1-2014

Fragmentation of the Kitengela Ecosystem, Kenya

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ANNUAL REPORT FOR THE GNU PROJECT

1. I have completed data collection which includes the following;
   - Household survey administered 419 questionnaires
   - 30 focus group discussion
   - 12 Key informant interviews
   - 9 In depth interviews
   - Unstructured participant observations with GPS coordinates taken (419) of interviewed households and photos taken during data collection.

2. I have started one draft paper on land use choices in ASAL peri-urban Kajiado

3. I presented some of findings in the student led conference on 29th May 2013 by Centre for Sustainable Dryland Ecosystems and Societies (CSDES).

Below are some field photos taken during data collection;

Manual mining of gypsum in Ilipolasat sub-location of Isinya District. The quantities are not enough to engage heavy machinery. They sell at ks 2000 per tone. The mines are a danger to both wildlife and livestock.

Fencing for livestock led to invasive species making people abandon their homesteads. Livestock cannot eat it. It has thorns that prick if one desires to harvest fruits. It is very adapted to the ASAL conditions; hence harsh climatic conditions do not kill it.

Gypsum mining waste makes land unusable for both livestock grazing and crop production. The soil from the mines does not support life for up-to ten years. Local people use the soil dumps to look for mobile network like the one seen on top.

Above sign posts at a junction displaying land development activities in Kisaju area of Isinya.

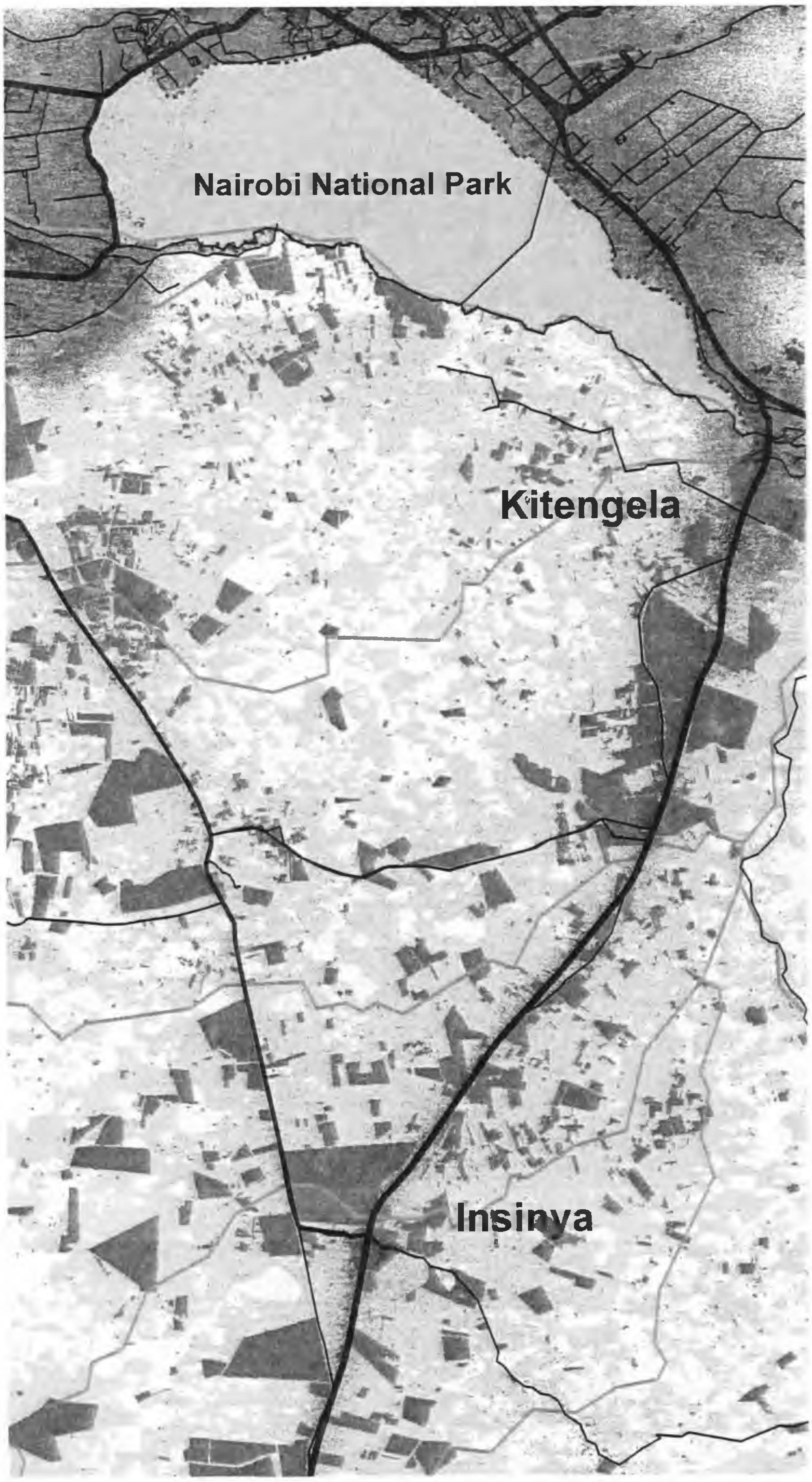
A homestead with goats in Ilipolsat sublocation showing how they nurture trees and protect them from destruction by livestock and wildlife

Double fencing in Ololoitikoishi that make livestock and wildlife movement impossible.

Gypsum mines develop into water ponds which attract livestock and wildlife to drink water. The soil is sticky, slippery and unstable; there is loss of wildlife and herders' normally loose livestock in the process as they get trapped while drinking water. The water ponds have fish which has attracted fishermen from other areas

A household in Ilipolasat sub-location showing the transition process from "Manyatta to the modern Maasai homestead; current typical housing structure in the study area.

