hmmm, what if...?

Mongolian Gazelles and Grassland Management

(a *first* attempt at modelling a population of Mongolian gazelle)

October 2004

hmmm, what if...?

Mongolian Gazelles and Grassland Management

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Contents

1. What are models and how they can help
    - everyday examples
    - conservation examples
2. Building a Mongolian model
    - components
    - numbers
    - scenarios

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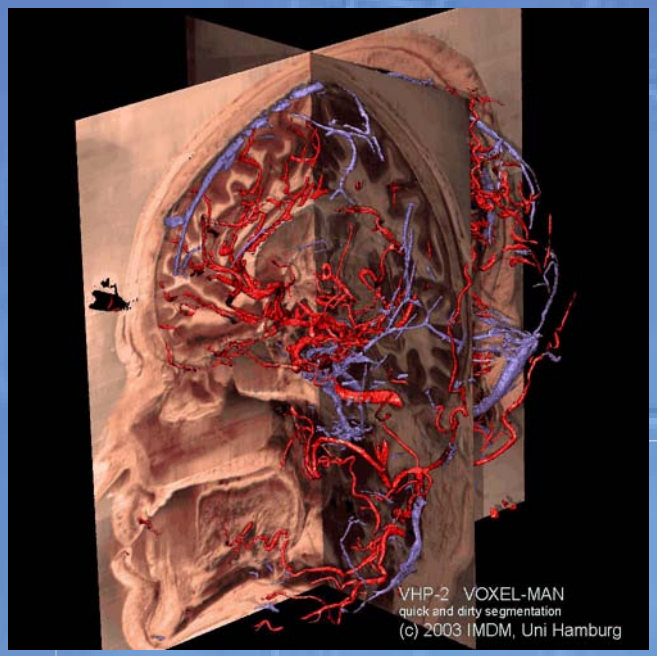
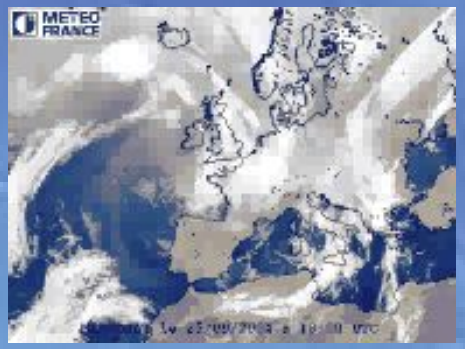
Everyday examples #1

Medicine





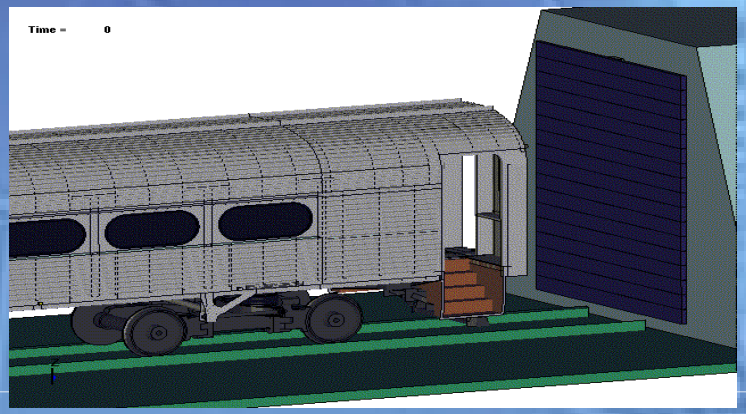
Weather forecasts

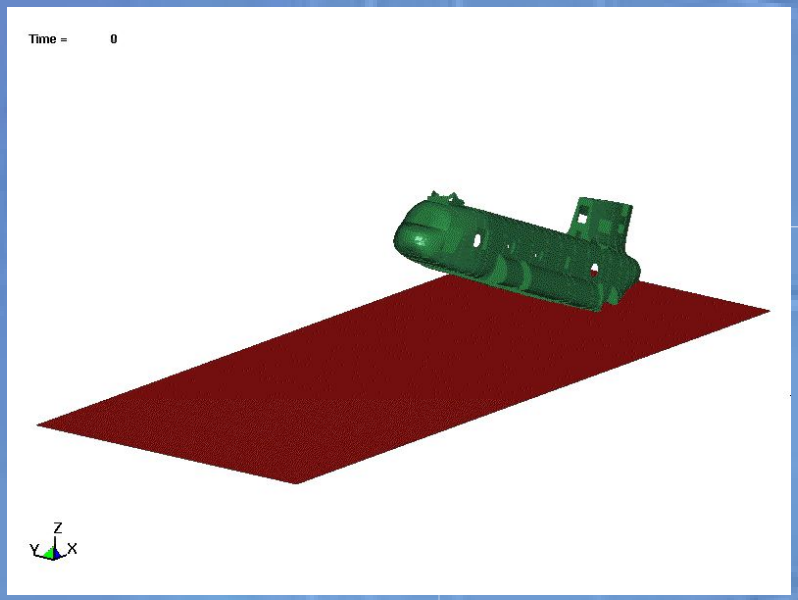
Final Fantasy: The Spirits Within
Hironobu Sakaguchi & Moto Sakakibara

