

Lecture 13

Cities in History; Urban Precursors: Hunter-Gatherer Camps and Densification

13.2 Urban Precursors: Hunter-Gatherer Camps and Densification

IUS 7.2

Anthropology

Early and Small Scale Societies

Anthropology

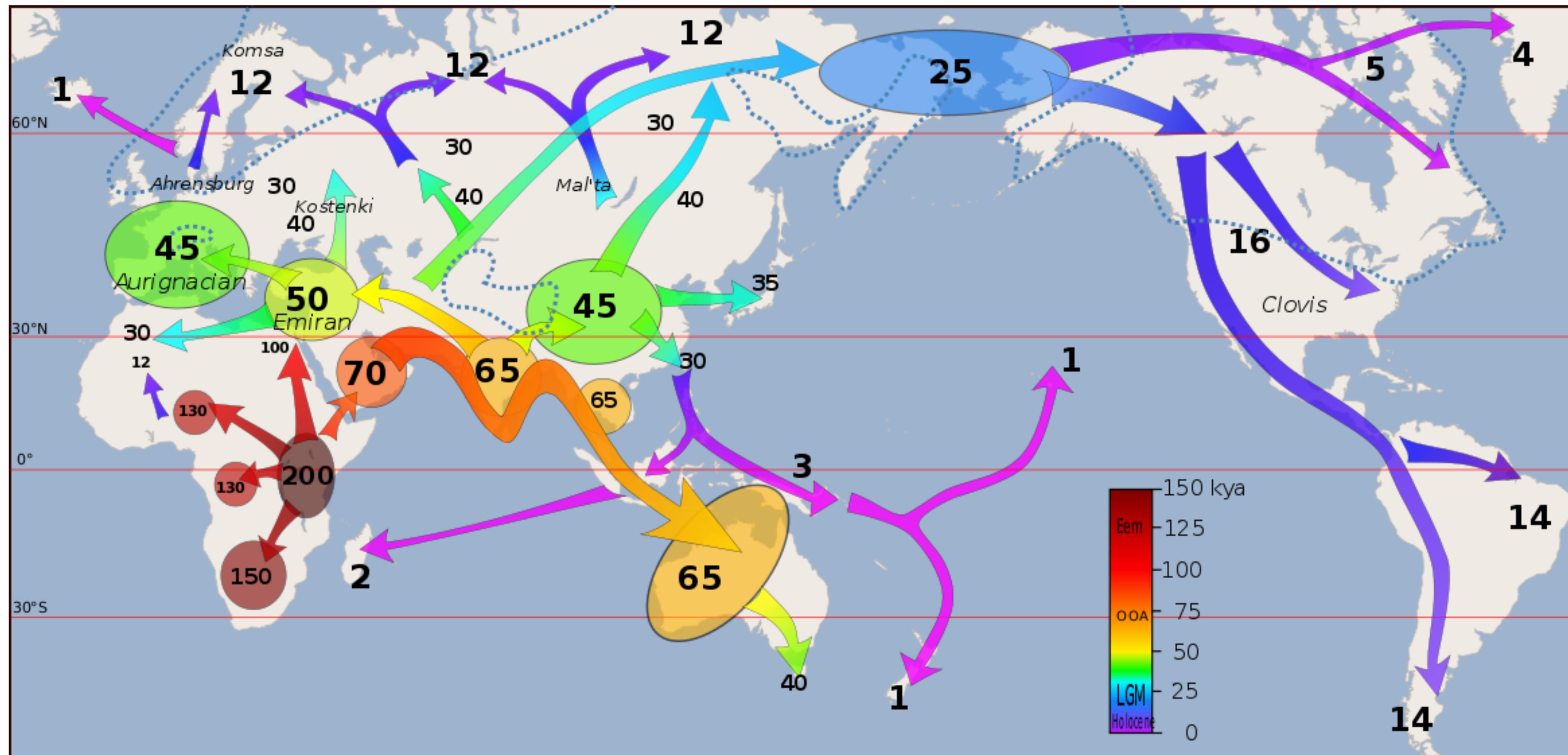
From Wikipedia, the free encyclopedia

Anthropology is the study of humans and human behavior and societies in the past and present.^{[1][2][3]} Social anthropology and cultural anthropology^{[1][2][3]} study the norms and values of societies. Linguistic anthropology studies how language affects social life. Biological or physical anthropology^{[1][2][3]} studies the biological development of humans.