Nairobi Alternative Futures Study
Scenario 1: Trend to 2040
Draft: May 10, 2013



Development Assumptions:

Study wide: 4.5% increase
- North: 3.5% increase
- South: 8.3% increase

Based on model of current probability as function of distance to roads, road density, and existing development density

Fencing Assumptions:

North - no fencing

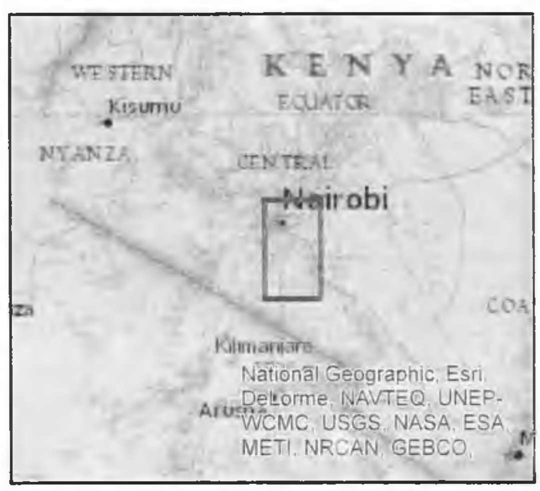
South - 5.08% annual increase up to cap of 75% of total area

Mimics current size distribution of fencing parcels

Fencing based on model of current probability as function of distance to water, distance to roads, and existing fencing density

Legend

- 2040 Developed
- 2040 Fenced
- Currently Developed
- Currently Fenced
- Nairobi National Park
- Rivers
- Roads



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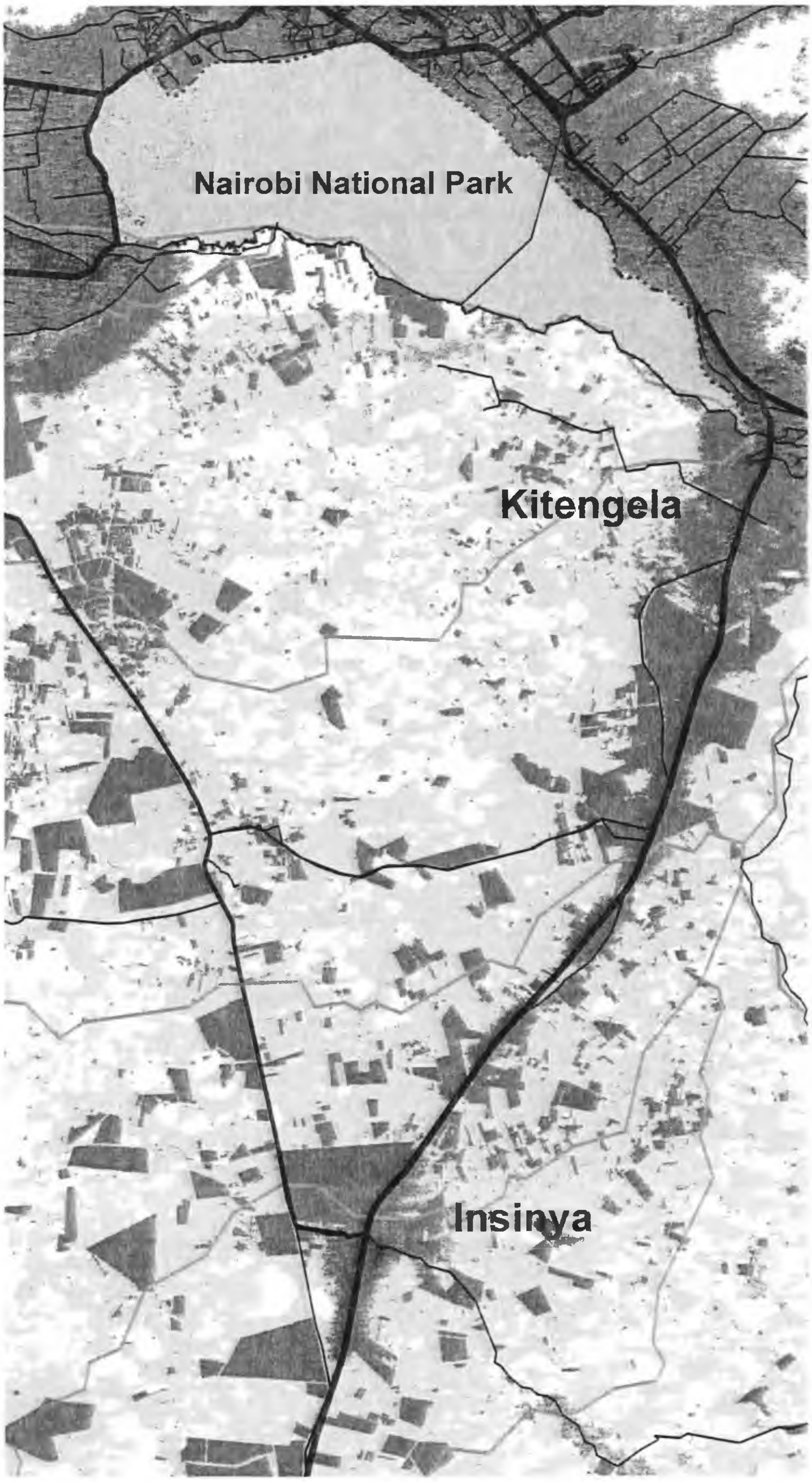
Nairobi Alternative Futures Study
Scenario 2: Trend with Smart Growth to 2040
Draft: May 10, 2013



Development Assumptions:

Study wide: 4.5% increase
- North: 3.5% increase
- South: 8.3% increase

Development is clustered
Based on model of current probability as function of distance to roads, road density, and existing development density

Fencing Assumptions:

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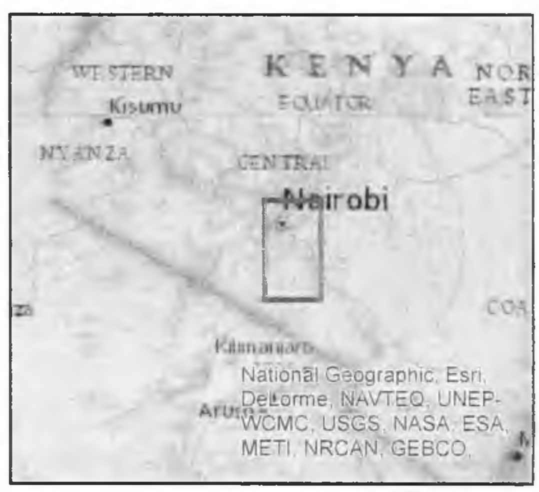