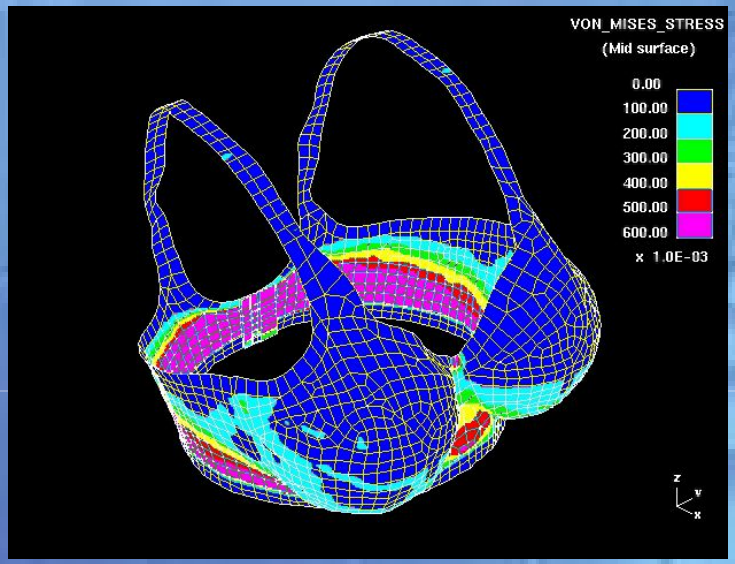
Film and entertainment

Everyday examples #2

Travel safety



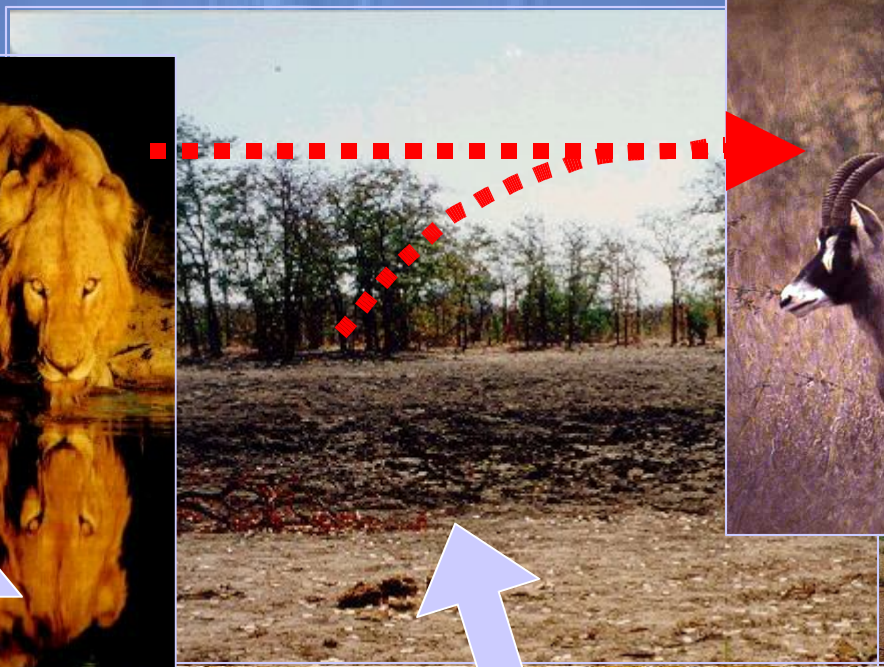




Stress tests

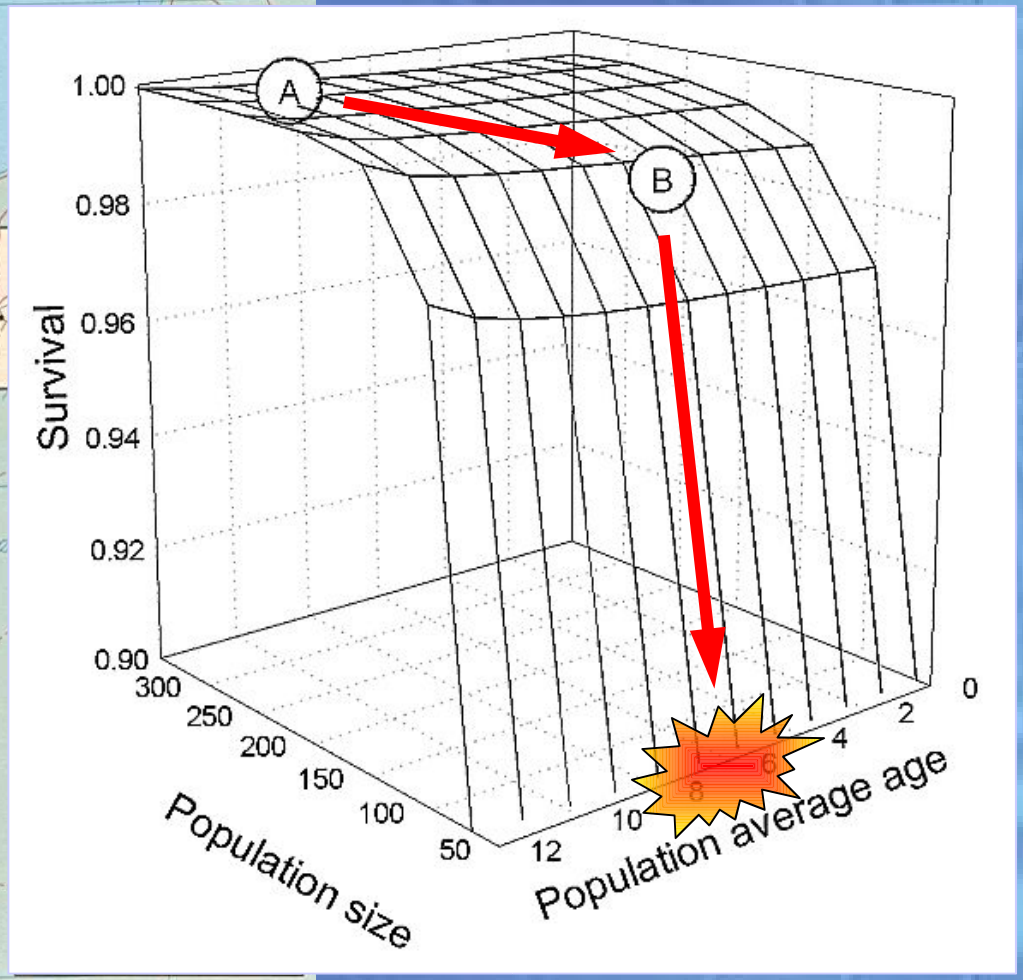
Conservation examples

Roan antelope, Northern Plains,
Kruger National Park, South Africa



Conservation examples

Mediterranean monk seal



Contents

1. What are models and how they can help

   - everyday examples

   - conservation examples

2. Building a Mongolian model

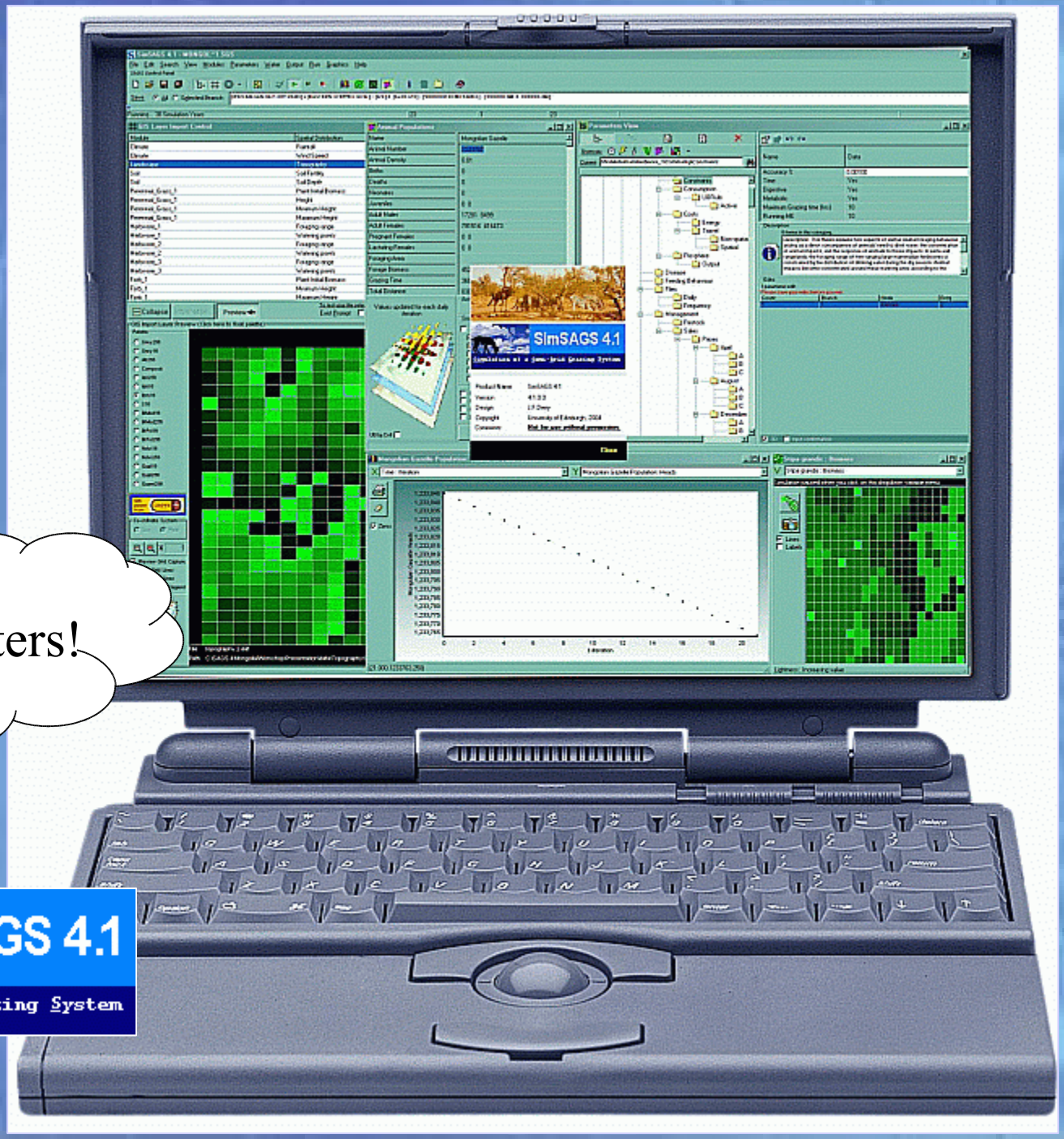
   - components

   - numbers: data

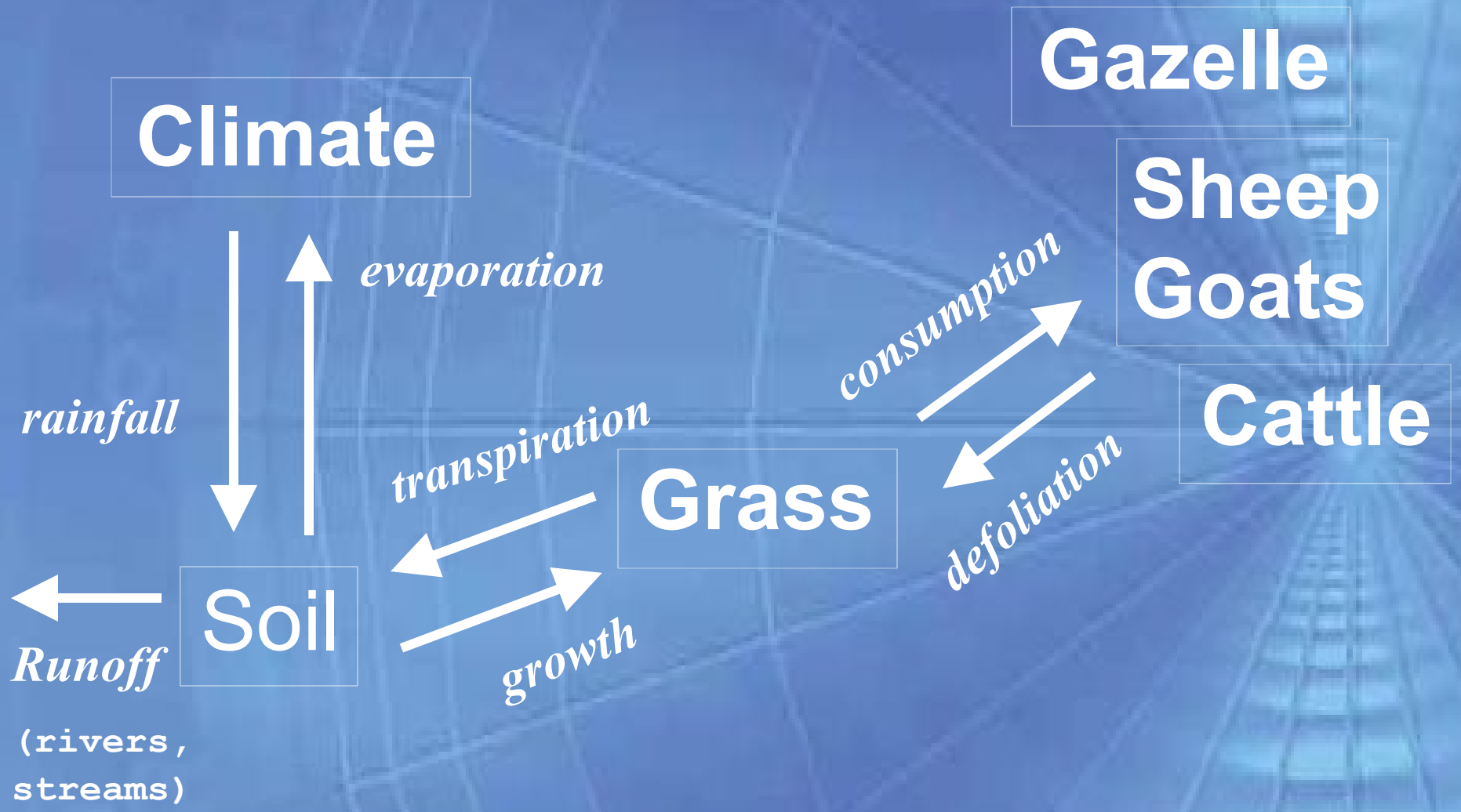
   - scenarios: competition with livestock & hunting

