Ninety years of pastoralists land use change – A case study from Northern Kenya

Horst Jürgen Schwartz[1], Neal W. Sobania[2], Markus G. Walsh[3]
[1]Faculty of Life Sciences, Humboldt University of Berlin;
[2]History, Pacific Lutheran University, Tacoma;
[3]Earth Institute at Columbia University, New York

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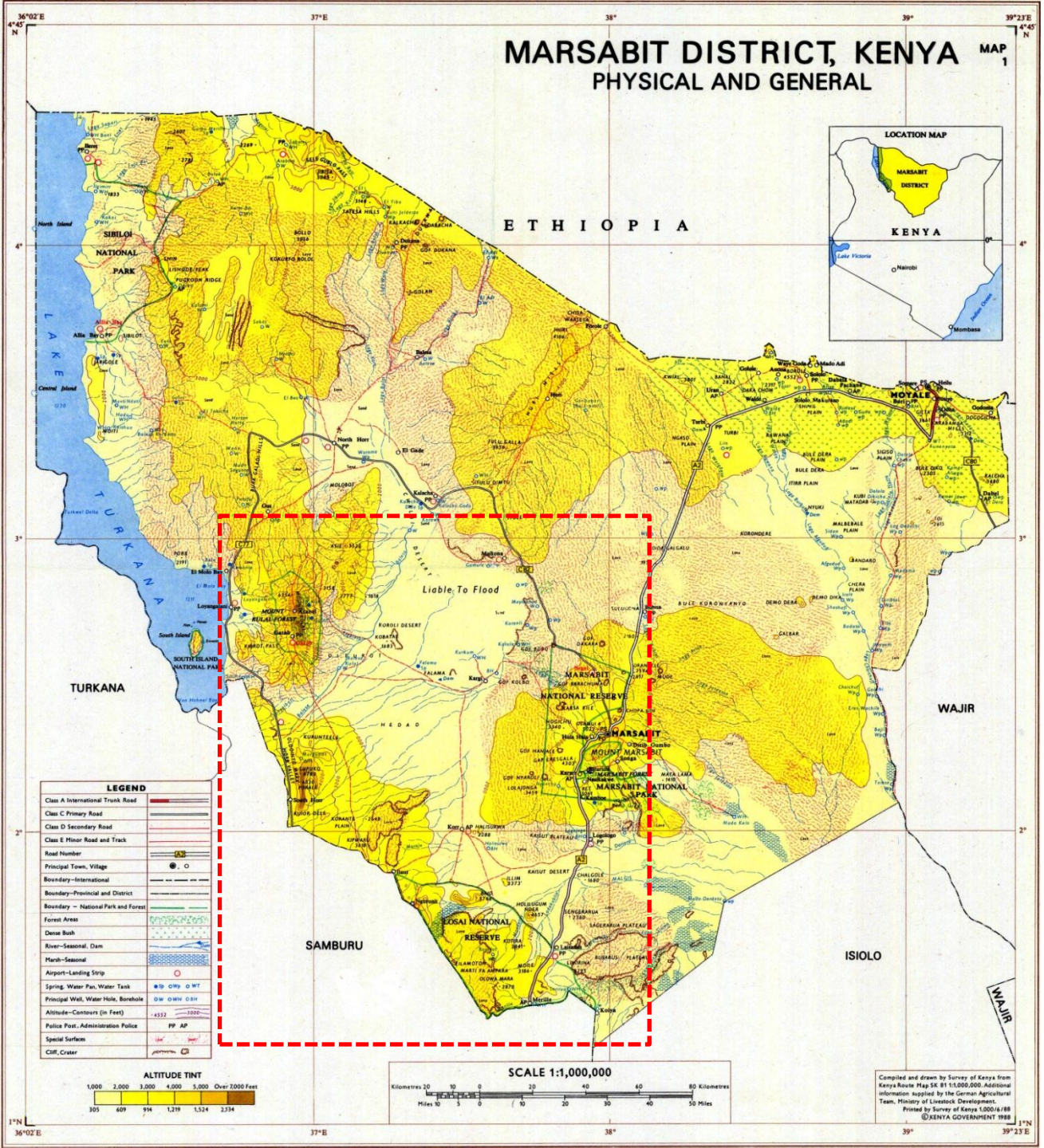


Marsabit District in Kenya borders Ethiopia. with the exception of a few mountain ranges going up to nearly 3000 m a.s.l. it is largely covered by lowlands between 400 and 700 m a.s.l. Correspondingly rainfall varies between 200 and to over 1000mm. Vegetation types vary between true desert through various grass- and bushlands to evergreen high biomass tropical mountain forest. The district, now county, amounts to approx. 75000 km² and carries a population of some 300000 inhabitants from several ethnic groups: Borana, Gabbra, Samburu, Dassanech, Burji, Rendille and others. Livestock herding is the main agricultural activity in the District.

Approximate study area

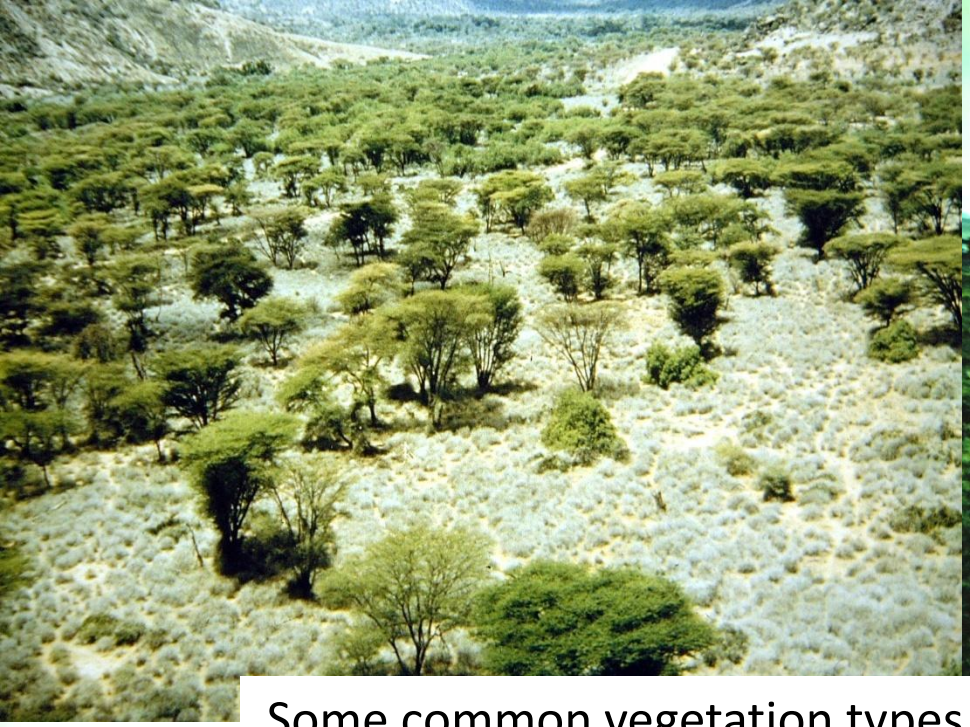
The South-Western Quarter of the District is the home range of the Eastern Cushitic-speaking **Rendille** pastoralists, who are predominantly camel herders but keep also sheep and goats. They number probably 25000 people and were well suited for this particular study.

The vegetation in this part of the district is rather varied. The larger lowlands are covered with thorn-bush savannah, dwarf shrublands and annual grasslands, some pockets of seasonal wetlands and saltpans. There are large areas covered in igneous gravel with considerable bush and shrub layers but of little use to herding because of the rough surface.

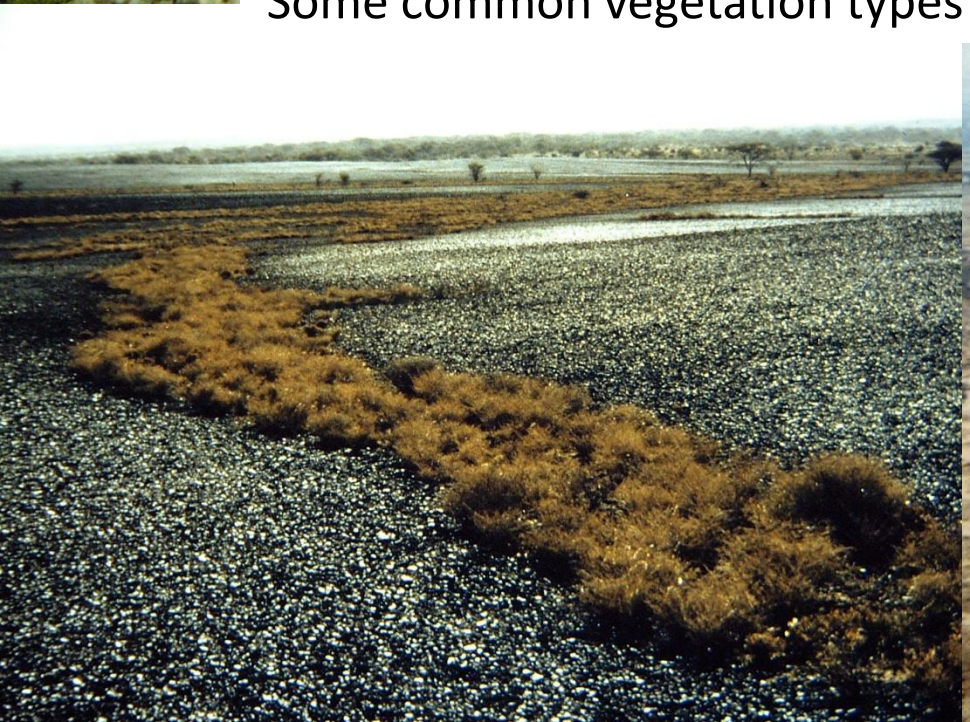
Mt. Marsabit, Mt. Kulal and OlDoinyo Mara carry substantial evergreen mountain forests.