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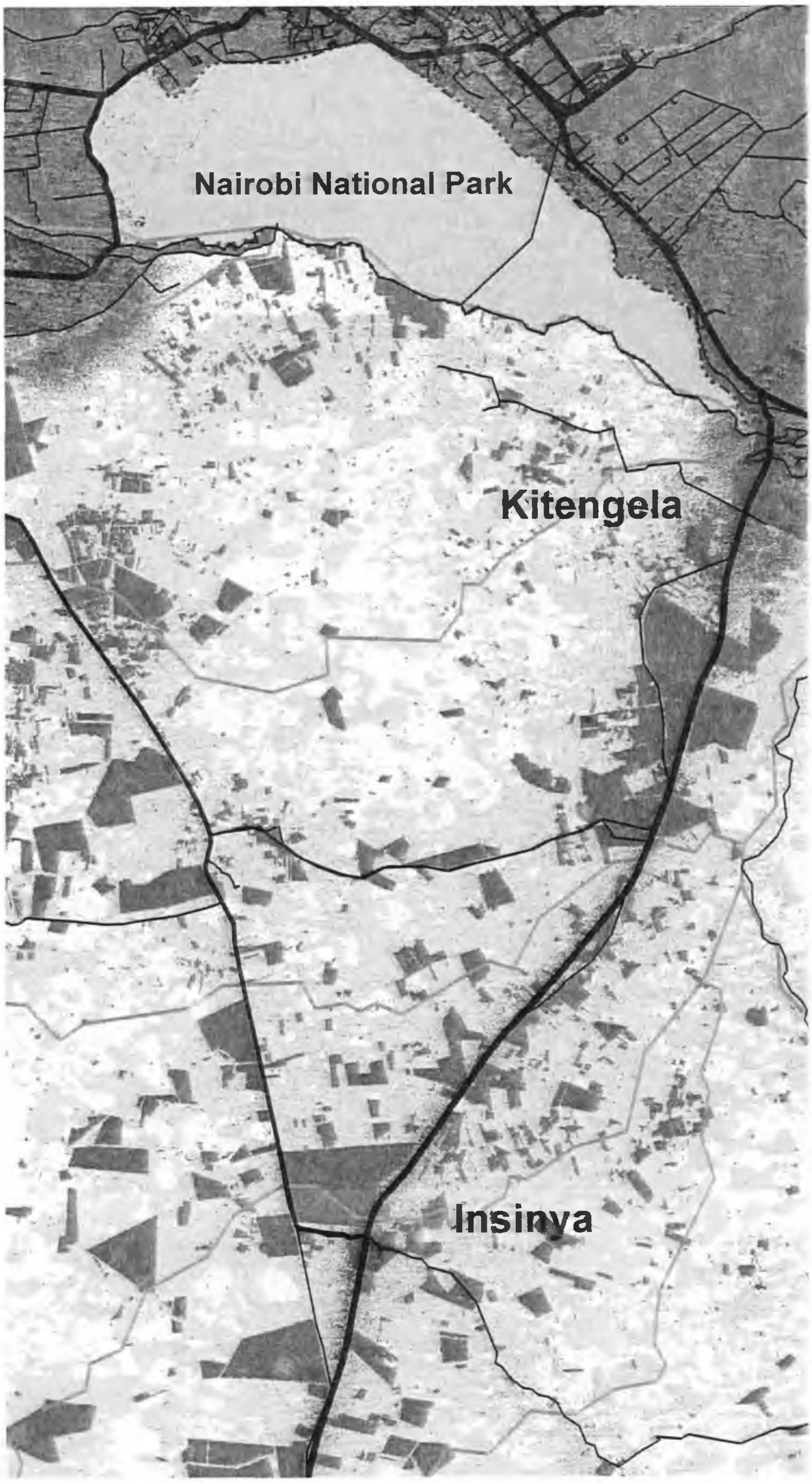
Nairobi Alternative Futures Study
Scenario 3: Increased Development to 2040
Draft: May 10, 2013



Development Assumptions:

Study wide: 6.0% increase
North: 4.5% increase
South: 10.7% increase
Based on model of current probability as function of distance to roads, road density, and existing development density

Fencing Assumptions:

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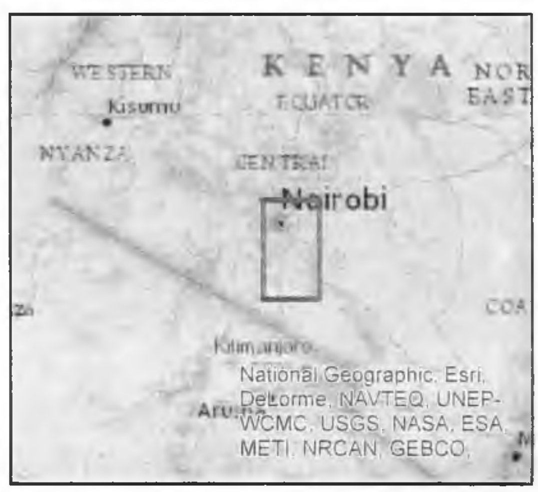