The model

Julian Derry
Andrew Illius
Iain Gordon



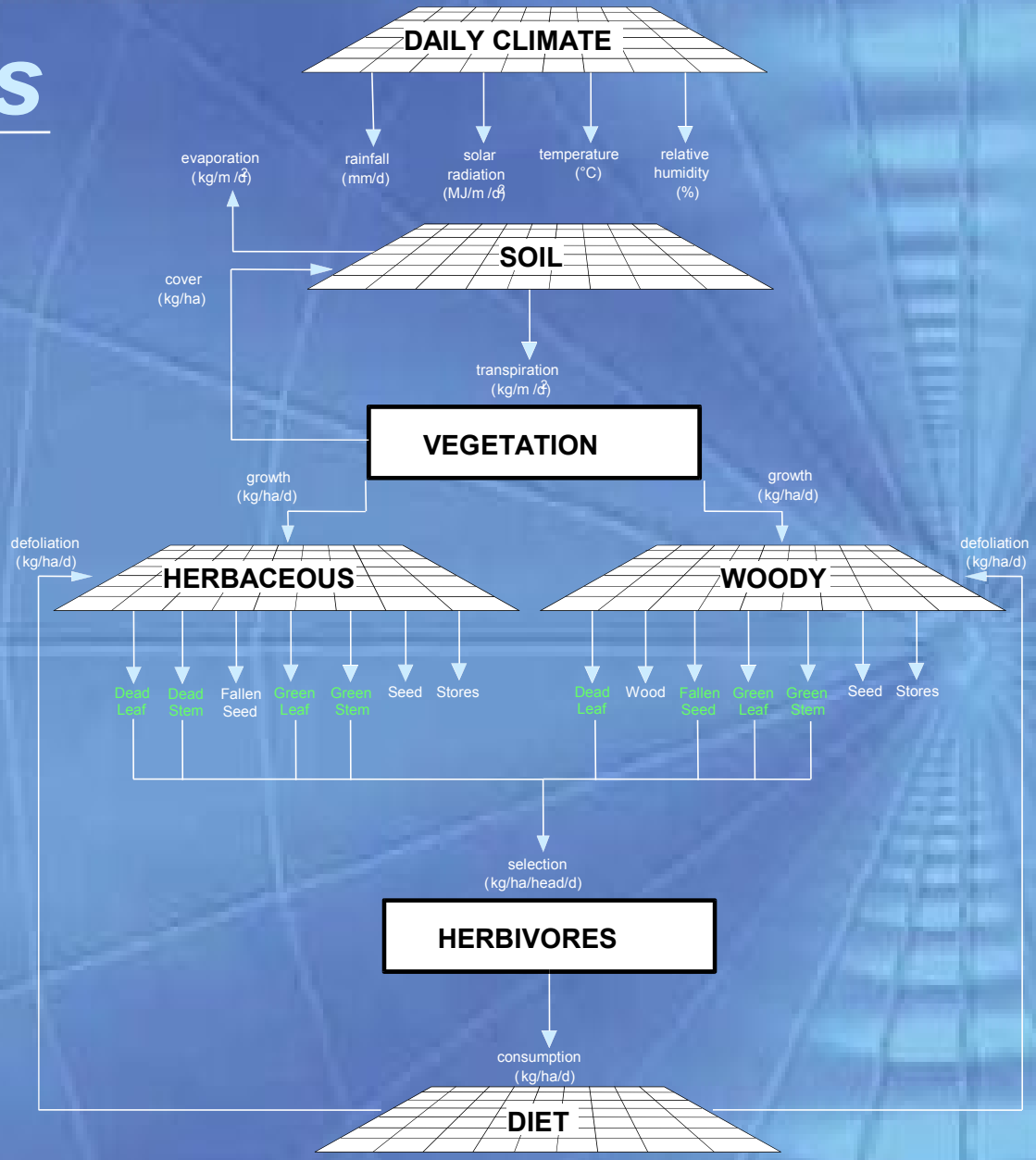
Components



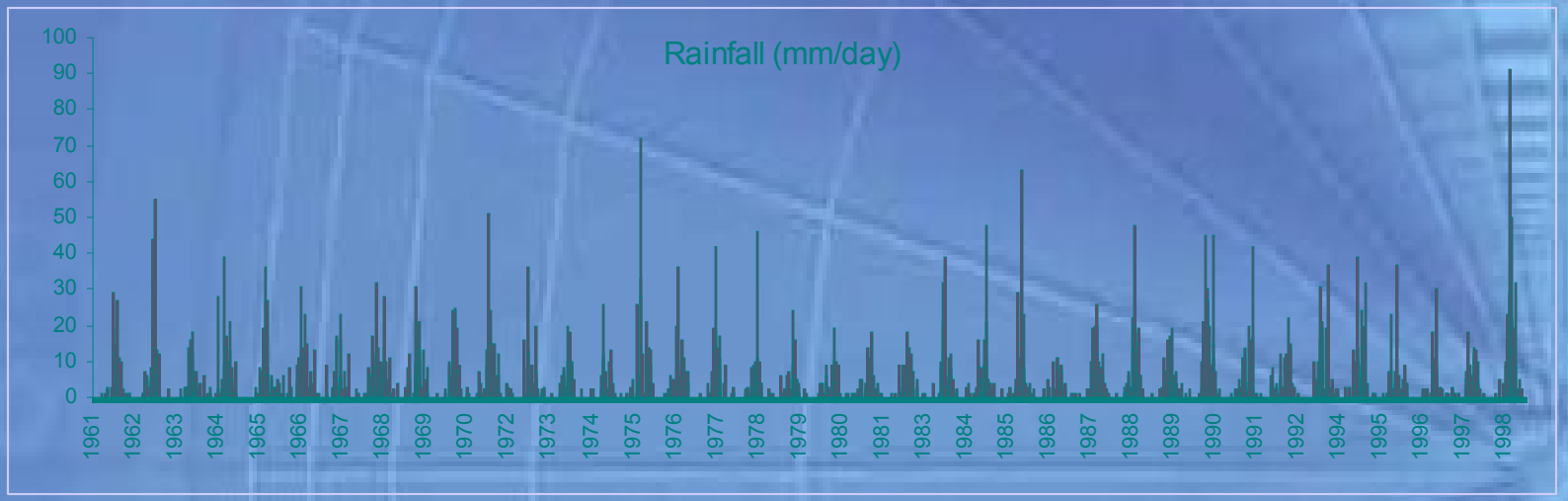
Key components of the models of soil water balance, plant phenology and animal metabolism

Components

Grids were used within each module to model spatial processes such as climatic variation, landscape topography, surface water runoff, vegetation distribution and animal movement. The flow of energy for each iteration (arrows) passed data from the climate module to the soil module where daily transpiration was predicted before being converted into growth for each vegetation type and allocation to plant parts. Selecting the maximum energy intake rates of optimal mixtures of plant parts from the range of available forage components (green), predicted on an individual basis (per head), determined a foraging pathway for each animal herd. Herd consumption was levied on the selected forage plant parts.



Numbers: climate



- Daily rainfall (mm)
- Atmospheric pressure (mb)
- Minimum temperature (^{o}C)
- Average temperature (^{o}C)
- Wind Speed (ms^{-1})

Paul Hudspeth, US National Climatic Data Center (NCDC)

Numbers: climate

Hi Julian,

I notice two major greenup periods. The first once it becomes warm enough for plants to grow it seems the entire steppe initiates a sort-of green flush, areas where snow fall was deeper is greener. Then starting any time after mid June the rains begin and the steppe greens up according to where more rain falls. It stays green longer in areas where the rains came late or rained longer.

Kirk

LEE *et al*. (2002) *Int. J. Remote Sensing*, 23, 2505-2512

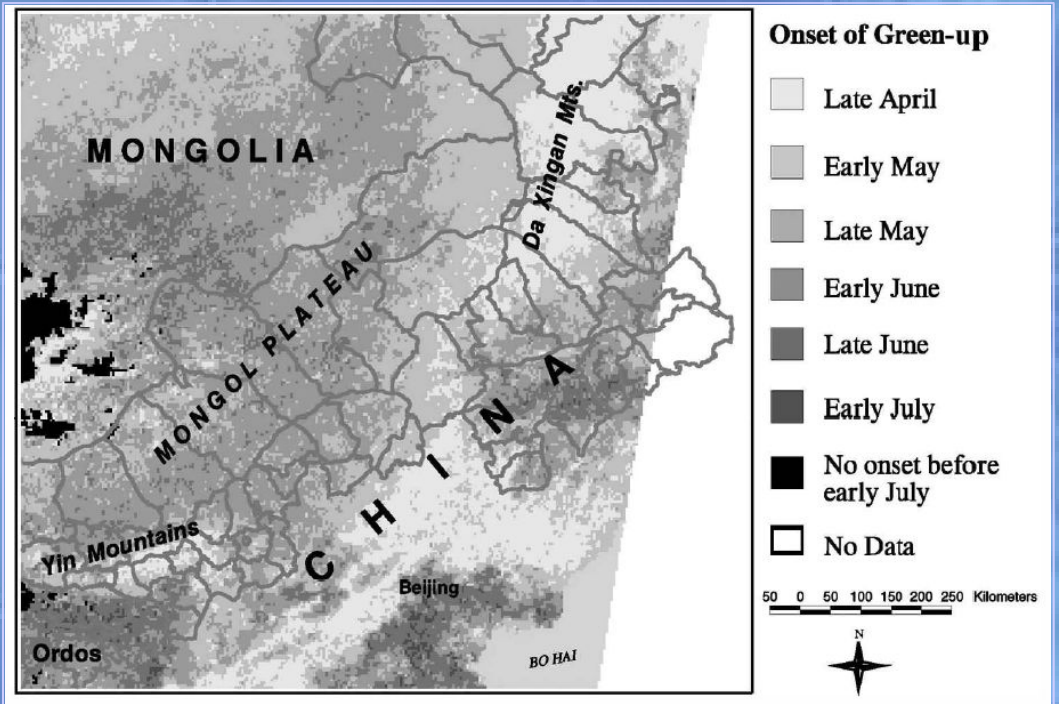


Figure 2. Mean date of onset of green-up from 1982–1990.