Archaeology, which studies past human cultures through investigation of physical evidence, is thought of as a branch of anthropology in the United States and Canada, while in Europe, it is viewed as a discipline in its own right or grouped under other related disciplines, such as history.

Anthropology is the study of human cultures

A very successful species a subsistence way of life

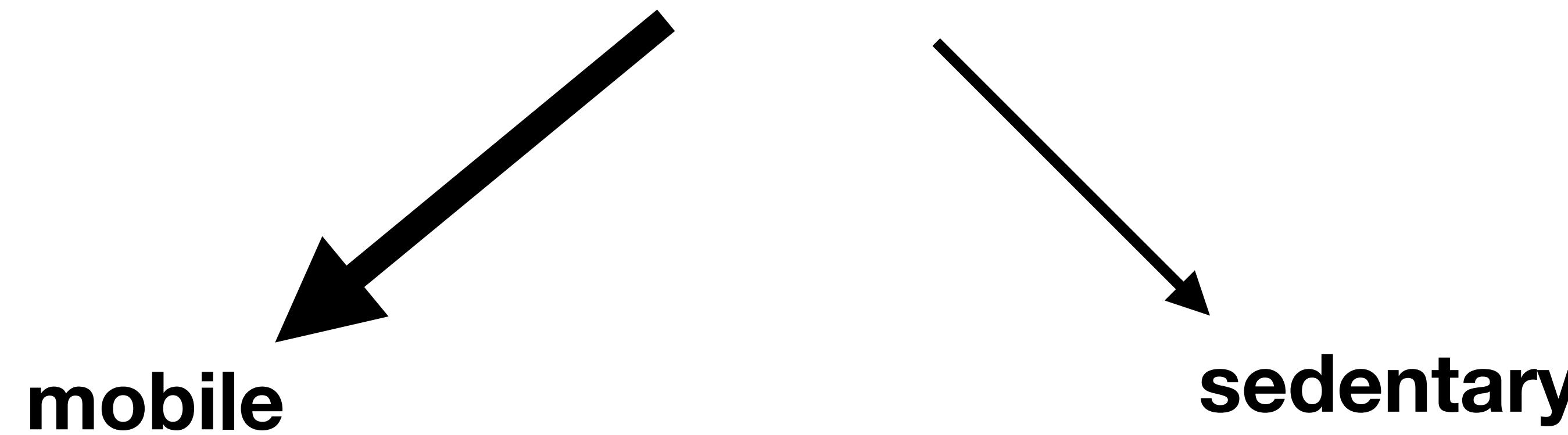


Humans' early expansion throughout the world

credit: wikipedia, Metspalu et al

Early cultures were

**Hunter Gatherers
“foragers”**



“The archaeological record shows that the mobile hunting and gathering way of life is also remarkably stable, exhibiting slow rates of material and technological change in comparison with more settled and denser societies.”

Gwayasdums / Gwaestums (Gilford Island)