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Sustainable Forests

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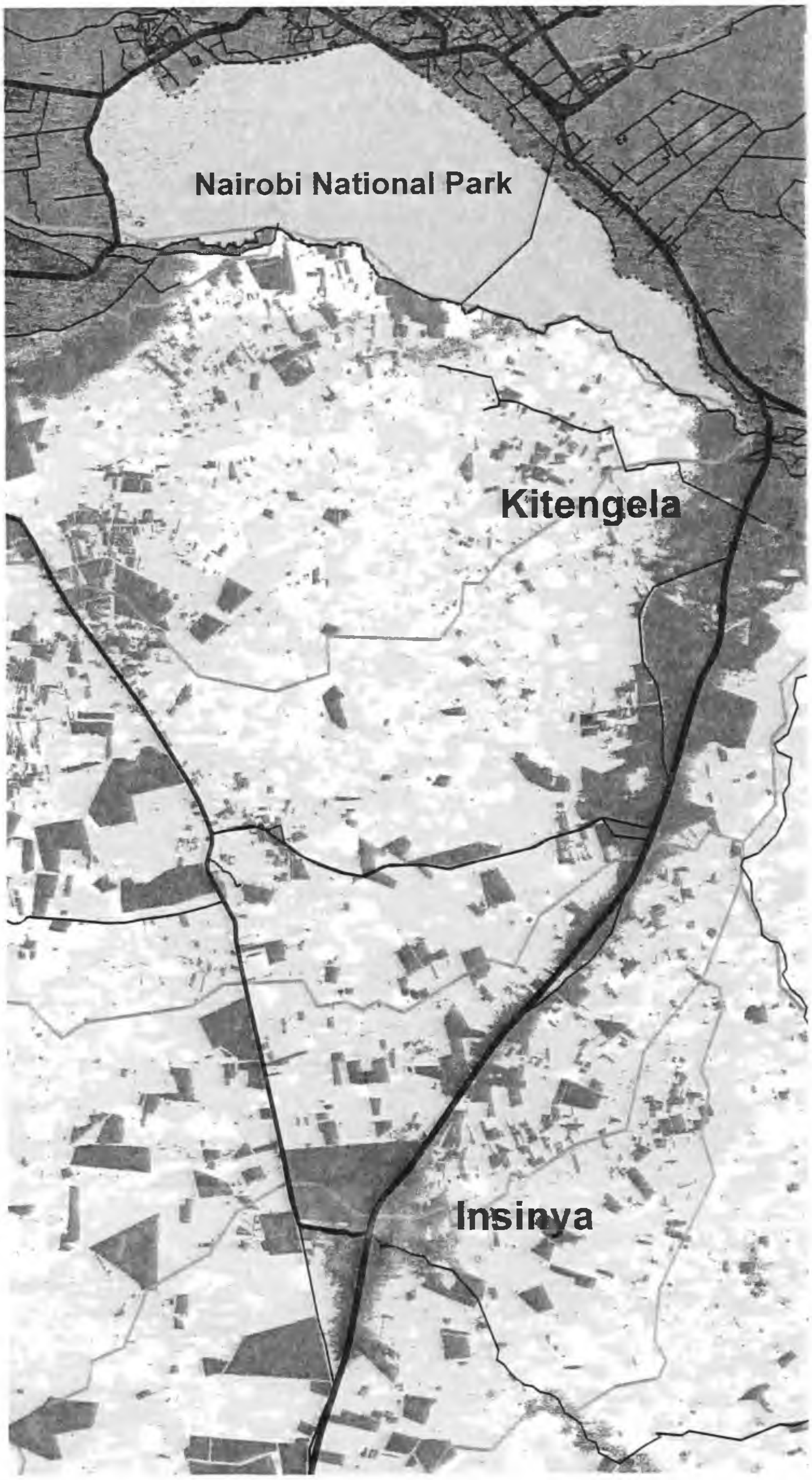
Nairobi Alternative Futures Study
Scenario 4: Increased Smart Growth Development to 2040
Draft: May 10, 2013



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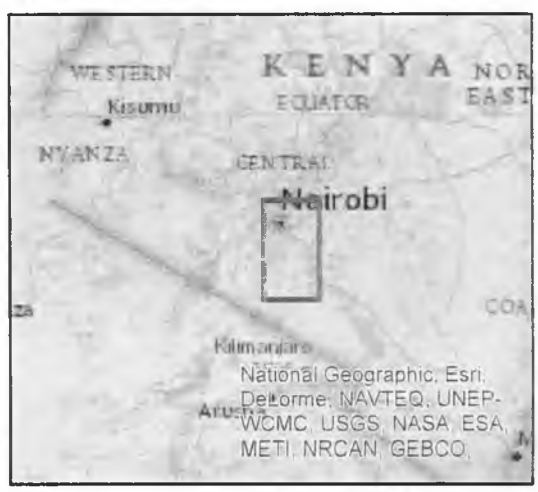

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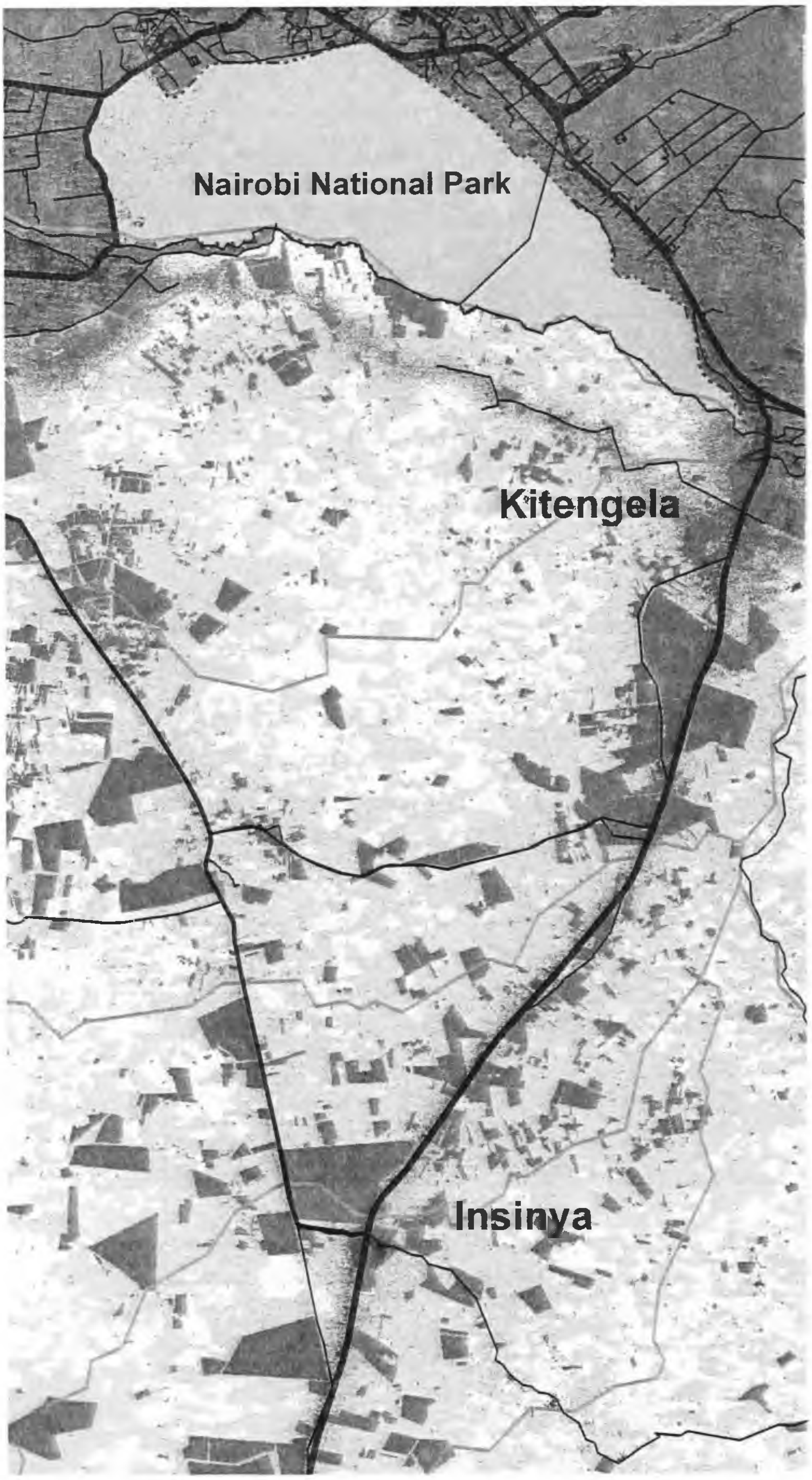
Nairobi Alternative Futures Study
Scenario 5: Increased Development & Transportation Infrastructure to 2040
Draft: May 10, 2013