Numbers: climate

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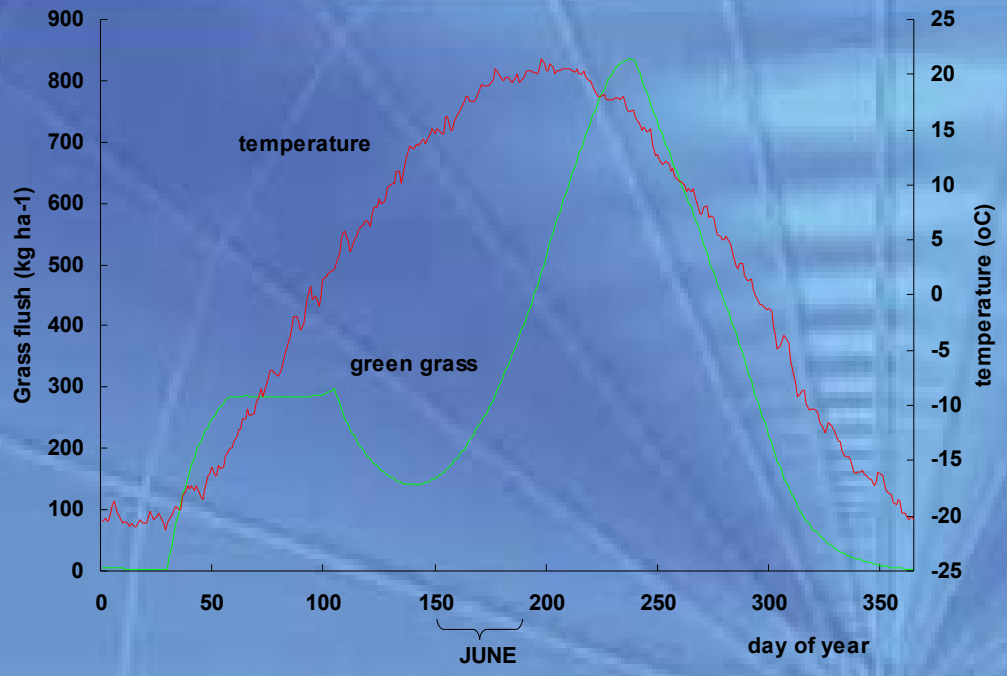
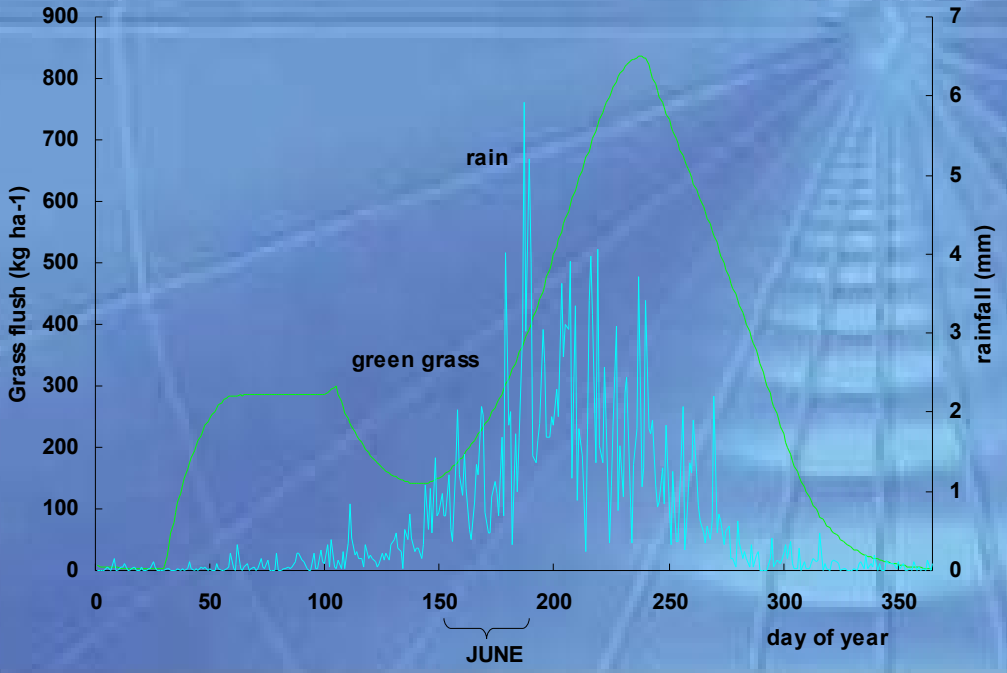
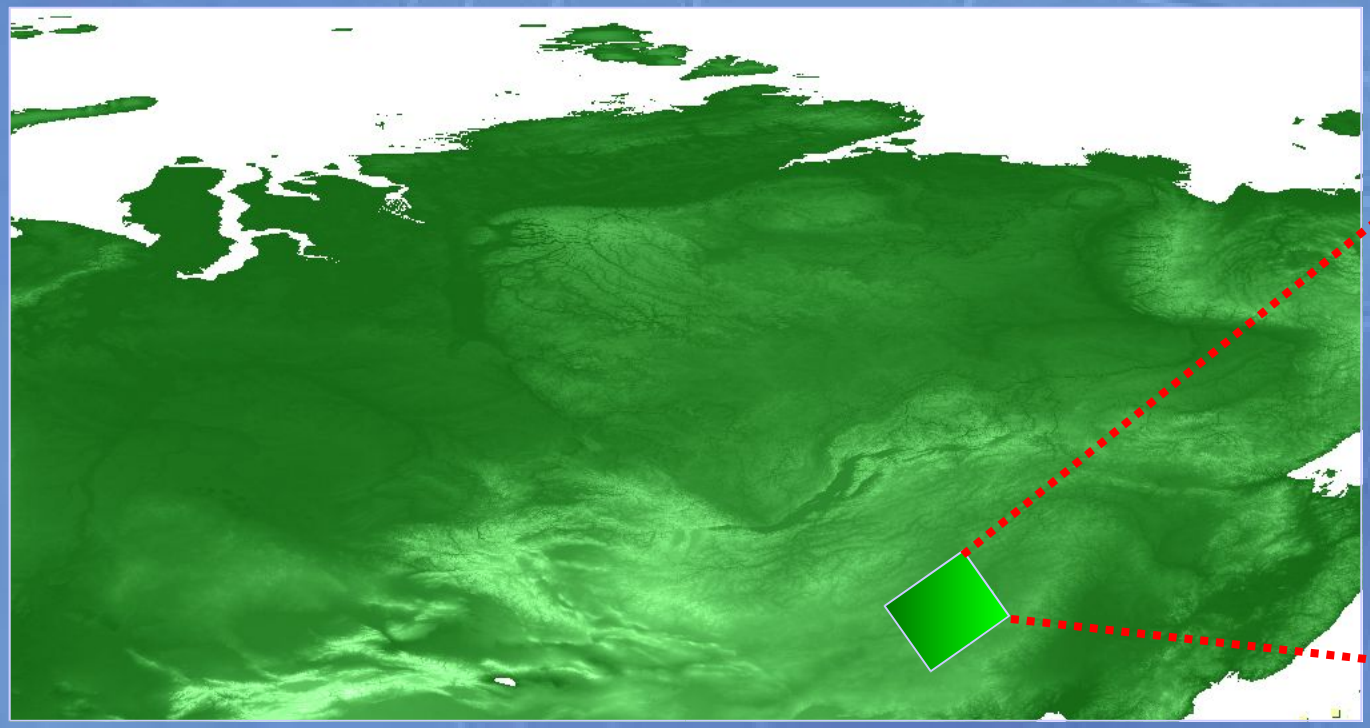




Numbers: topography

Gazelle survey
Choibalsan / Kherlen Gol / Dornod

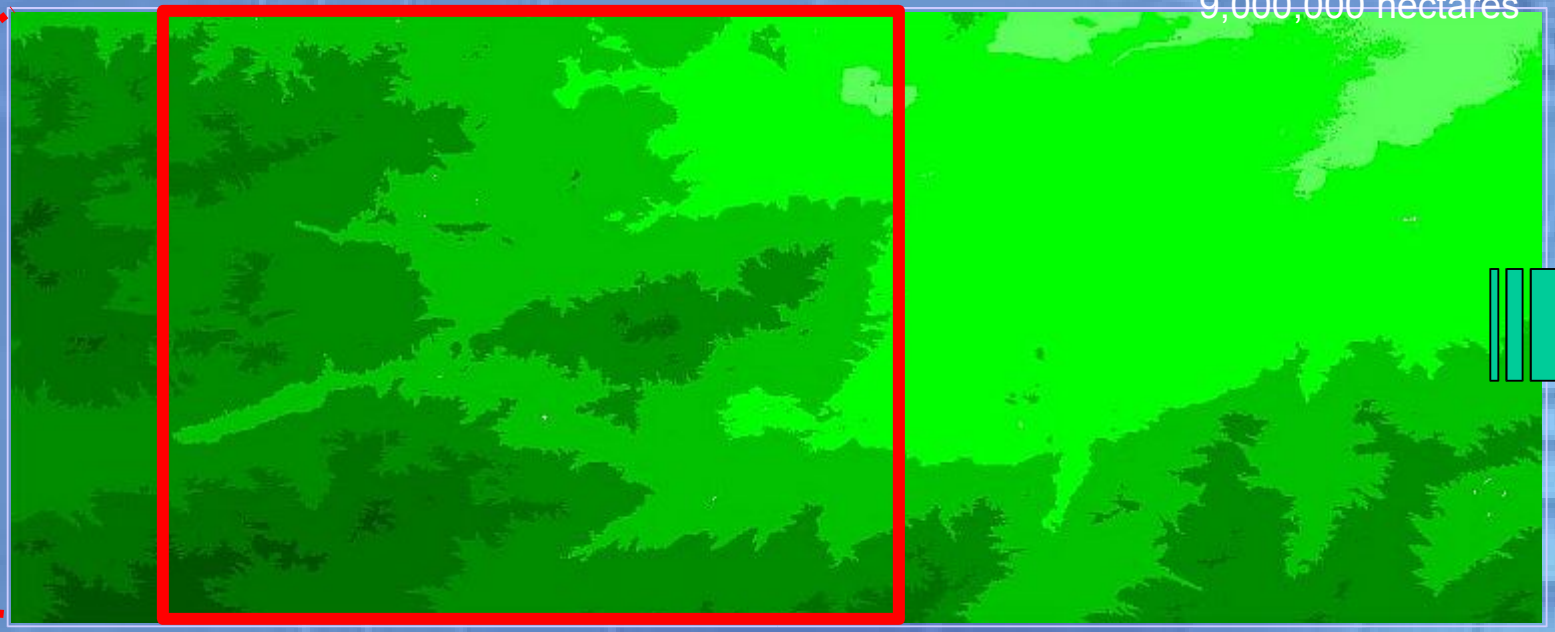


Numbers: topography

Gazelle survey
Choibalsan / Kherlen Gol / Dornod

Numbers: topography

Gazelle survey
Choibalsan / Kherlen Gol / Dornod
sample: [113.5E,46N] ➔
[115.5E,48N]
300 km x 300 km
9,000,000 hectares