Rain falls in two short seasons, March to May and October to November, the first season yielding 150 to 300 mm and the second one 100 to 150 mm with corresponding vegetation growth.

The herding system is best described as opportunistic horizontal nomadism.



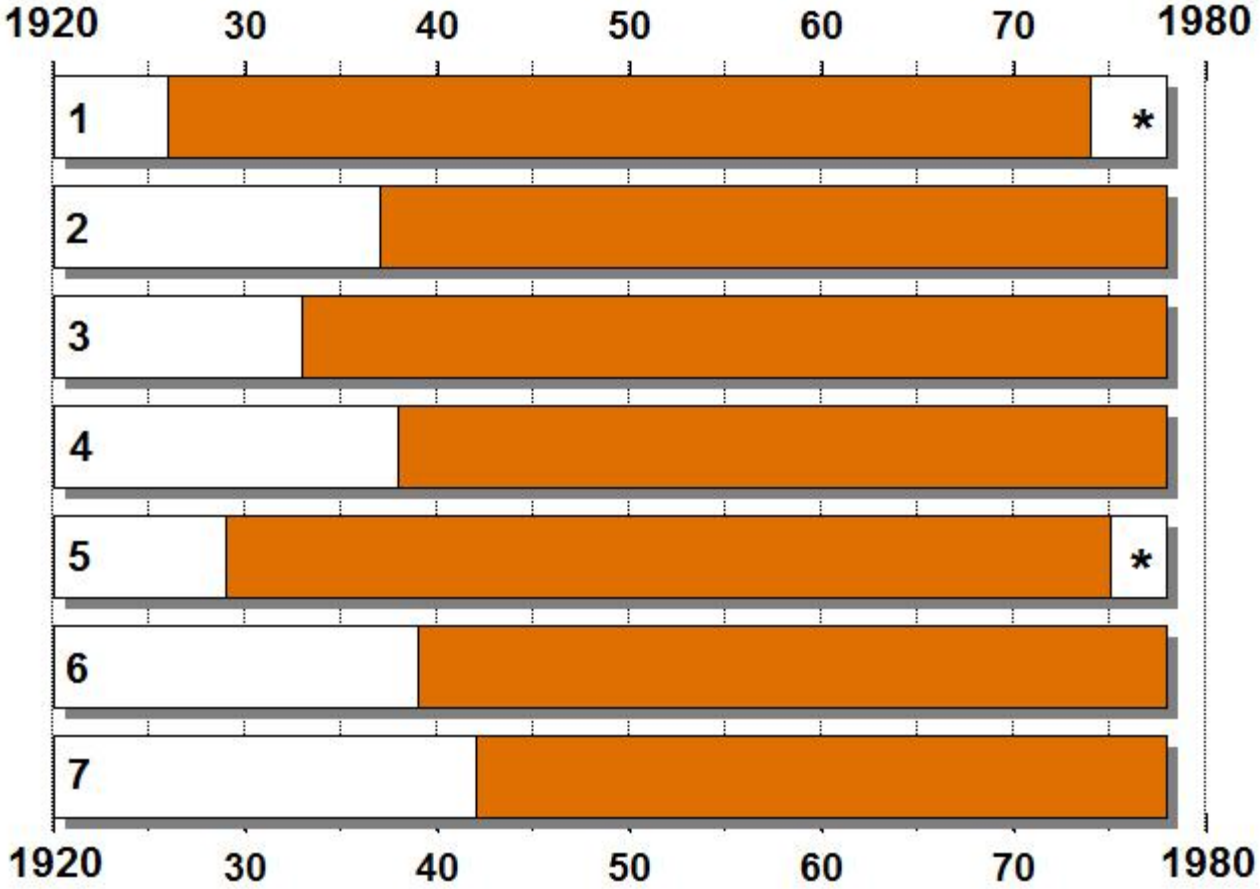
Some common vegetation types in South-West Marsabit District



Historical Survey 1927 - 1978

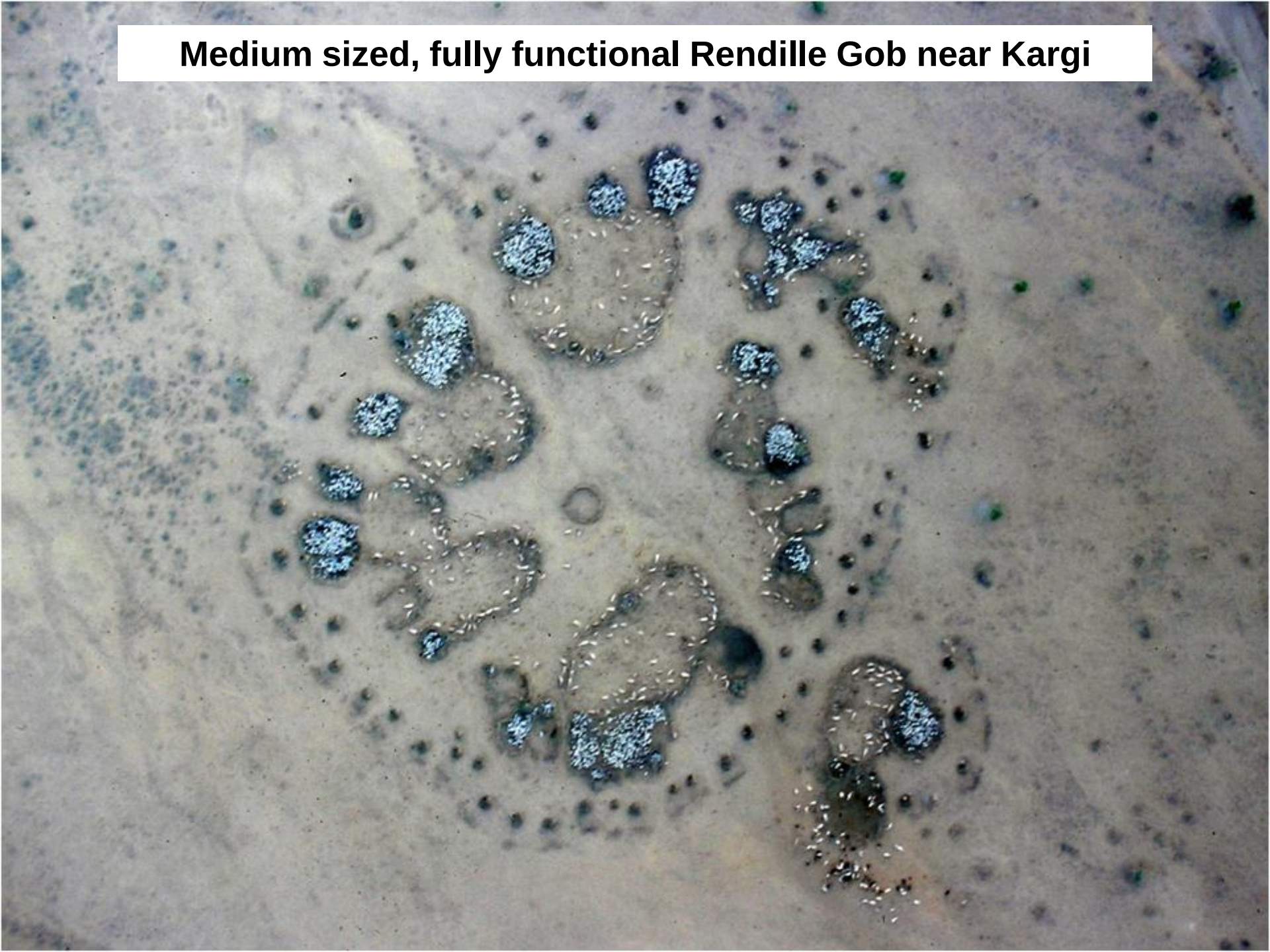
As part of a history of the peoples who live east of Lake Turkana, a survey was conducted among the pastoralist Rendille to better understand their pattern of migration. The research was aided significantly by the Rendille living in clan-based settlements, and their use of a calendar of years that can be correlated with Western dates. Elders from 7 clans were asked to name all the places in which they lived (settlements = gobs) and grazed their camels (herding camps = fora), beginning with the first time they personally went to fora camp (earliest date 1927) up to the present (1978). Each location (140 were identified) and migration from place to place was plotted on maps and summarized in 4 time periods. This showed clearly that in the earliest years, Period 1, 1927–1949, the Rendille followed a pasture management strategy of taking animals during the rainy season to graze as far away from natural permanent water as possible and only moving back toward permanent water as this temporary grazing became exhausted. With colonial government's water development of constructing bore holes and sinking of permanent wells, (Period 2, 1950–1962) both the frequency and distance of migration decreased significantly. This pattern continued after independence (Period 3, 1963-70) until, with the establishment and growth of missions and shops at permanent water sites in Period 4 (1971 – 1978), the movement of settlements almost ceased, followed by an unmistakable increase in desertification around sites of permanent water.