Development Assumptions:

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North: 3.5% increase
South: 8.3% increase
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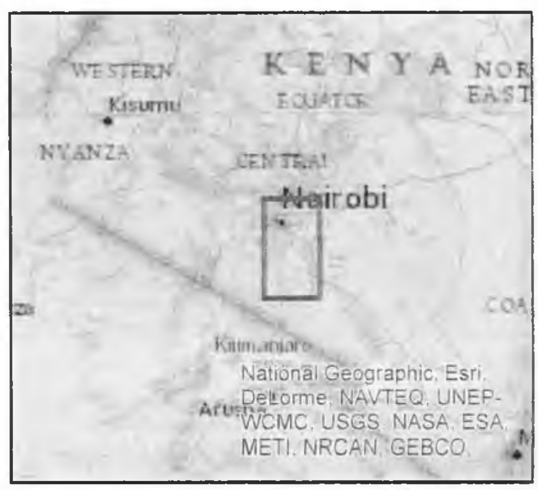

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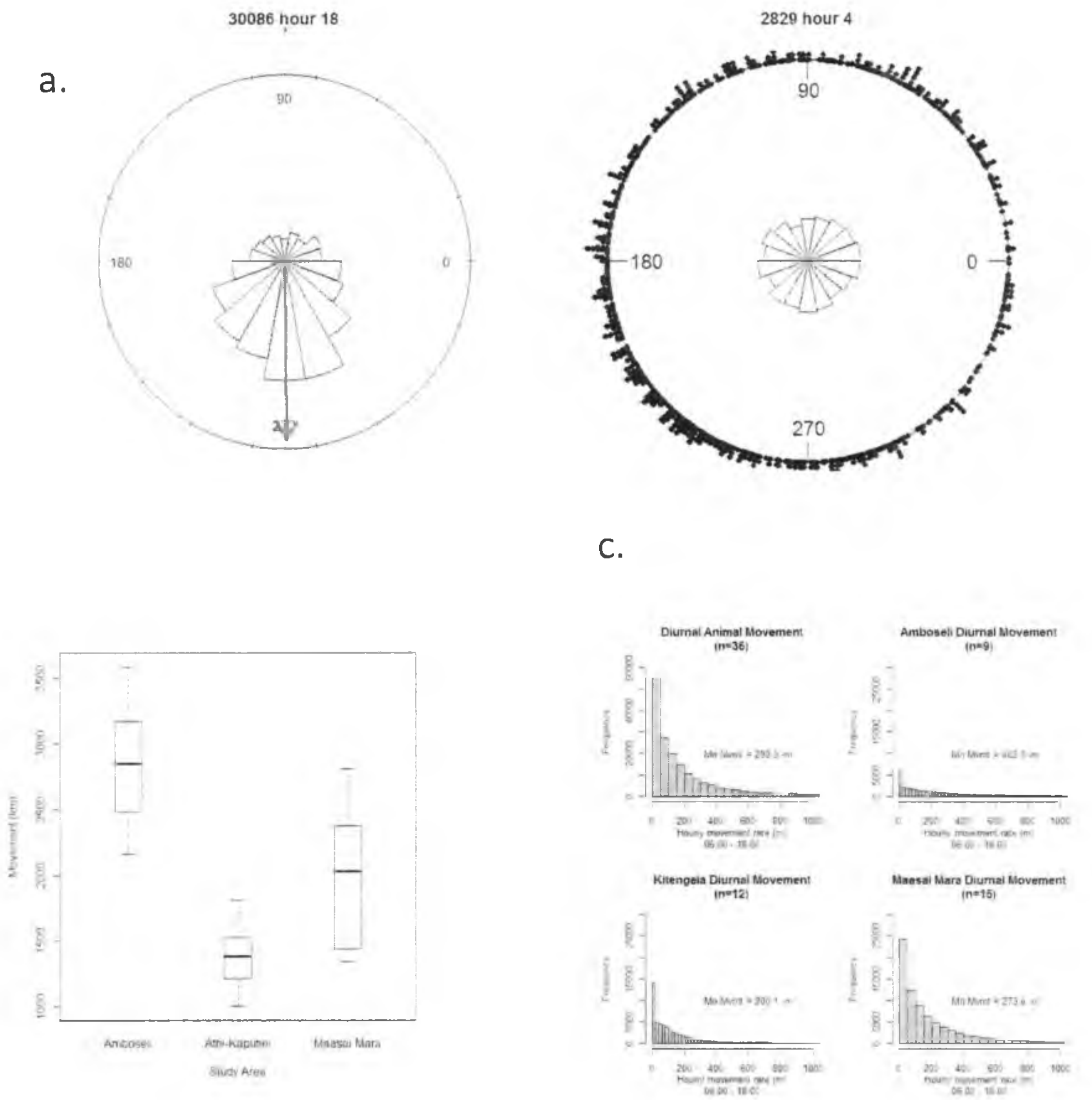


Fig. 1: Various summaries made from location data from individual wildebeest. Images above (a) represent directions of travel by selected animals. The (b) average total distance traveled by animals in our three study areas. Frequency distributions (c) of animals in the study areas.