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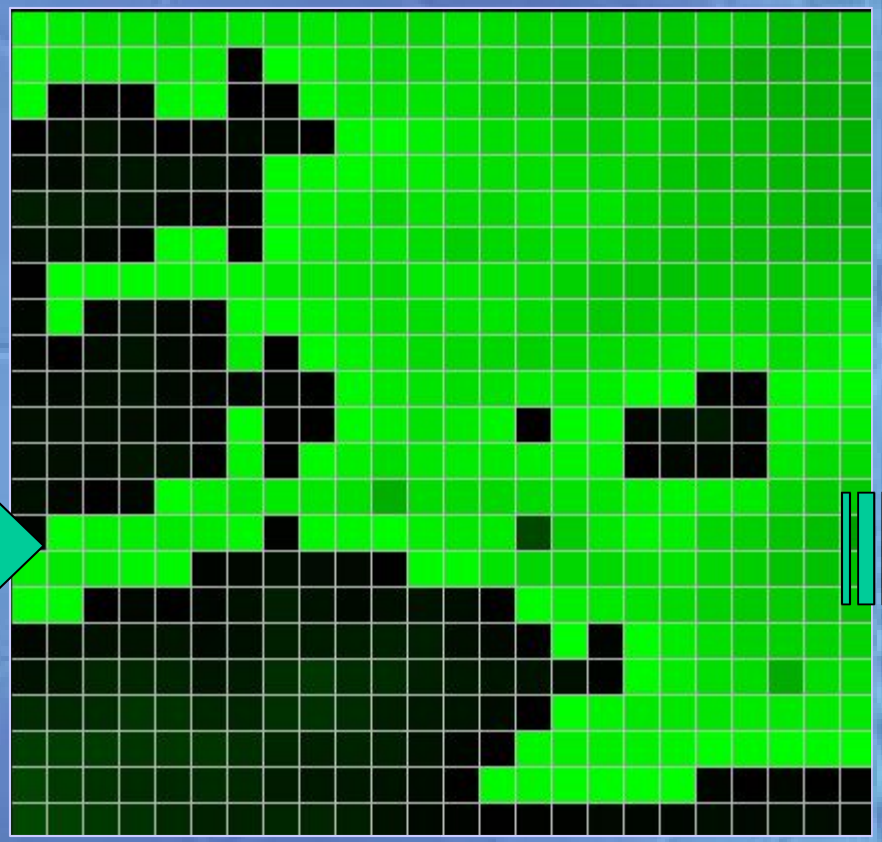
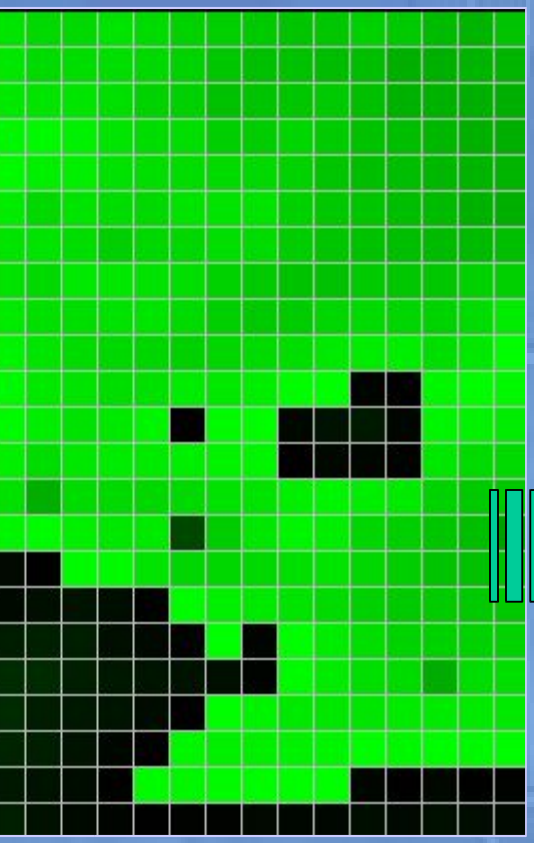
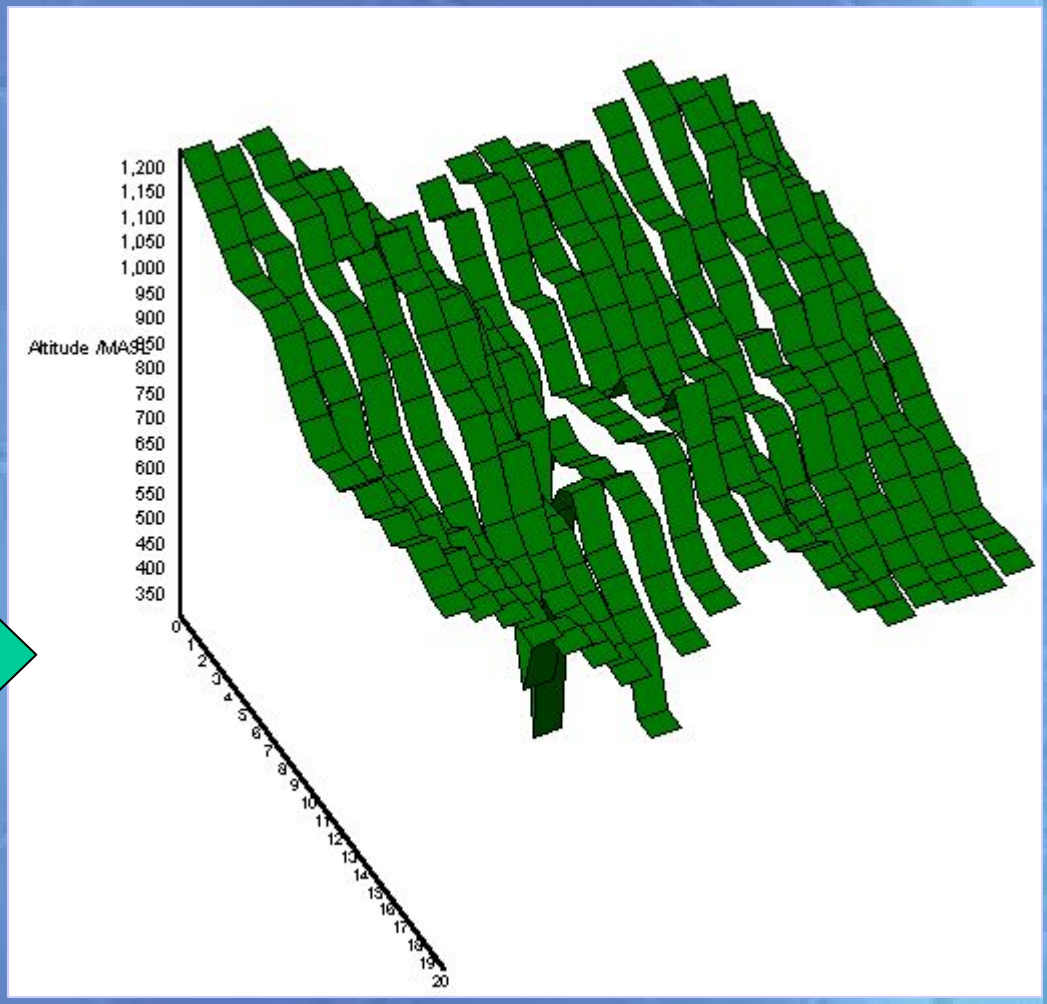
20 x 20 grid



