased heterogeneity	Neutral to negative

Conclusions (1)

- **Heterogeneity** is the basis for conservation of diversity at broad scales
- **Heterogeneity-based management** is increasingly practiced world-wide
- **Management to the middle** results in under-represented habitats for wildlife

Conclusions (2)

- Potential consequences of heterogeneity-based management for livestock production and wildlife habitat include:
  - Direct economic costs
  - Increased risks (overcoming predictability and constancy)
  - More flexibility
  - Greater drought mitigation
  - More fun ☺

Conclusions (3)

- Needs
  - 1) Suite of heterogeneity-based practices that can be applied to semi-arid, western Great Plains rangelands
  - 2) Conservation incentive payments to landowners for practices with well-documented economic costs
  - 3) Identification of spatial scales to apply heterogeneity management for different species, ecosystems and landscapes

Questions?