credit: George MacDonald

!Kung San



credit: Getty images

Mobile Hunter-Gatherers

Not enough food density to support large groups in one place

Egalitarianism: Socially sanctioned limits on privacy and private property

Limited conflict resolution

No elaborate construction, walls, limited food storage

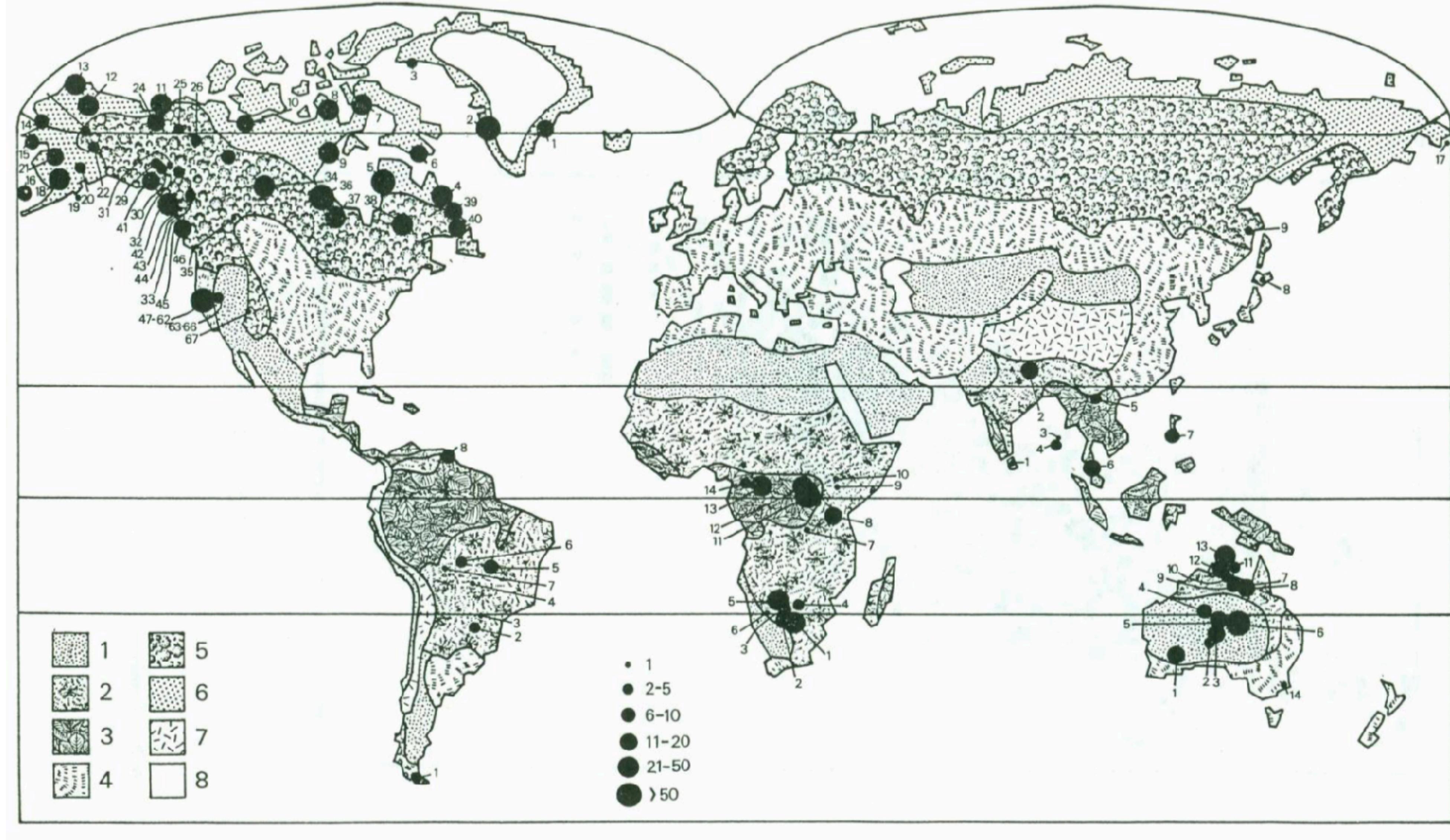
Characteristic Social Patterns of Fission and Fusion in Space-Time