Numbers: topography

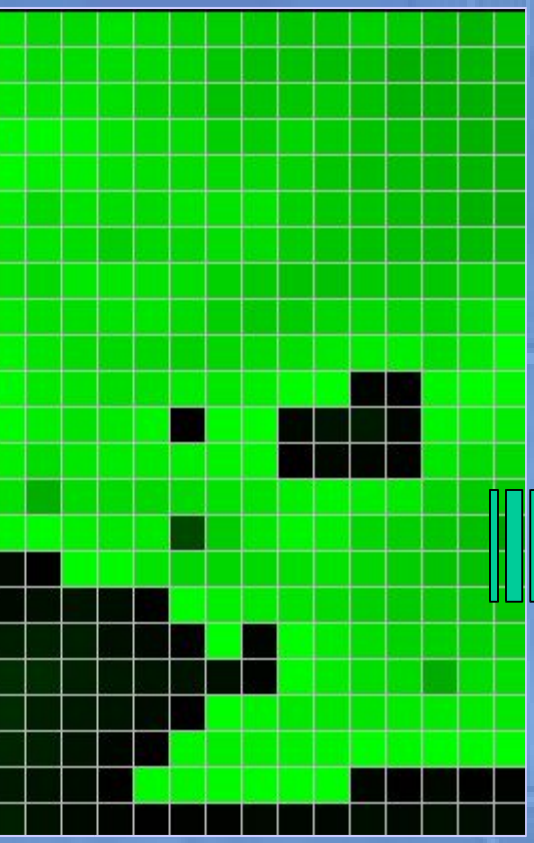
20 x 20 grid

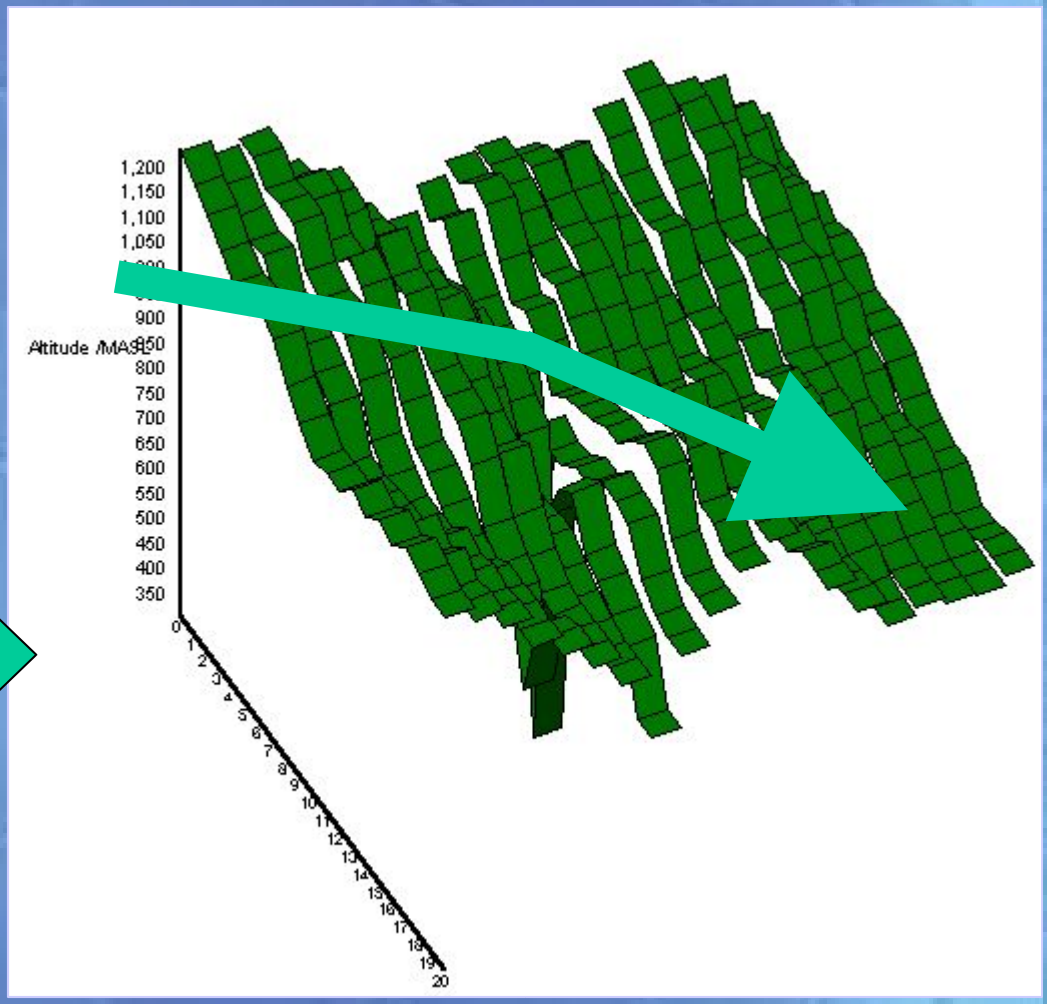




Numbers: topography

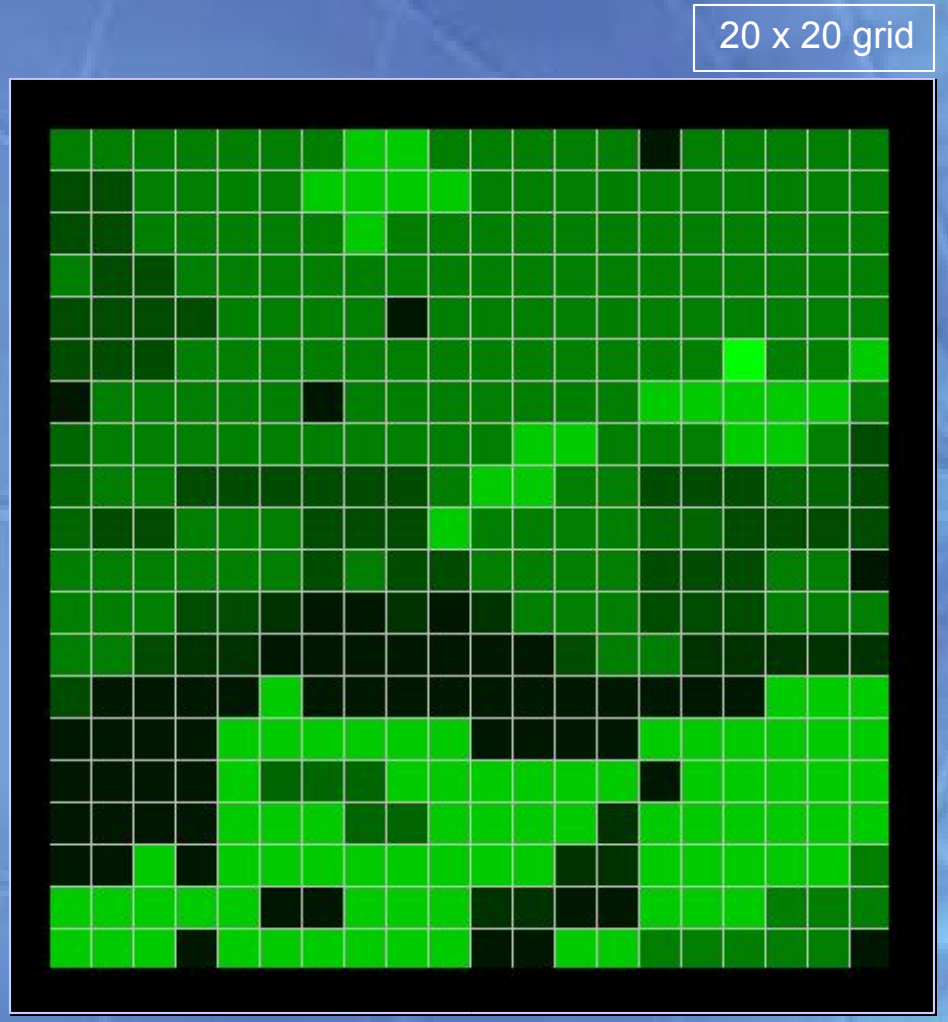
20 x 20 grid





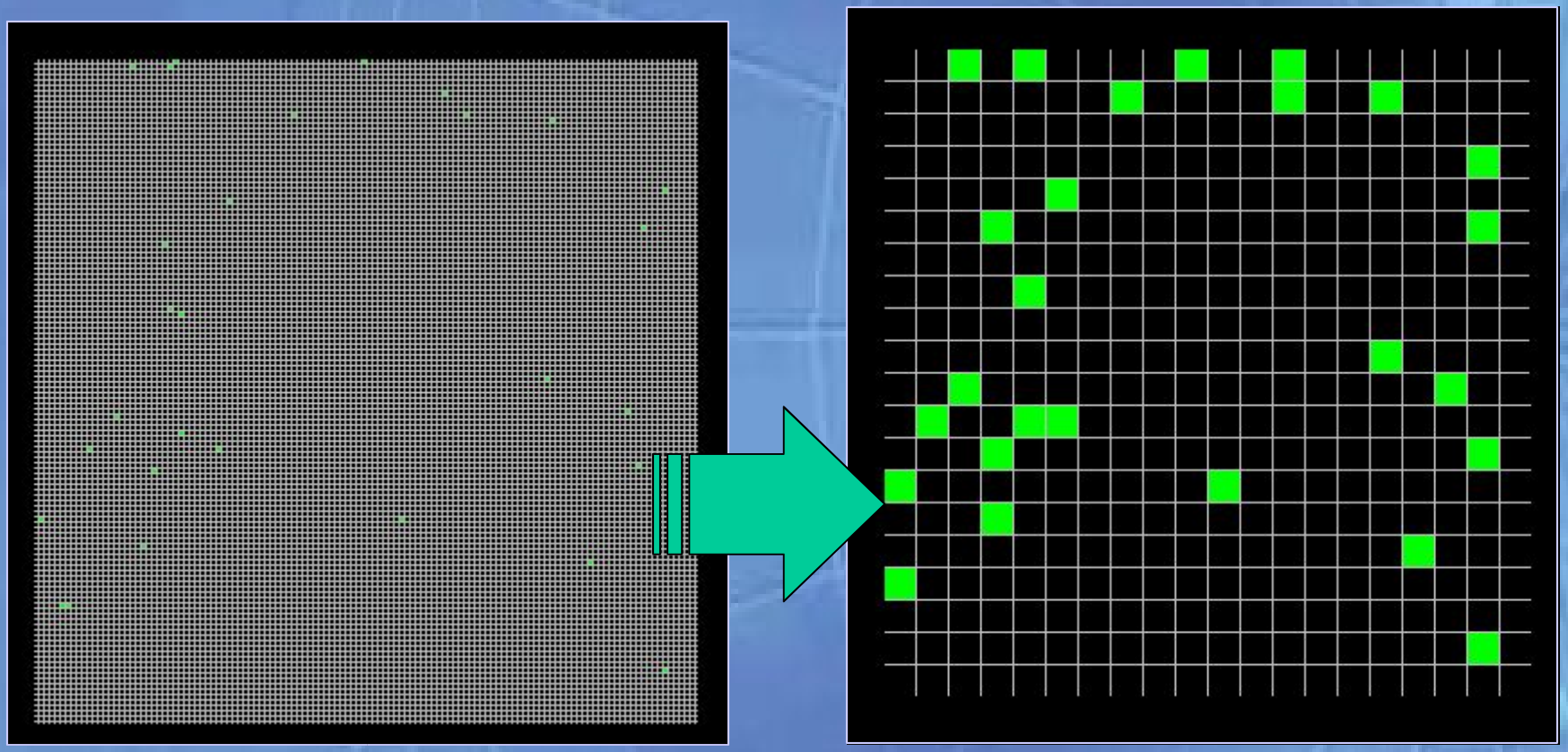
Numbers: grass

Starting distribution of grass



Numbers: sum centres

20 x 20 grid



Numbers: gazelle

Scientific data for the area

- 850,000 gazelle (66% female)
- 35 kg mature male
- 180 days gestation
- single breeding pulse ~10 days in late December
- 71% calf survival
- 12,500 gazelle die from disease each year
- 24,000 gazelle hunted each year in Choibalsan area