Time Frame of the Historical Survey 1927 - 1978

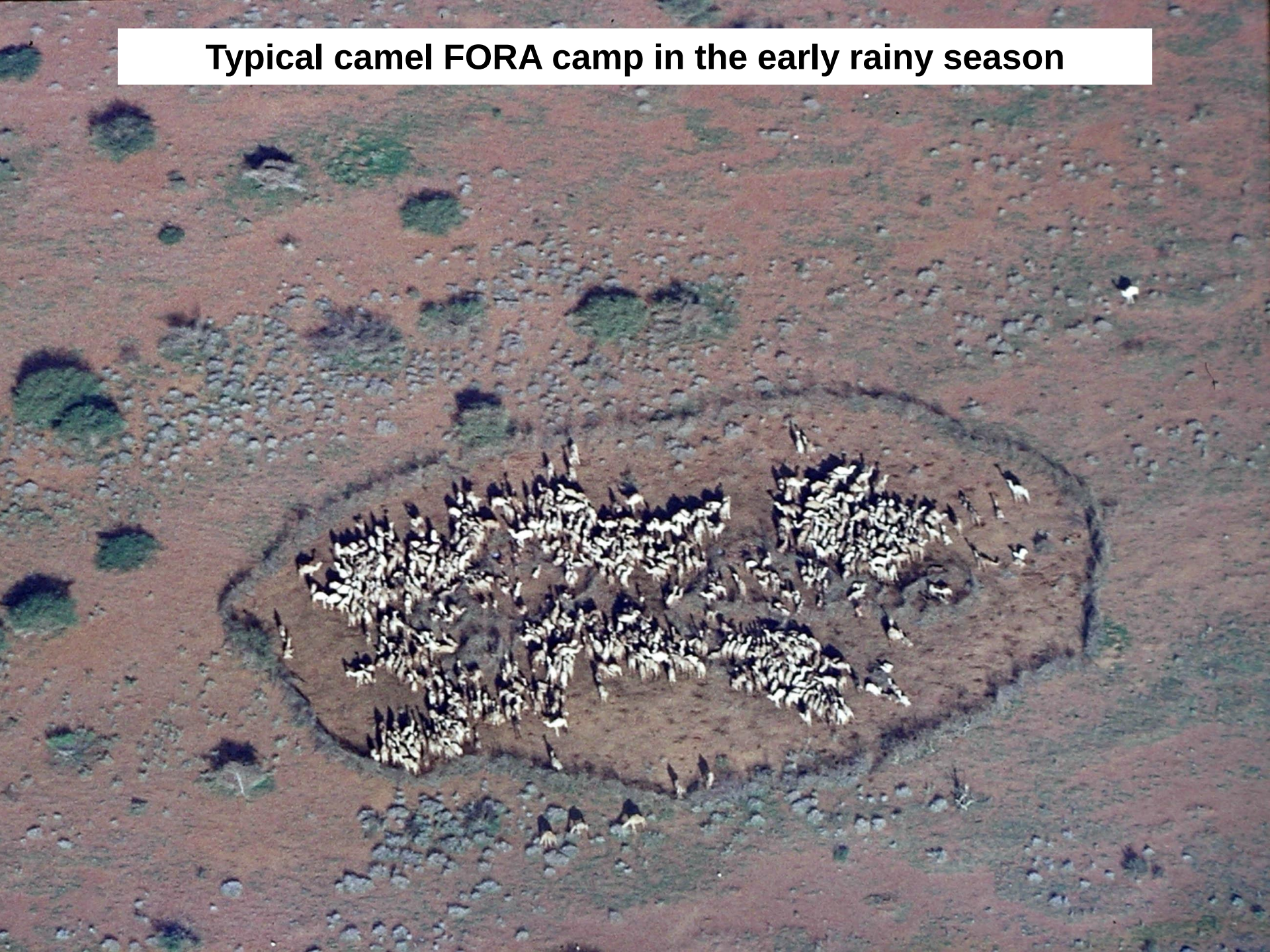


* No longer migrating

Medium sized, fully functional Rendille Gob near Kargi



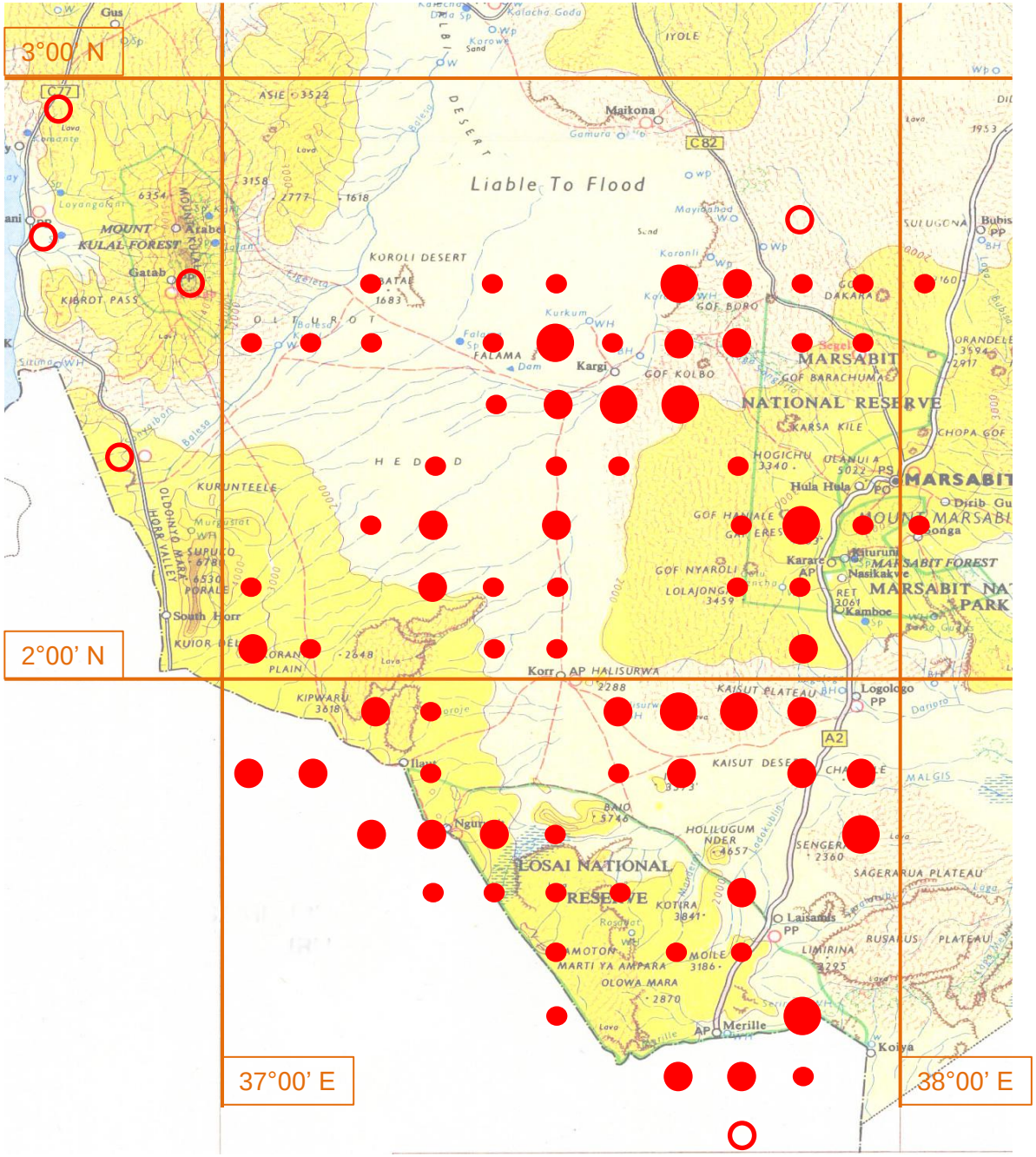
Typical camel FORA camp in the early rainy season