foraging single-family units



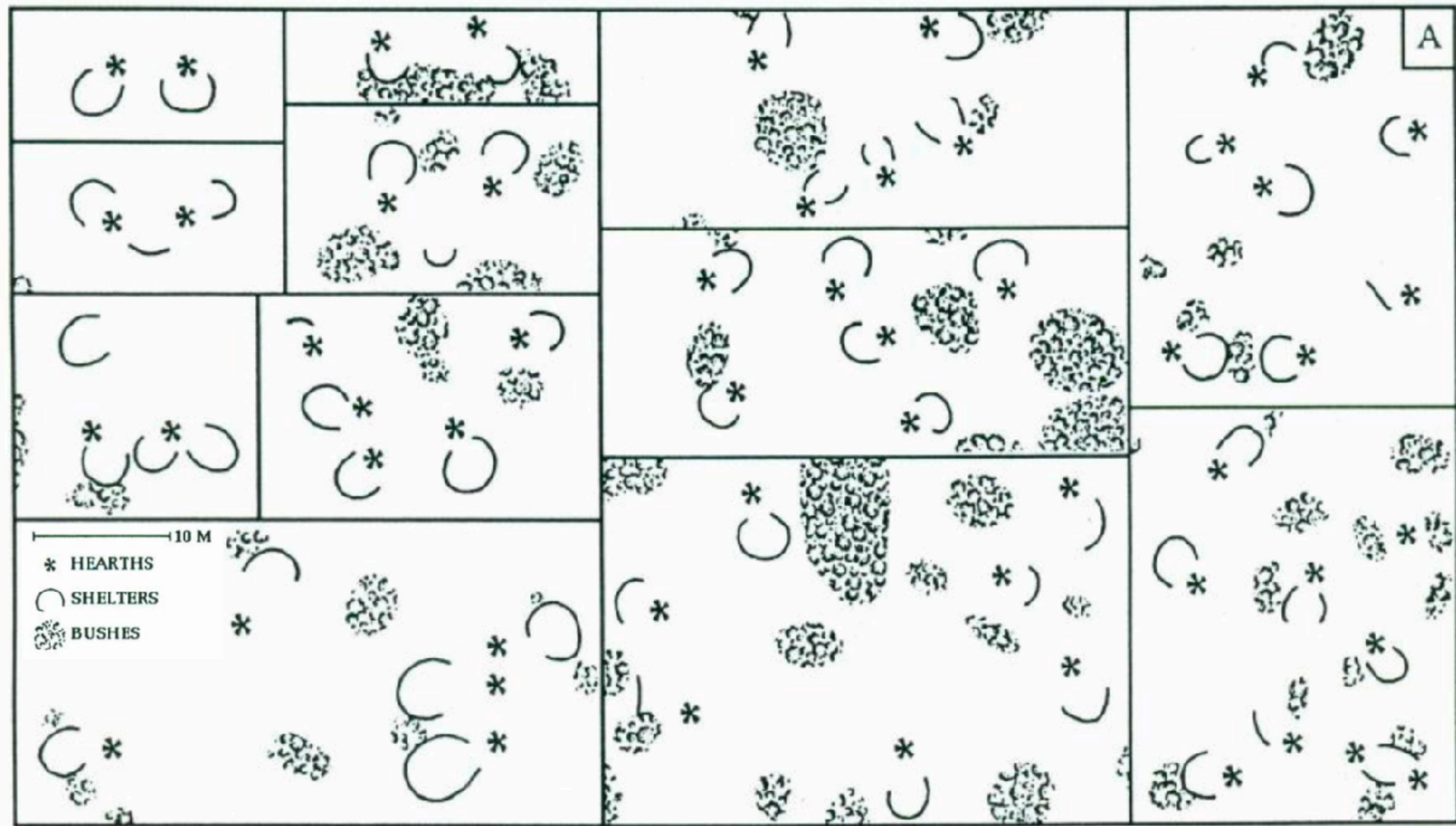
larger social “camps”