Social data for the area

- also possible to include colloquial data for the area,
  e.g., preferred hunting targets ⇨ mortality sequence

Scenarios: livestock competition

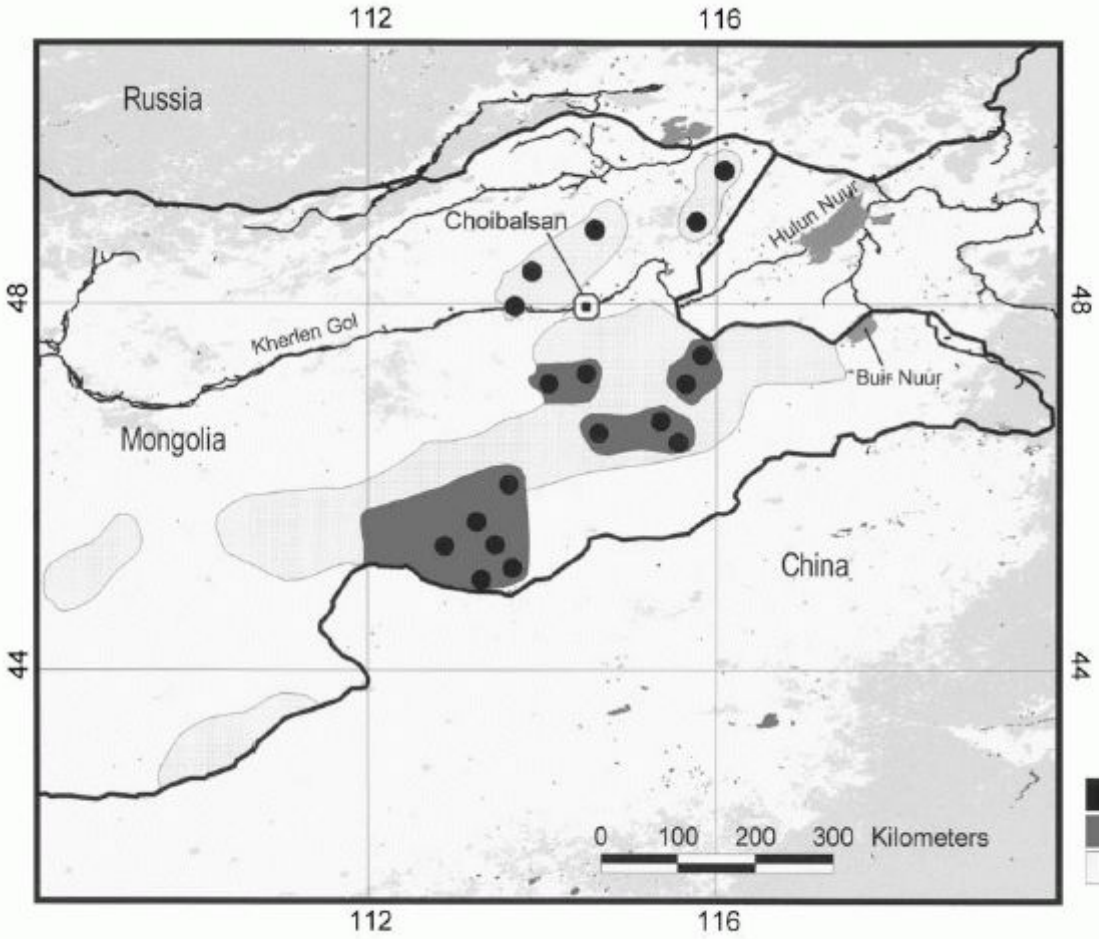
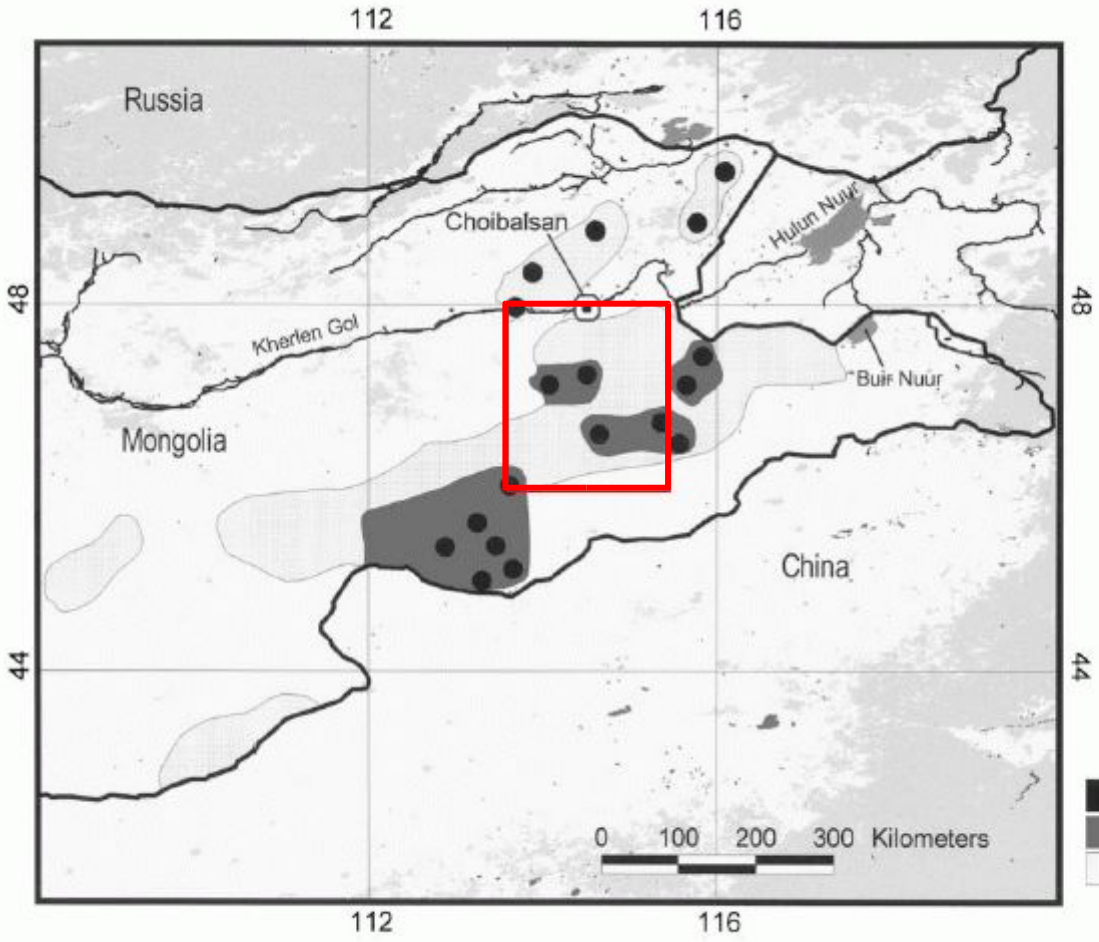


Fig. 2. Extent of known calving, summer, and winter grounds for Mongolian gazelles.