Number of Grid Squares (10x10km) occupied by seven clan settlements (gobs) and number of entrances by gobs into grid squares in four distinct time periods between 1941 and 1978

Time period	Number of grids occupied	Total number of movements	Movements within the present home range	
			Total period	Mean annual total
1941-49	81 (+30)*	589	499	55.4
1950-62	70 (24)*	564	506	38.9
1963-70	61 (+8)*	324	318	39.7
1971-78	35 (+1)*	248	237	29.6

* Figures in brackets indicate movements outside the 1980 home range

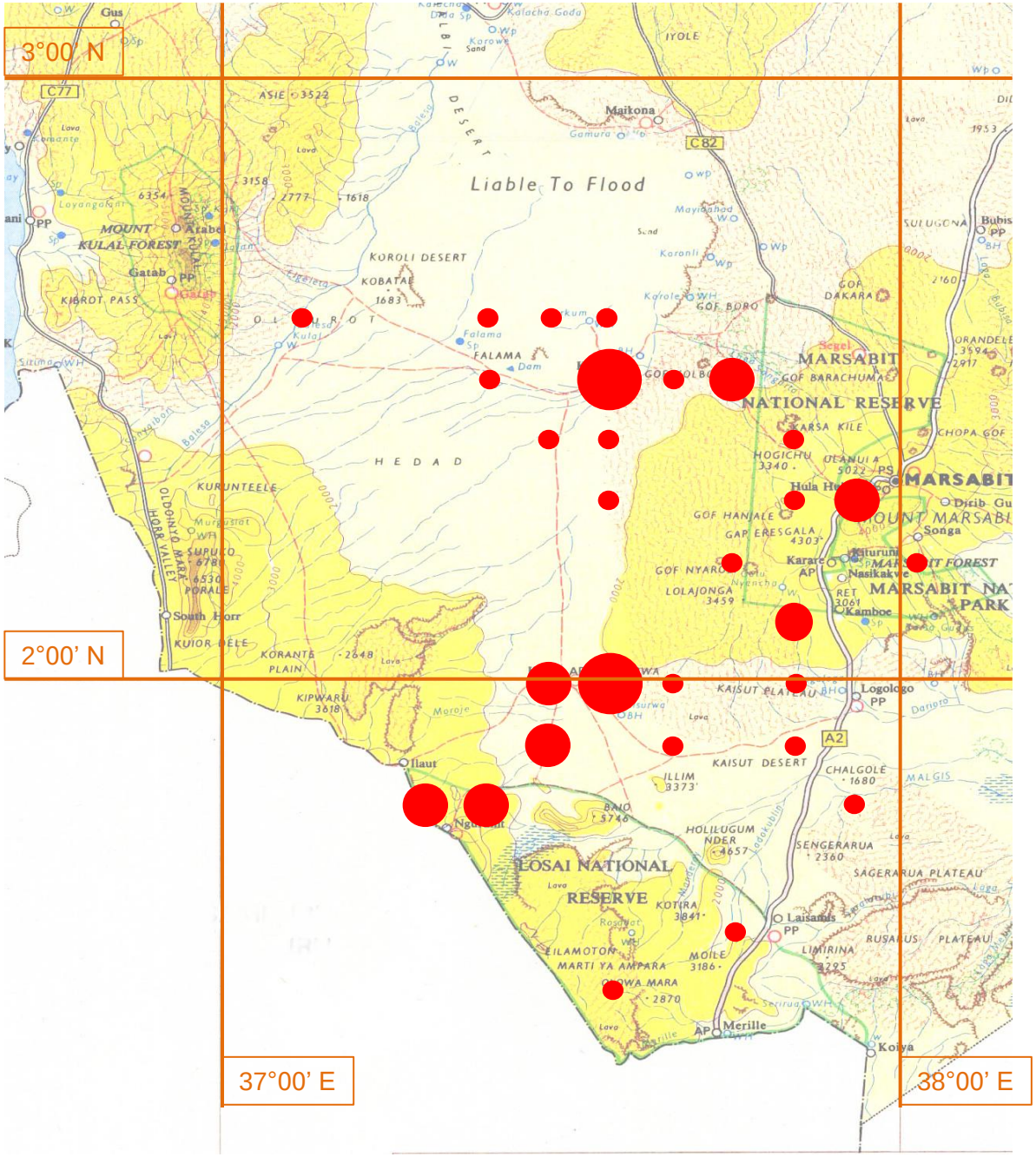


Occupation frequency* of South Western Marsabit District recorded for seven Rendille gobs for the time period **1941 - 1949**

*number of in-migrations into defined 10x10 km grid squares

- 1 - 2
- 3 - 5
- 6 - 10
- 11 - 20
- > 20

- pre-1941 sites



Occupation frequency* of South Western Marsabit District recorded for seven Rendille gobs for the time period **1971 - 1978**

*number of in-migrations into defined 10x10 km grids

- 1 - 2
- 3 - 5
- 6 - 10
- 11 - 20
- > 20

Aerial Survey 1979 - 1980

In an effort to determine short term land use and migration patterns in the Rendille home range 12 aerial surveys were carried out at approximately two-monthly intervals over two years in 1979 to1980. Due to technical difficulties and bad weather conditions only nine out of the 12 surveys could be used for the analysis.

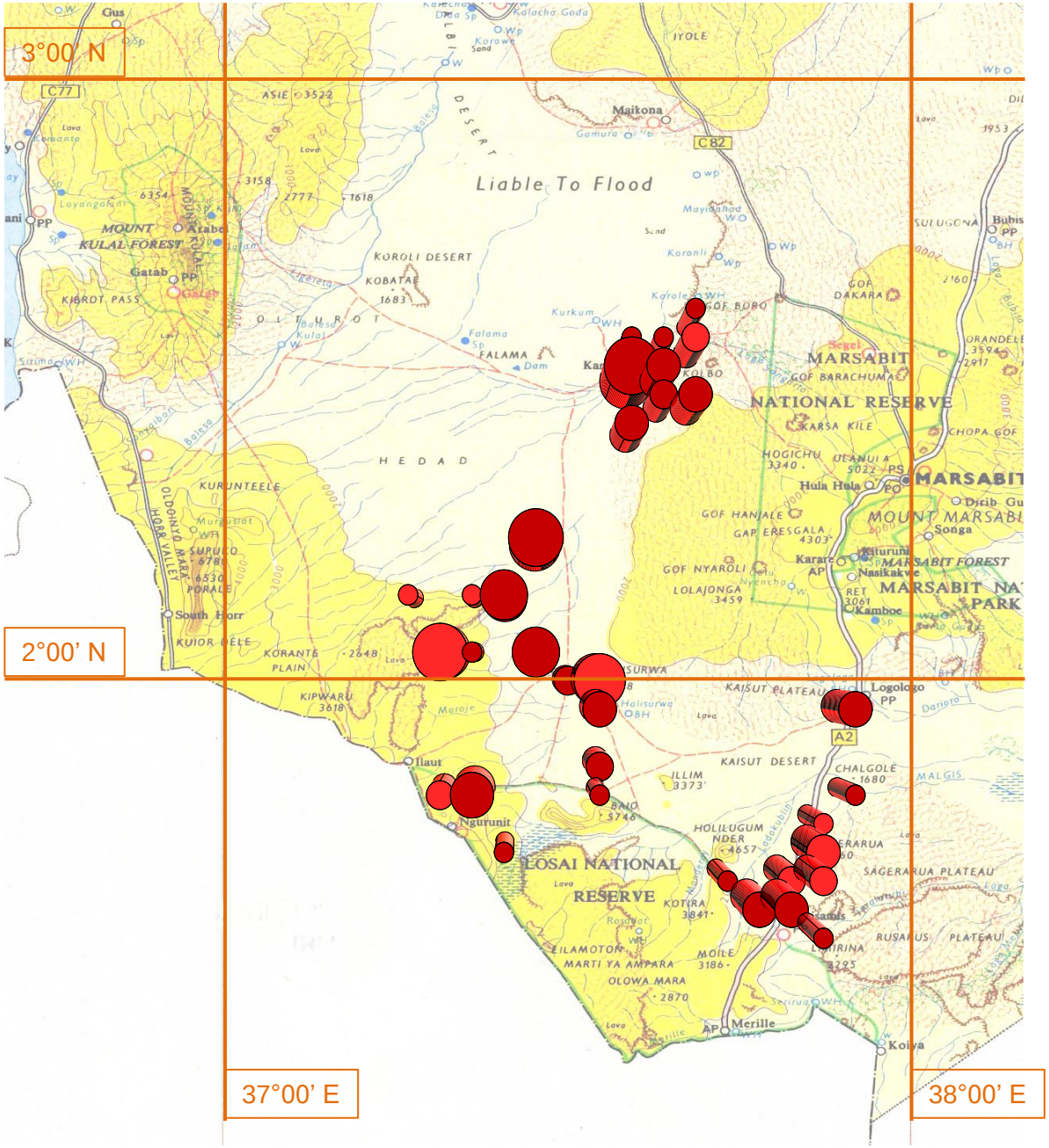
Site and size of settlements as well as numbers of households and numbers of domestic livestock present in the settlements were recorded. This involved total photographic cover of all settlements in the survey area from a low flying aircraft during the hour immediately after sunrise, when all stock was still expected to be retained in the night enclosures. All counts were accumulated within a map grid of 5 by 5 km squares.