Table 1. Coefficient estimates for both development and fencing models. Estimates for interaction terms are indicated. All estimates were significant at the $\alpha = 0.05$ level.

Coefficient	Dev_{north}	Dev_{south}	Fencing	Coefficient
B_0	-3.17	-5.66	-2.93	B_0
B_1	-1.21E-03	-3.17E-04	-1.69E-04	B_1
B_2	6.10E-04	1.02E-03	-1.12E-04	B_2
B_3	1.76	3.34	3.87E-04	B_3
dstrd : dden	1.05E-07	8.85E-07	3.97E-08	dstwat : dstrd
dstrd : rdden	-1.74E-03	2.58E-03	-5.19E-08	dstwat : fdden
dden : rdden	-2.54E-04	-3.26E-04	5.01E-08	dstrd : fdden
dstrd : dden : rdden	-2.59E-07	1.83E-06	-1.34E-11	dstwat : dstrd : fdden

Table 2. Error matrix for cover change map agreement assessment.

	Reference Data					
Classified Data	Structure/ Pavement	Other (combined)	Veg Dec 88-00	Veg Dec 00-09	Total	User's Accuracy
Structure/Pavement	23	4	2	2	31	74.19%
Other (combined)	2	57	0	0	59	96.61%
Veg Decrease 88-00	3	1	22	4	30	73.33%
Veg Decrease 00-09	3	7	2	18	30	60.00%
Total	31	69	26	24	150	
Overall Classification Accuracy [illegible]						

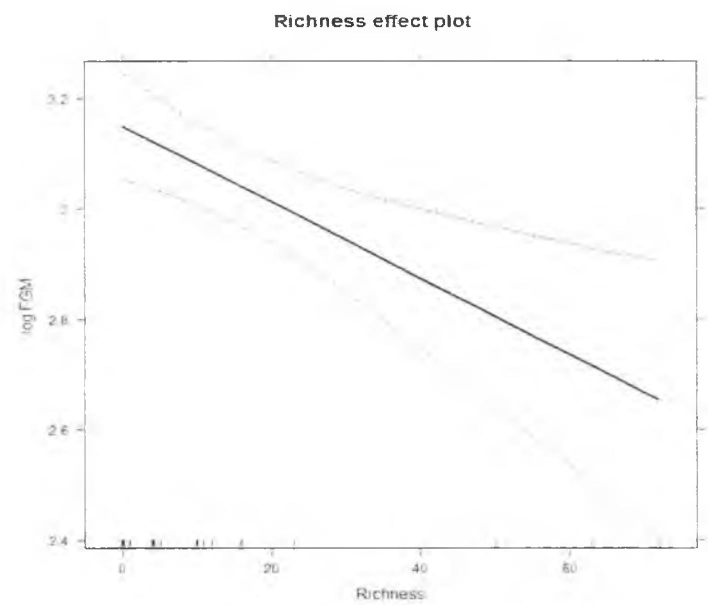


Fig. 2: Effect plot comparing the effect of local species richness with fGC metabolite concentration (log) throughout the Amboseli Basin study area. Confidence intervals provided for reference (red, dotted).

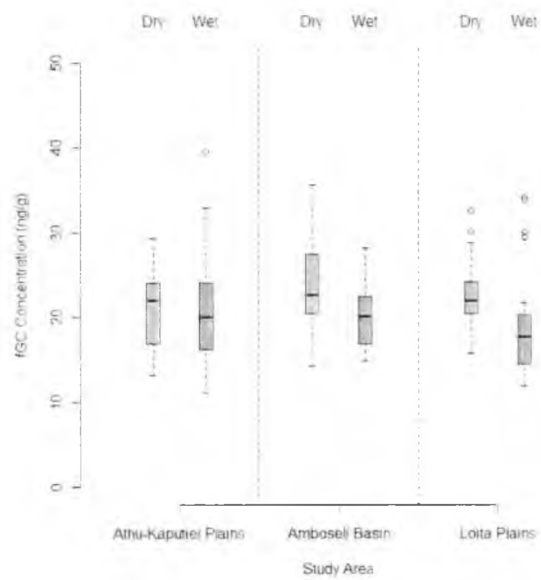


Fig. 3: Comparison of fecal glucocorticoid (fGC) metabolite concentration of sampled white-bearded wildebeest throughout three study areas in Kenya. Samples were collected throughout the dry and wet seasons throughout each study area.

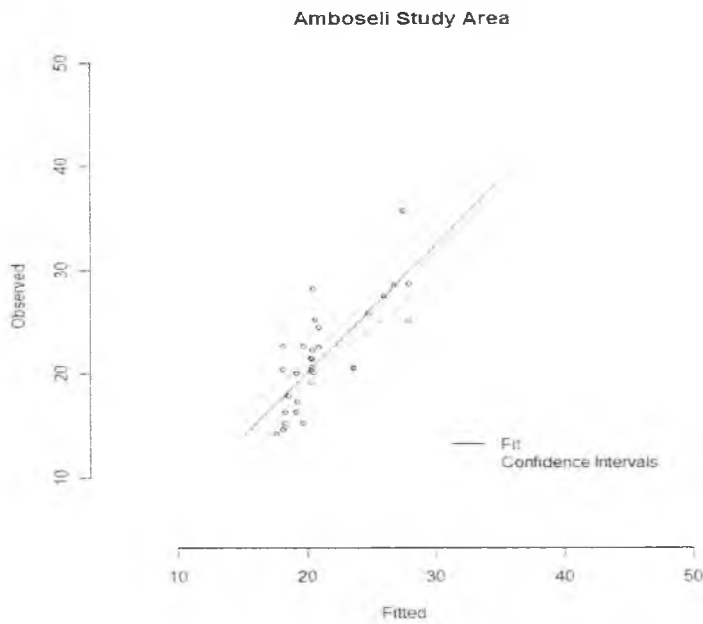


Fig. 4: Model fit for the Amboseli Basin, showing observed vs fitted vales of fecal glucocorticoid metabolites. 95% Confidence Intervals provide as reference.