Scenarios: livestock competition



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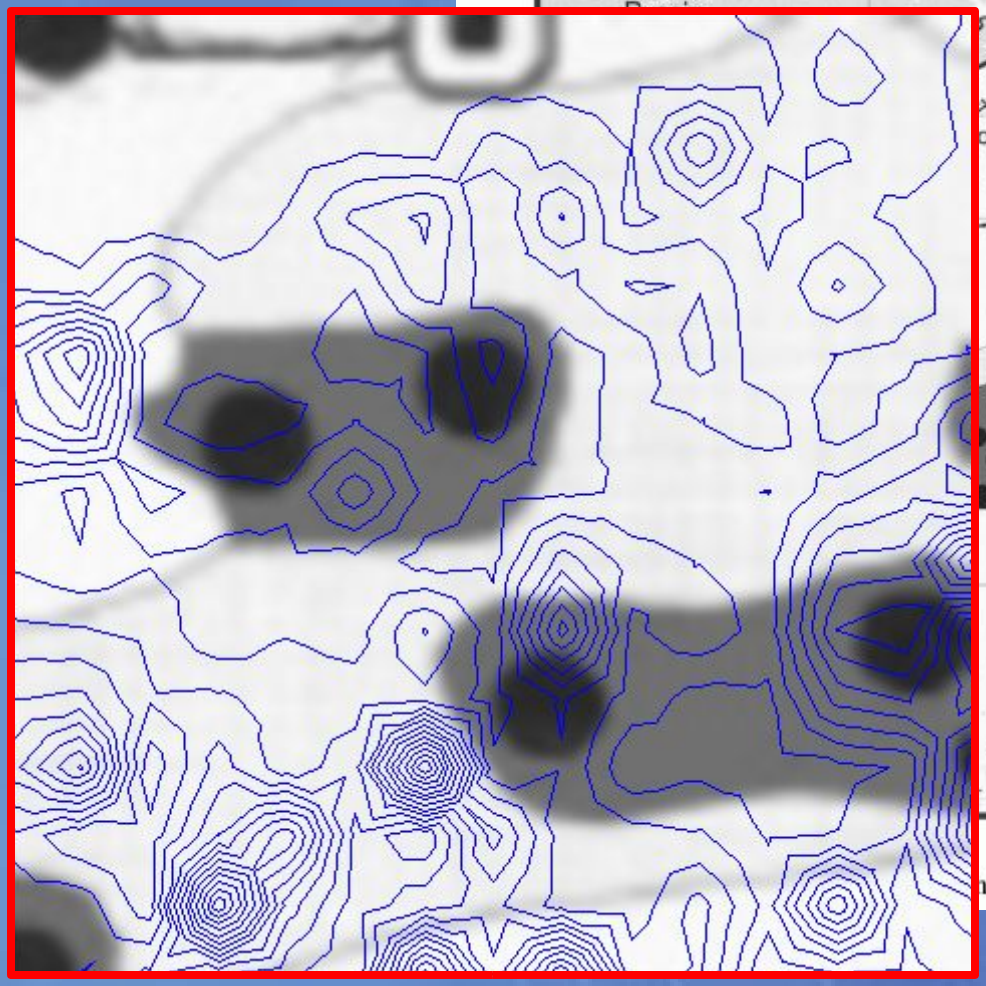
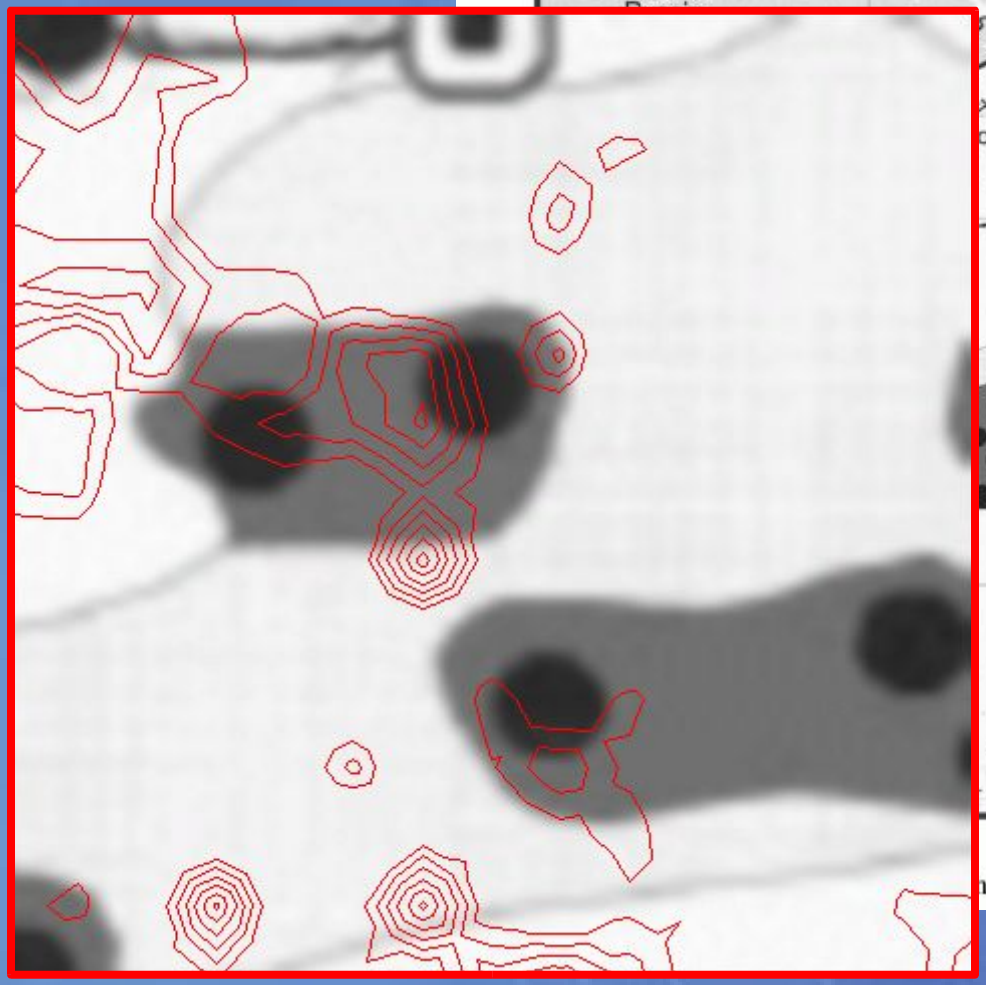


h calving, summer, and winter grounds for Mongolian gazelles.

Winter grounds

Scenarios: livestock competition

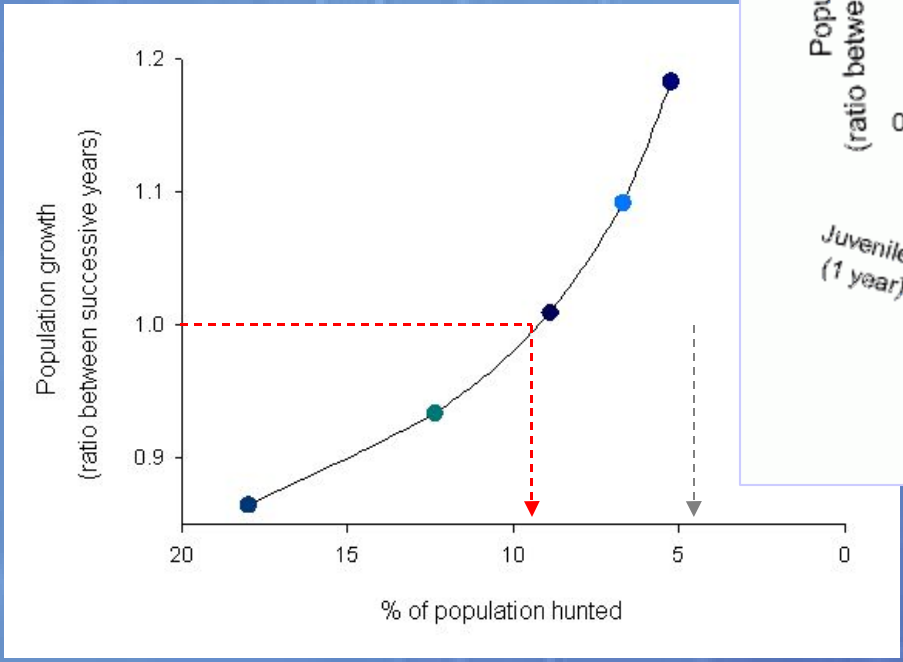


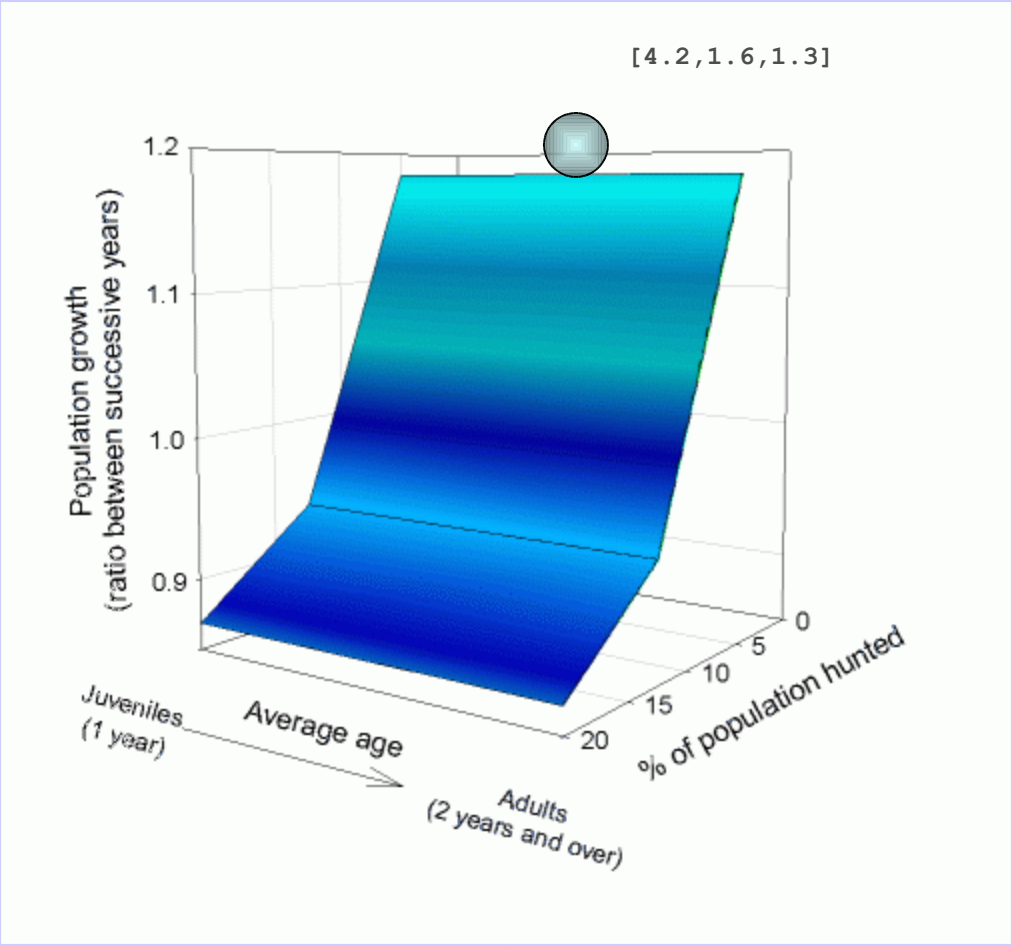
h calving, summer, and winter grounds for Mongolian gazelles.

Summer grounds

Scenarios: hunting

***NB*: *NO* large losses to disease**





Grassland Management #1

7 Lessons from the model...

1. Gazelle and livestock can co-exist, if the livestock herds are kept small.

2. Gazelle are least in competition with animals much larger than themselves - they feed on different plants and parts of plants.

3. Gazelle need to be able to find enough food to eat, especially in Winter. If where they need to go is blocked by railroads, roads, fences, etc., then this will limit their chances of surviving the Winter.

Grassland Management #2

4. Summer grounds are specialized areas that need to be protected because gazelles are choosing to go there because of the food that is there, particularly when they are calving.

5. Hunting is the major threat to survival of the gazelle.

6. Hunting is estimated to be about 4% at present, (but it is probably more) .

7. The gazelles will go into decline when hunting is killing 10% of the gazelle numbers, IF THERE ARE NO OTHER LARGE LOSSES TO DROUGHT AND DISEASE.