The results show a pronounced seasonal variation in several key parameters of pastoral land use, like occupation density of gobs and households, and number of animals kept within the gobs. Two maps show the variation in seasonal dispersal of the gobs, a third one the cumulative dispersal of gobs over the two year survey period.

In a parallel exercise numerous ecological maps were produced of Marsabit District (GTZ Range Management Handbook of Kenya). One of them was a map of range condition which we superimposed with the gob distribution. The correlation between high settlement density and poor range condition is evident and indicates the detrimental effects of pastoral settlements on range vegetation.

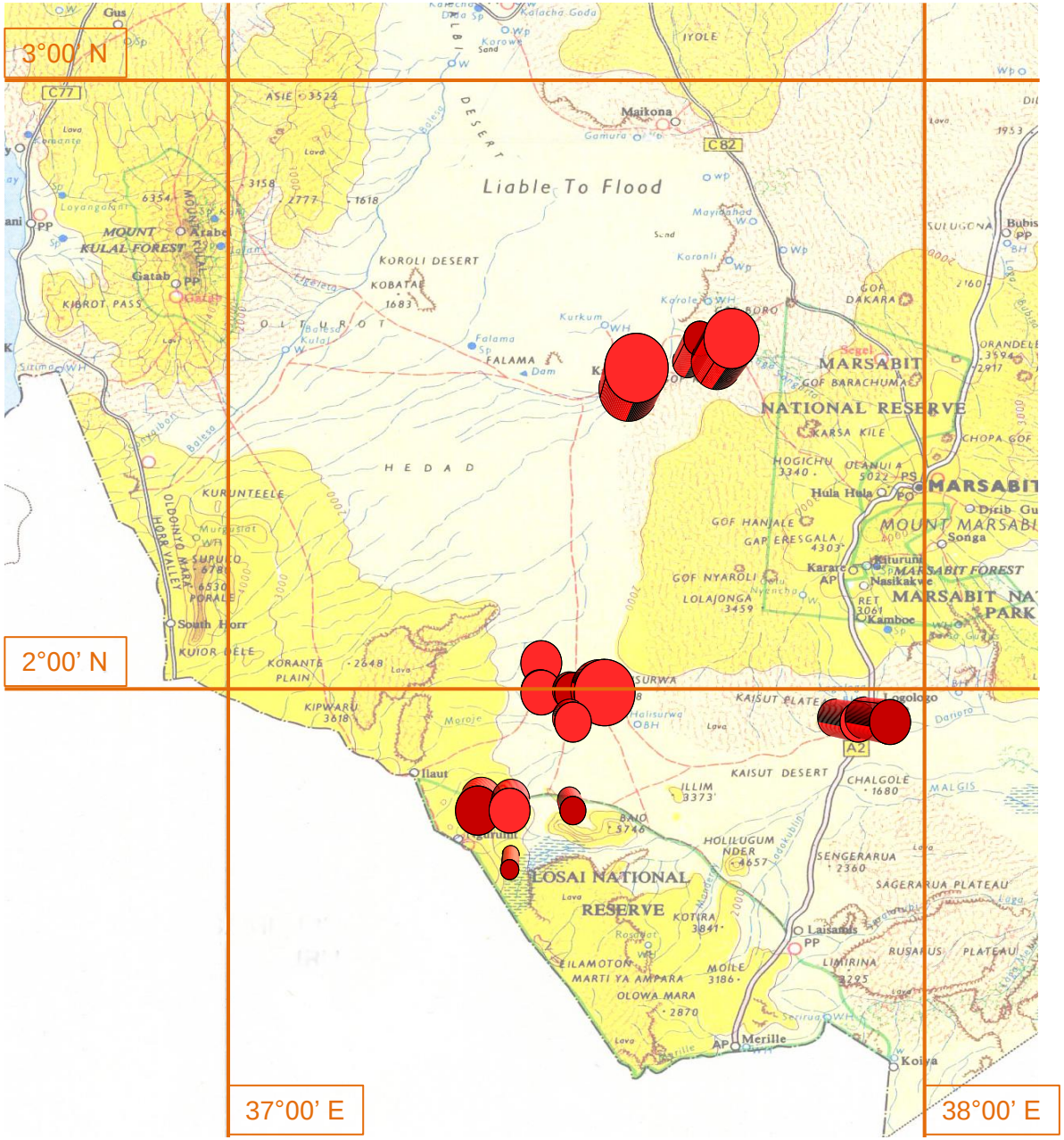
Survey season, number of grid squares occupied and total count of households and livestock at nine aerial survey dates between August 1978 and September 1980

Survey number	Survey season	# Grids occupied	# households	TLU/ household	HHDs/grid square
3	late rainy	36	2646	10.15	73.5
5	early dry	32	3247	12.04	101.5
6	mid dry	24	3348	5.89	138.5
7	end dry	15	3040	3.95	202.6
8	late rainy	20	3315	8.79	165,8
9	early dry	32	2984	3.78	93.2
10	mid rainy	26	3743	5.8	143.9
11	mid dry	22	2328	13.8	105.8
12	end dry	28	3356	3.72	119.8



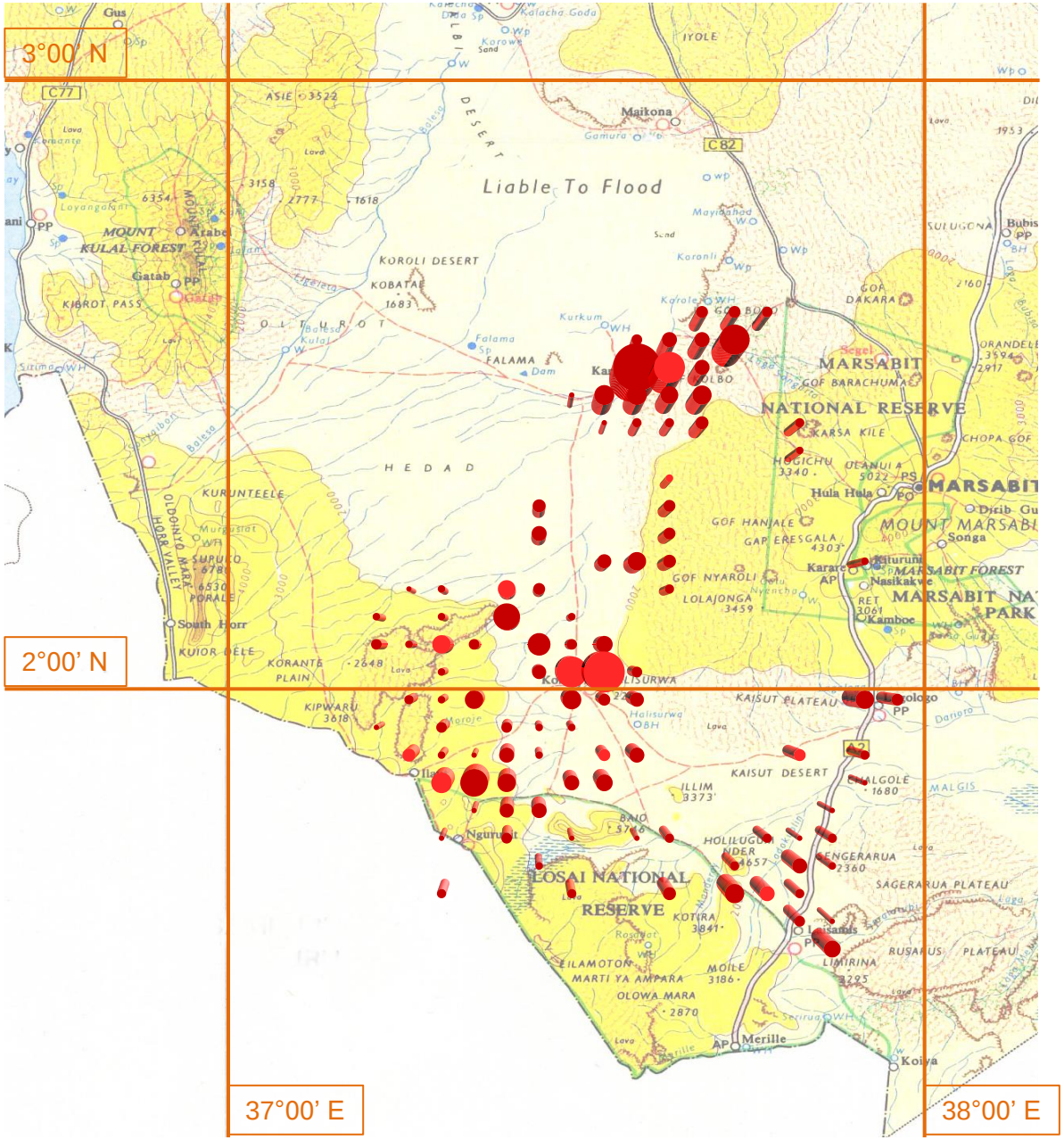
Distribution of gobs recorded during **Survey 3**, late rainy season April 1979