Table 3. Candidate model rankings for predicting fecal glucocorticoid (fGC) metabolites for Kenyan resident white-bearded wildebeest.

Model[a]	K^b	AIC_c	$\Delta AIC_c{}^c$	$w_i{}^d$
Overall Study Model				
ln(Biomass)*Disturbance + ndviDiff*Disturbance + Landscan + Visit	10	2.15	0	0.28
ln(Biomass)*Disturbance + ndviDiff*Disturbance + Visit	9	2.71	0.56	0.21
ln(Biomass)*Disturbance + ndviDiff*Disturbance	8	3.50	1.35	0.14
ln(Biomass)*Disturbance + ndviDiff*Disturbance + Landscan + Visit + Richness	11	3.50	1.35	0.14
ndviDiff*Disturbance + Landscan + Visit	8	3.77	1.62	0.12
ln(Biomass)*Disturbance + ndviDiff*Disturbance + Landscan	9	3.99	1.84	0.11
Amboseli Basin				
Richness + Visit	5	-6.28	0	0.52
Richness + Visit + ndviDIFF	6	-4.95	1.33	0.27
Richness + Visit + SettDensity	6	-4.48	1.79	0.21
Athu-Kaputiei Plains				
ln(Biomass)*Disturbance + ndviDIFF	7	6.81	0	0.17
ln(Biomass)*Disturbance + ndviDIFF + Landscan	8	6.88	0.07	0.17
ln(Biomass)*Disturbance	6	7.10	0.29	0.15
ln(Biomass)*Disturbance + Visit	7	7.57	0.76	0.12
ln(Biomass)*Disturbance + Landscan	7	8.24	1.43	0.09
ln(Biomass)*Disturbance + Visit + Landscan	8	8.26	1.44	0.09
ndviDiff*Disturbance + Landscan	7	8.50	1.69	0.08
ndviDIFF*Disturbance + ln(Biomass)	7	8.64	1.82	0.07
ndviDIFF*Disturbance + ln(Biomass) + Landscan	8	8.68	1.87	0.07
Loita Plains				
Visit	4	9.18	0	0.10
Visit + ParkDistance + SettDensity + Richness	7	9.20	0.02	0.10
ndviDIFF + SettDensity	5	9.27	0.09	0.10
Visit + ParkDistance + SettDensity	6	9.54	0.36	0.08
Visit + SettDensity	5	9.58	0.40	0.08
Visit + Richness	5	9.66	0.48	0.08
ndviDIFF + SettDensity + Richness	6	9.92	0.74	0.07
Visit + SettDensity + Richness	6	9.93	0.75	0.07
ndviDIFF + ParkDistance + SettDensity	6	10.19	1.01	0.06
ndviDIFF + ParkDistance + SettDensity + Richness	7	10.30	1.12	0.06
ndviDIFF	4	10.78	1.60	0.05
Visit + ln(Biomass) + SettDensity + Richness	7	10.98	1.80	0.04
Landscan + ndviDIFF + SettDensity	6	11.11	1.93	0.04
Visit + ln(Biomass) + Richness	6	11.13	1.94	0.04
Visit + ParkDistance	5	11.17	1.99	0.04

[a] ndvi, Normalized Difference Vegetation Index.

[b] Number of estimable model parameters.

[c] Difference in value between Akaike's Information Criterion for small sample sizes (AIC_c) of the current and best model.

[d] Akaike weight: the probability that the current model is the best model.