Large worldwide survey of Hunter-Gatherer Camps



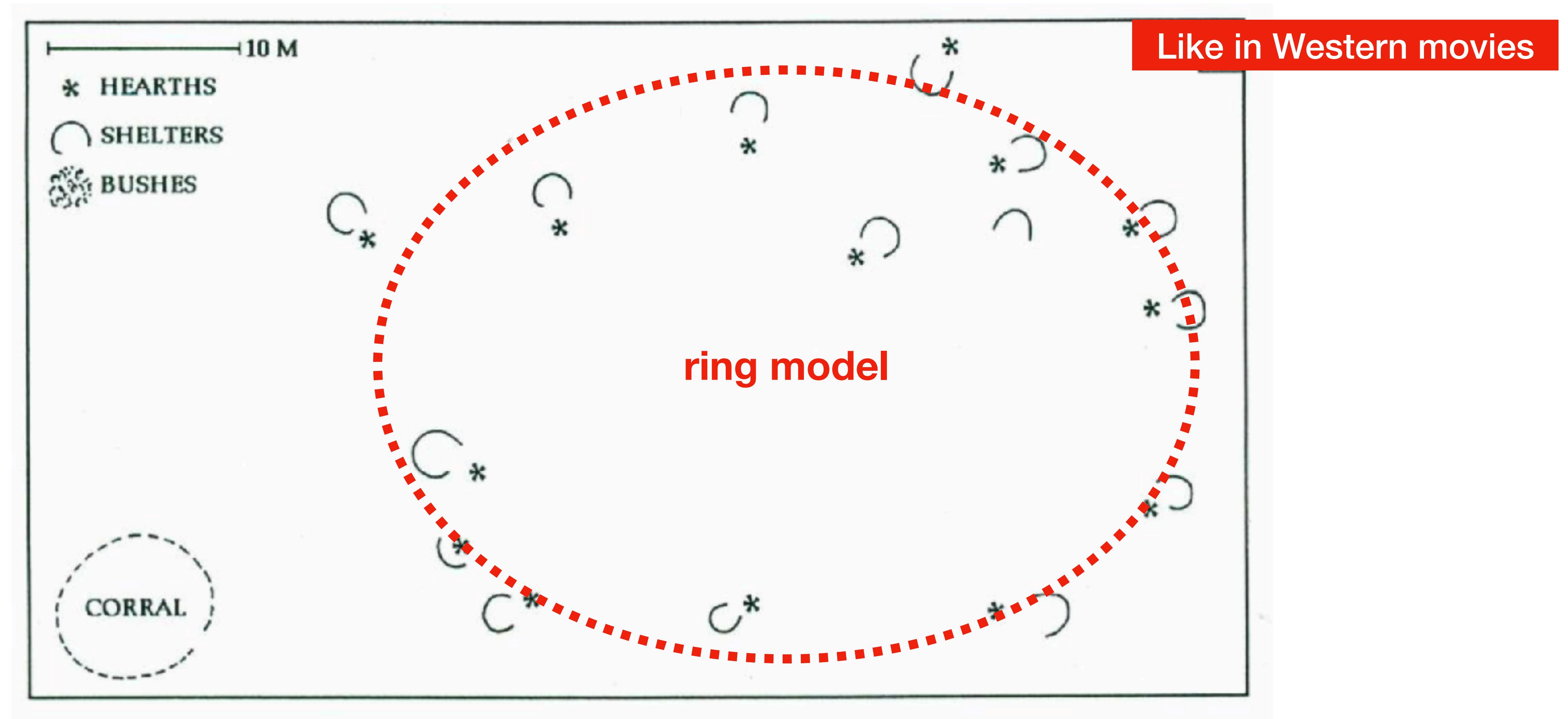
credit: T. Whitelaw 1989

Small “Extended Family” camps



credit: T. Whitelaw

Large rainy-season camp



credit: T. Whitelaw

Ring Model for H/G Camps

families camp along the *perimeter* of a common area

area

$$A = \pi R^2 \rightarrow A = \frac{a^2}{4\pi} N^2$$

circle

perimeter

$$P = 2\pi R \rightarrow P = aN \rightarrow R = \frac{a}{2\pi} N$$

Area is *superlinear* on Population !!!

Area - Population relationship of H/G camps

$$A(N) = A_0 N^\beta$$

forgive notation of exponents not consistent

std. errors in parentheses	Model 1	Model 2	Model 3	Model 4
	all observations	controlling for ecology type	controlling for regional group	controlling for culture type
<i>constant</i>	1.225 (0.132)	1.846 (0.124)	1.955 (0.132)	1.476 (0.121)
β	1.698 (0.034)	1.533 (0.031)	1.505 (0.034)	1.631 (0.031)
95% CI	[1.631, 1.766]	[1.471, 1.596]	[1.437, 1.572]	[1.571, 1.694]
R^2	0.68	0.78	0.76	0.89
N	1209	1209	1209	1209
<i>estimation method</i>	OLS w/ a correction for heteroskedasticity	GLS w/ FE	GLS w/ FE	GLS w/ FE

Superlinear !?