Maximum spatial dispersal 34 grid squares occupied within 13 weeks (850 km²)



Distribution of gobs recorded during **Survey 7,** end of dry season, September 1979

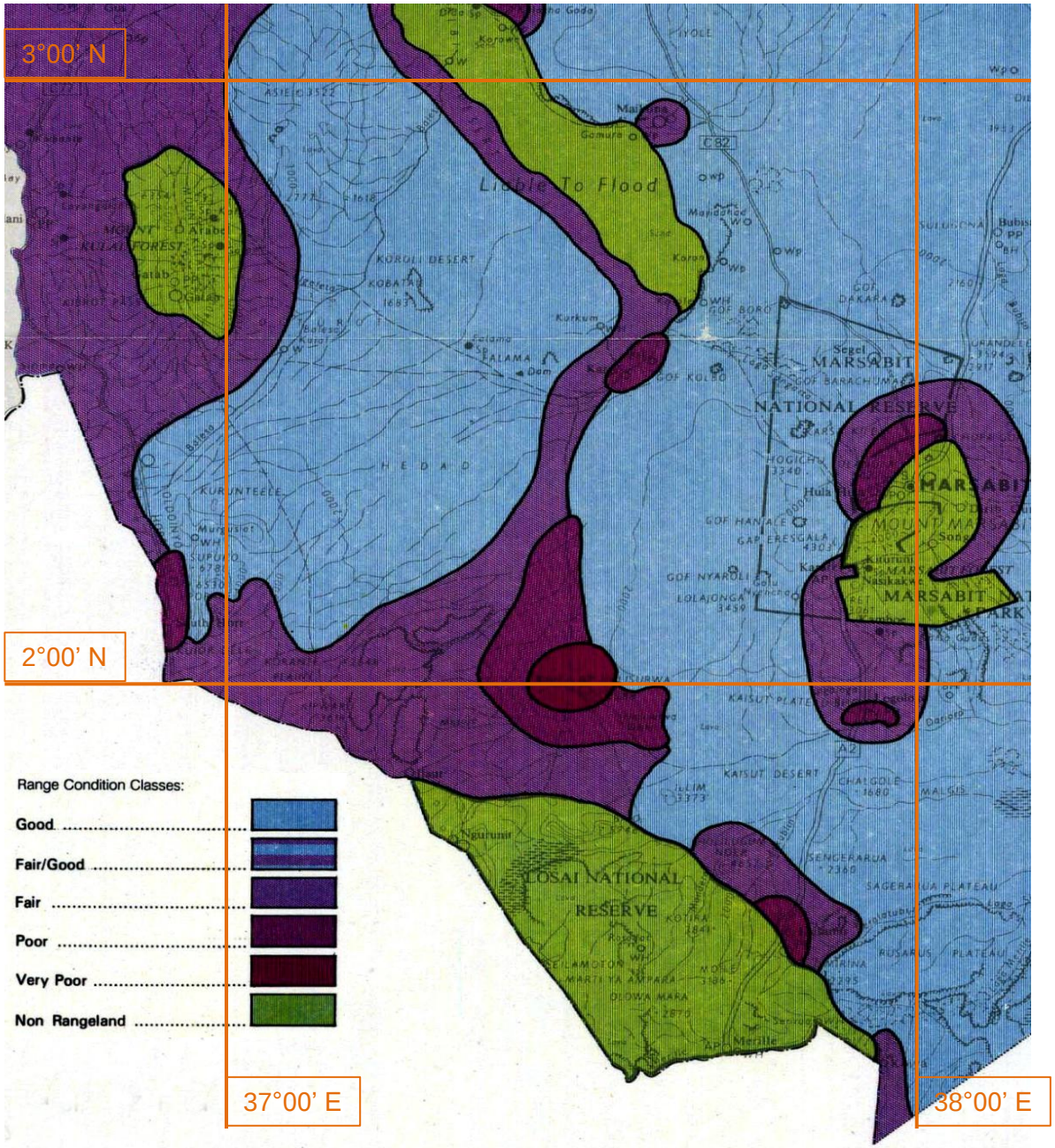
Minimum spatial dispersal 15 grid squares occupied within 9 weeks (375 km²)



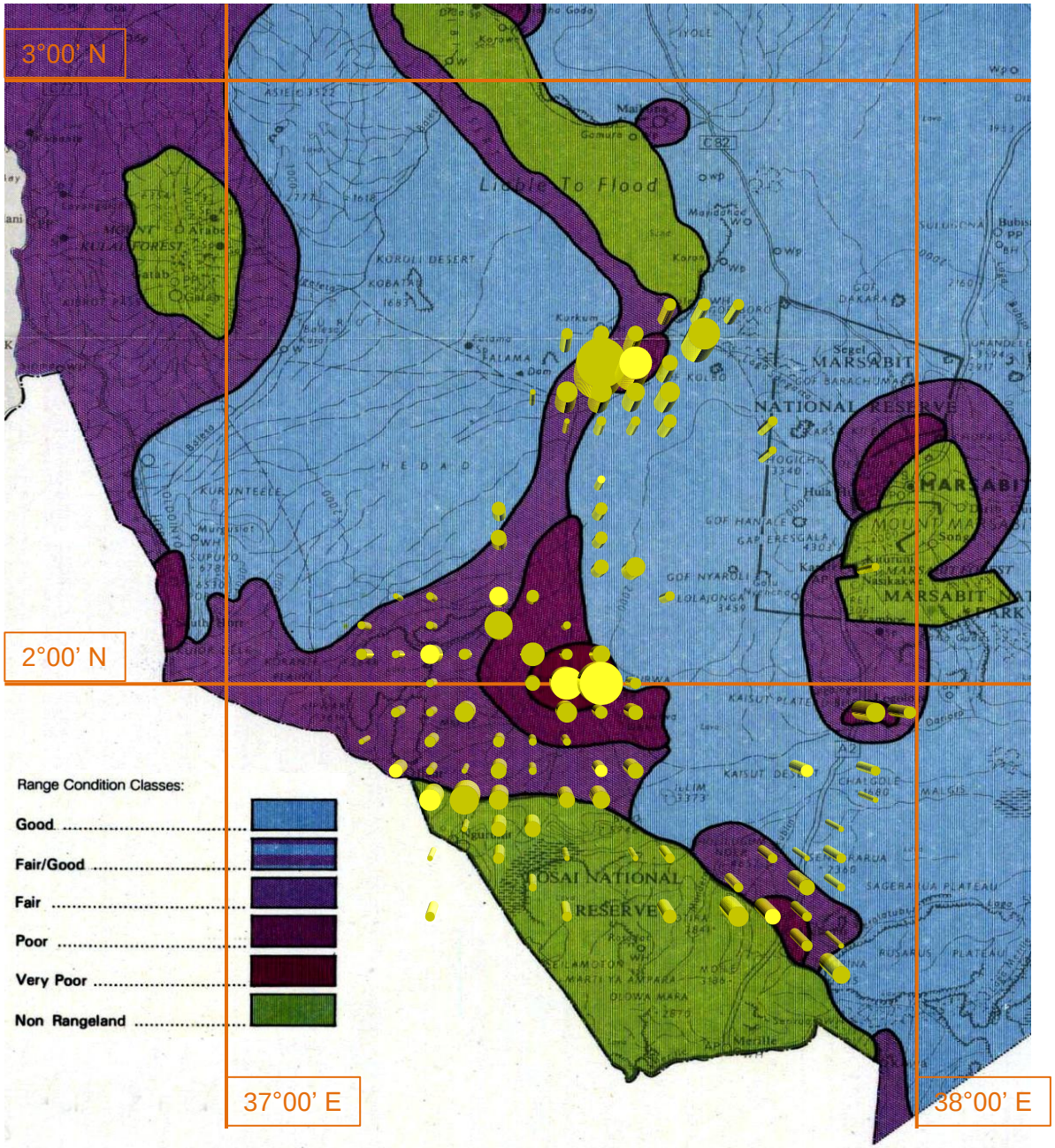
Cumulative distribution of gobs recorded at nine aerial survey dates, between October **1978** and September **1980**

A total of 103 grid squares of 5 by 5 km had been occupied by gobs during this period, equivalent to 2575 km²

Map of range condition in five different classes



Herlocker & Walther 1990: Range Management Handbook of Kenya, Marsabit District, MOLD & GTZ



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Map of range condition in five different classes