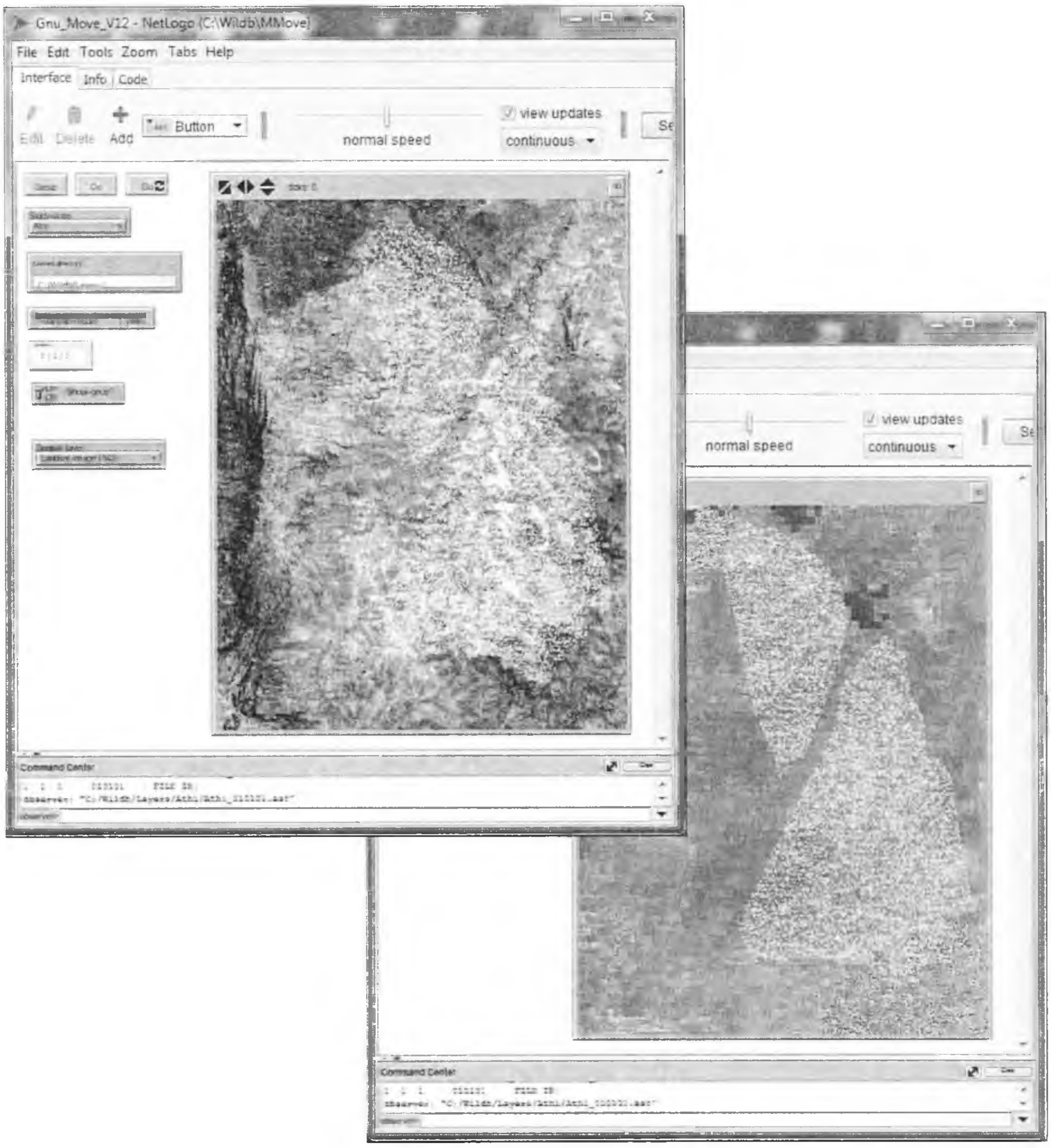


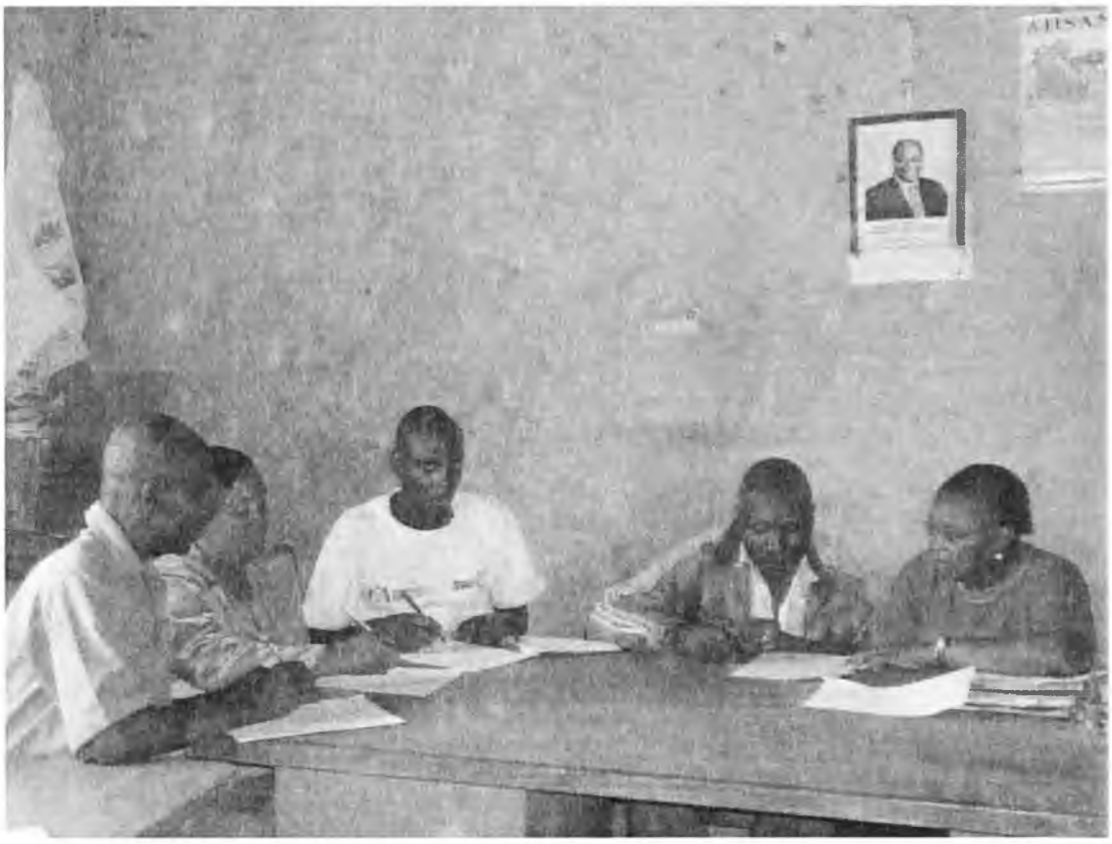
Fig. 5: The interface for our agent-based wildebeest model, showing Landsat imagery (left) and net primary production (right) for the Kitengela/Athi-Kaputiei Plains study area, with wildebeest initialized within their home ranges as defined from collar data.

Mboghoni location area Chief explains the challenges faced by banana producers in the irrigated zones of the district as a result of hippo attacks. (Inset – Judith and supervisors – Prof Charles Gachene and Dr Moses Nyangito)

A banana half eaten by Hippos – a major challenge in Mboghoni and Kitobo locations. Human-wilflife Conflicts are a threat to food security.

Habitat degradation – within the irrigated zones of Mboghoni location

Survival for the fittest- wildlife/livestock and local communities compete for water resources from L. Jipe. The shoats were driven away by elephants. Women who were fetching water literally ran away when the elephants approached. Watering places are good sites for livestock predation too.



Discussions with community/government leaders in Njukini location

PGIS session – Kitobo location – Local communities present resource changes by drawing mental maps (In red – Judith Mbau guiding the process)

Judith trains field enumerators/interpreters in readiness for socio-economic study

PGIS Session – Kitobo location – Participants discuss the mental maps drawn. Judith (In Red top) guiding the session

Invasion by *Prosopis juliflora* – a threat to livestock food resources.