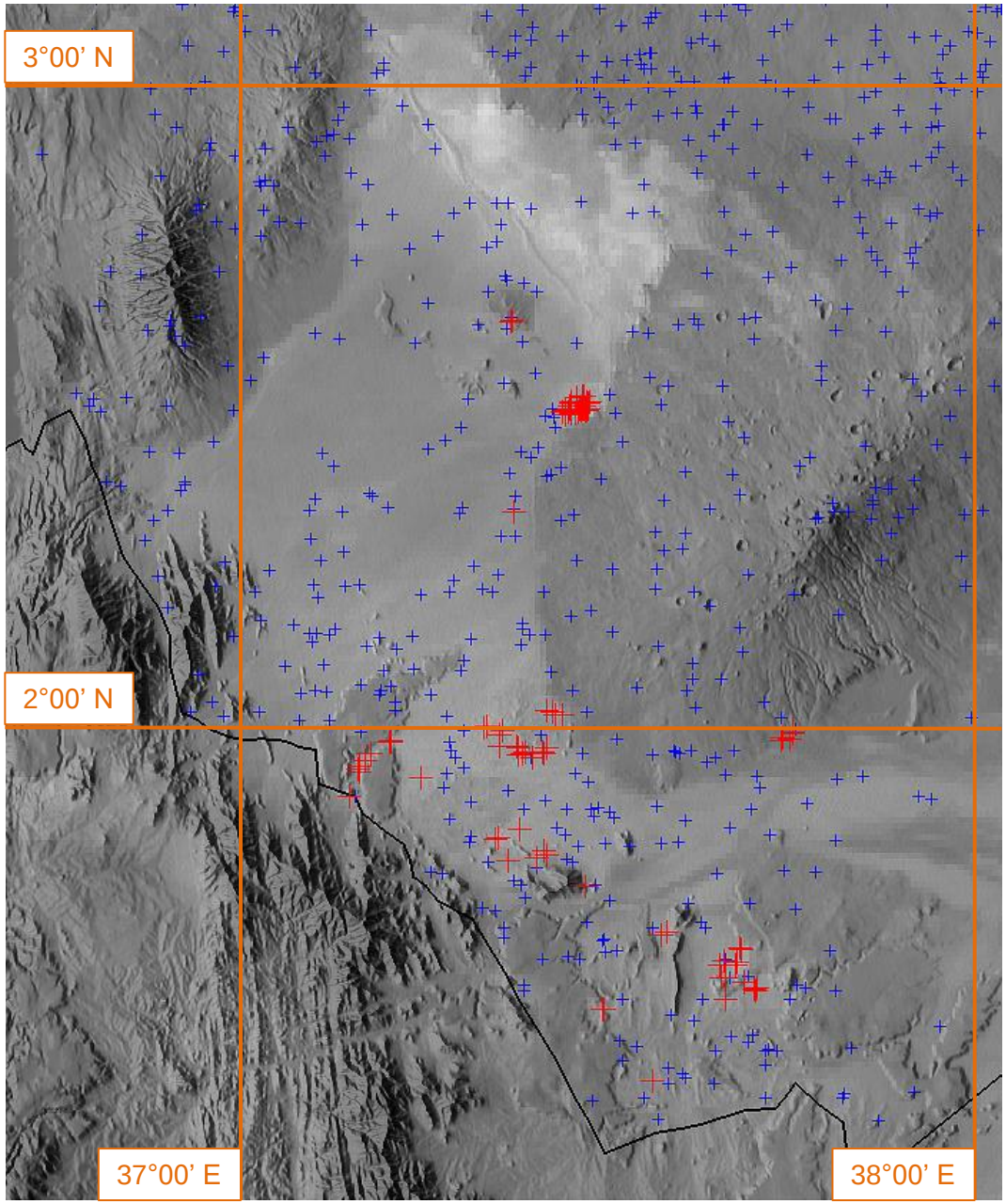
and cumulative distribution of gobs recorded at nine aerial survey dates, between October 1978 and September 1980

Digital Globe Survey 2012 - 2014

In a crowd sourcing exercise under https://geosurvey.qed.ai/ of Marsabit District we noticed the potential of Digital Globe images to yield identification and quantitative description of Rendille gobs and fora camps. We carried out a mapping exercise for the home range of the Rendille as delineated through the aerial surveys of 1978 to 1980 using Digital Globe images recorded during 2012 to 2014. We obtained geo-referenced data on settlement location, settlement size by households, as well as numbers and sizes of animal enclosures. We recorded 116 gobs with a total of 4826 households, ranging from 5 to 135 households per gob and a mean value of 41.6. In about 50% of the records we could estimate the duration of site occupation through time series of Digital Globe images. In several instances duration of site occupation was more than five years. In others migration distances were less than 1 km. Another observed phenomenon was the extremely dense clustering of gobs.

As fora camps are much more numerous and more ephemeral in nature than gobs we could not count or geo-reference them. We could only determine certain areas as preferred sites.

In comparison to the 1978/80 aerial survey the total area occupied by Rendille gobs decreased by approx. 45%, to about 1400 km^2.



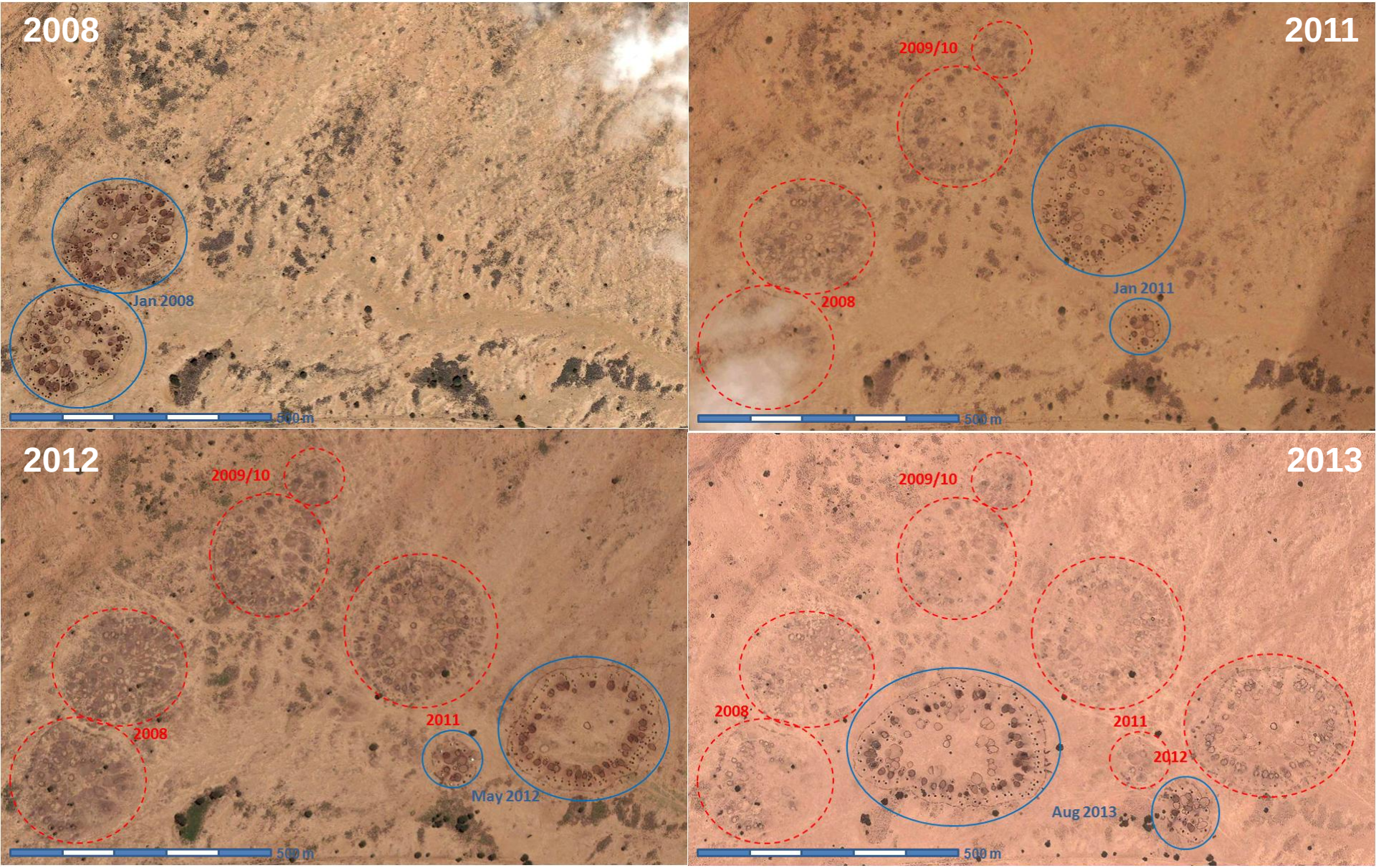
Digital Elevation Model: AFSIS

Geo-referenced distribution of Rendille gobs [+] between 2012 and 2014 over digital elevation map; [+] signify abandoned gobs, fora camps, or settlements of other ethnic groups

[+] from a crowd sourcing exercise under https://geosurvey.qed.ai/ Marsabit District

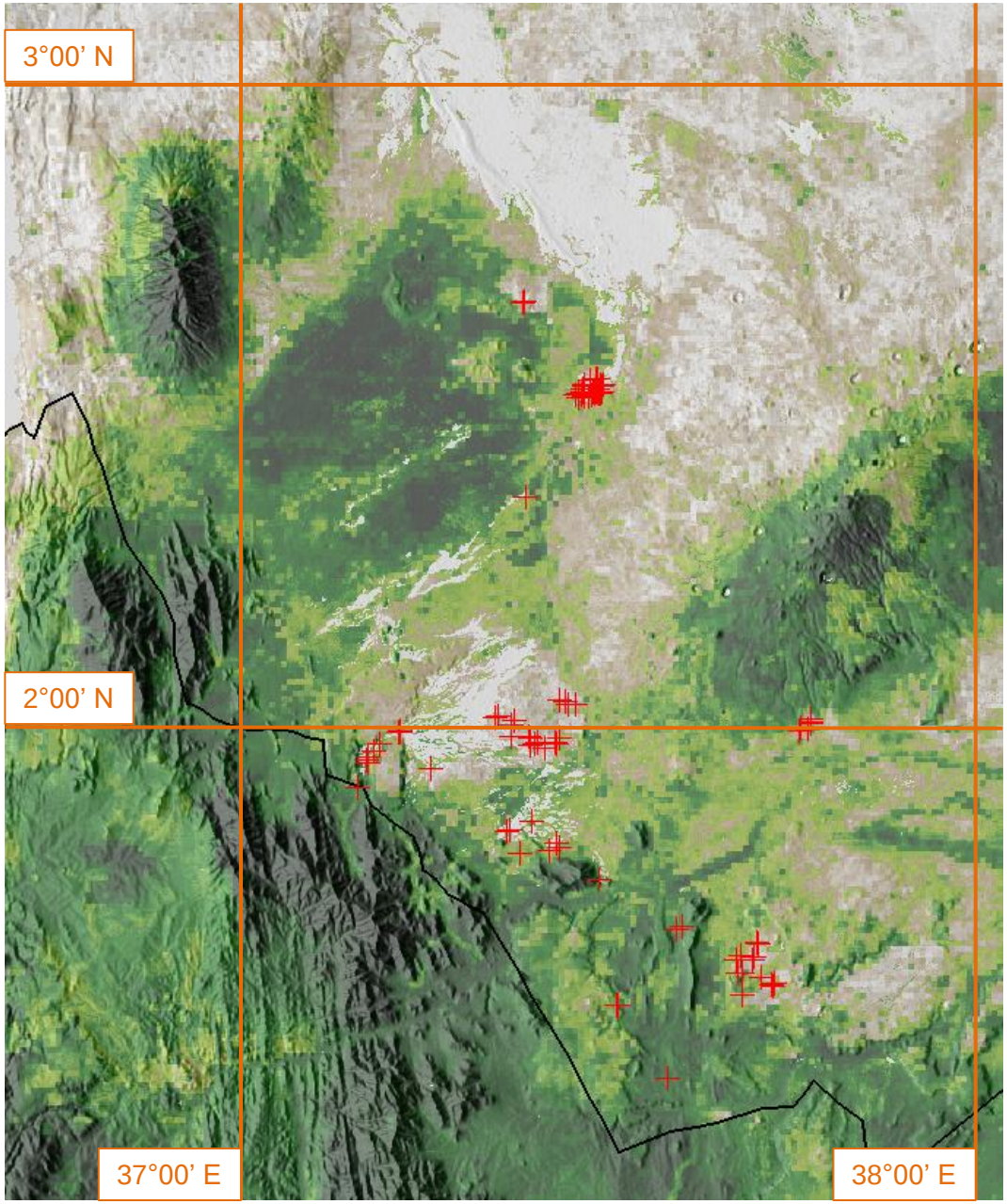
Extreme clustering of Rendille Gobs near Kargi throughout 2012

Minimal migration distances of two Rendille gobs for five years



abandoned

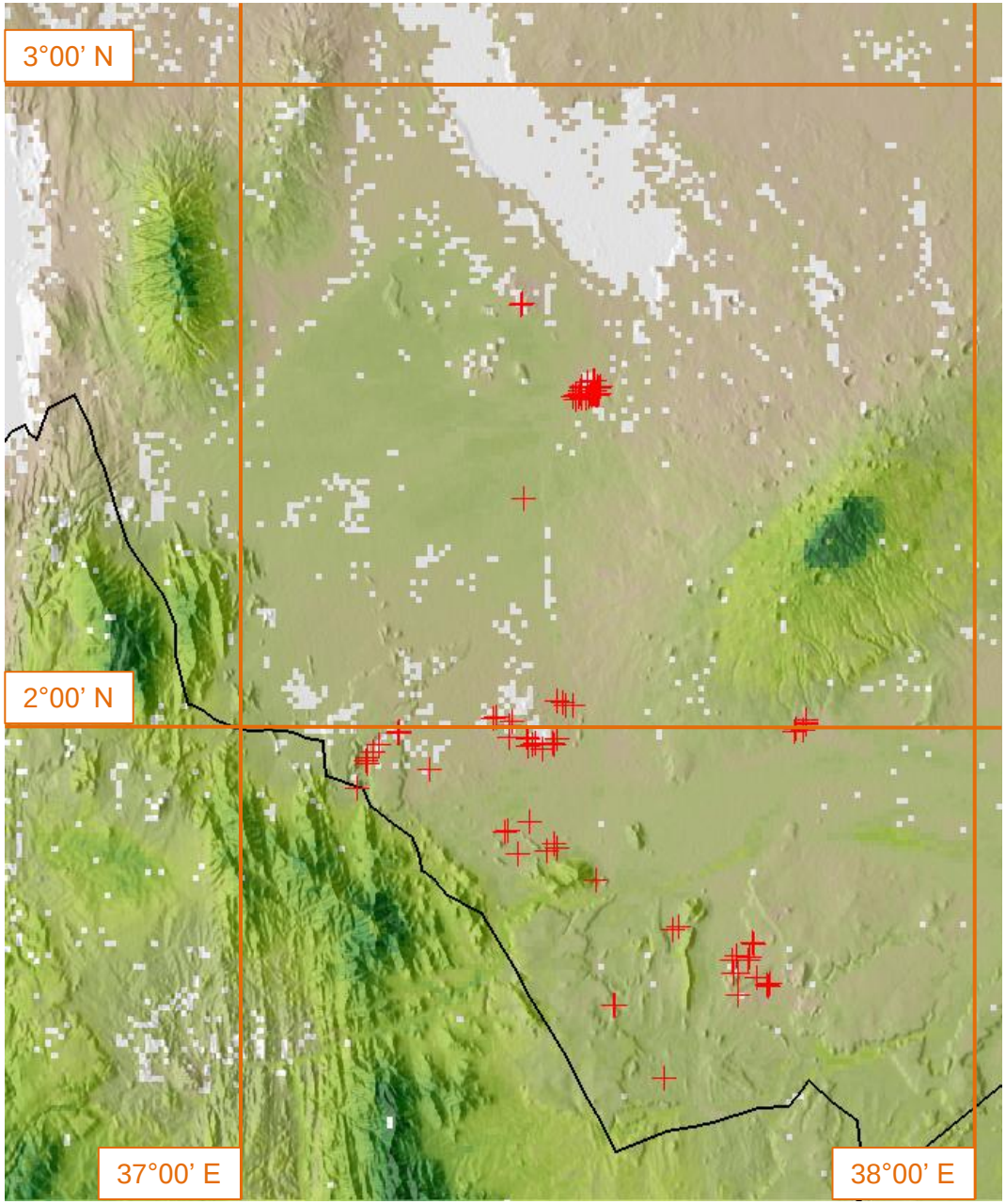
occupied



Probability Map: AFSIS

Rendille settlement locations [+] between 2012 and 2014 over map of probability of 60% woody vegetation cover in South-West Marsabit District

With geo-referenced siting of the gobs it becomes easy to interpret site selection against spatial information on various ecological and other spatial parameters. The first example shows the gob distribution over a probability map of woody vegetation cover which shows all gobs in areas with low or no cover.



FPAR map: MODIS Terra & Aqua data

Rendille settlement locations [+] between 2012 and 2014 over map of FPAR* of South-West Marsabit District

The next map shows gob distribution over FPAR, again indicating a strong correlation of high occupation density with low vegetation productivity. It appears that settlement site selection by the pastoralists is not motivated by forage availability but other factors.
Some potential factors are listed below.

*Fraction of absorbed Photosynthetically Active Radiation

Breakdown of internal security
Permanent water supply
Food aid stations
Social amenities (schools, dispensaries, shops)
Infrastructures (roads, markets)
Low labour supply

The way forward?