Lobo et al 2018

<https://www.journals.uchicago.edu/doi/abs/10.1086/719234>

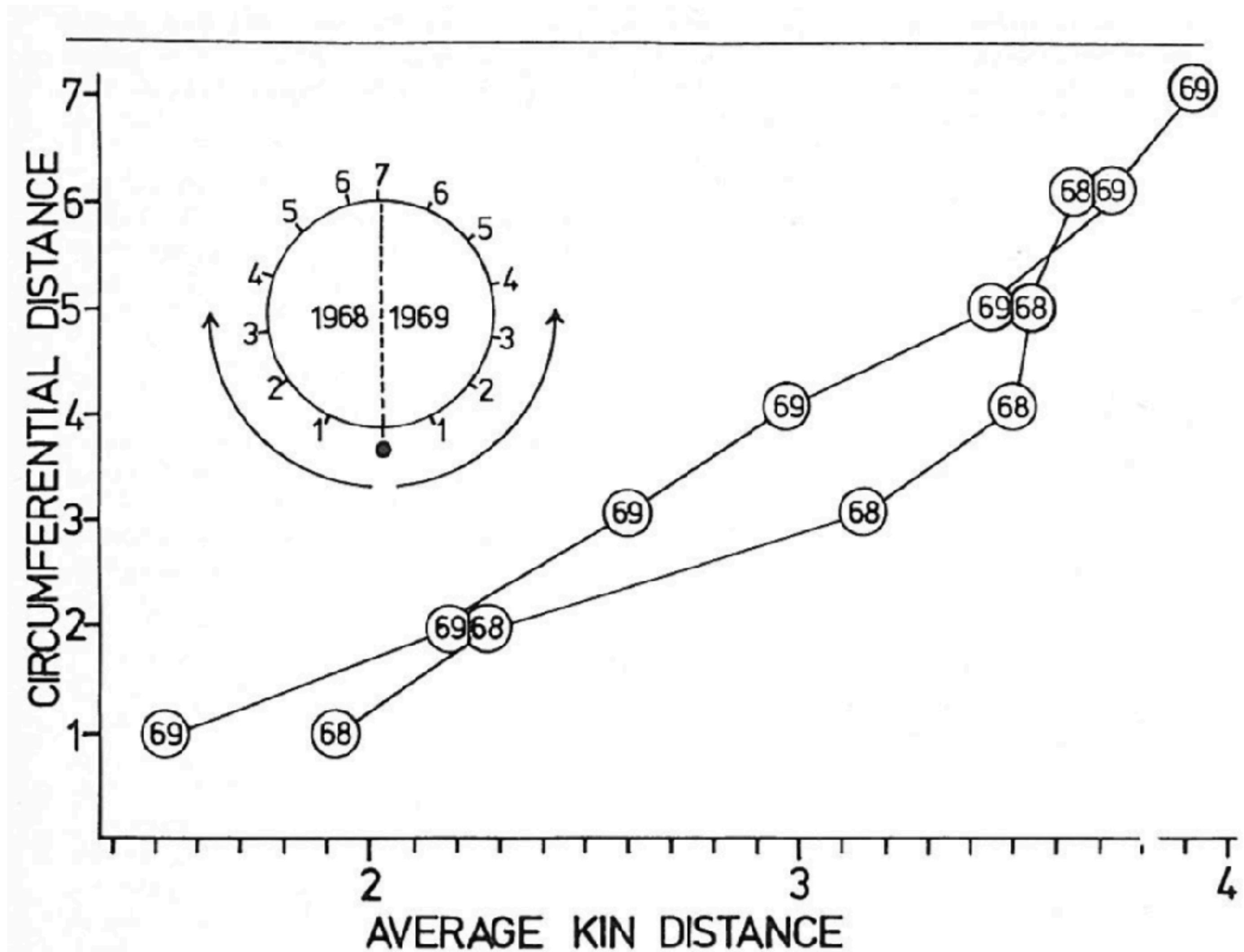


Figure 2: Dobe dry season camps, average kinship distance for each hut position.

credit: T. Whitelaw

superlinear

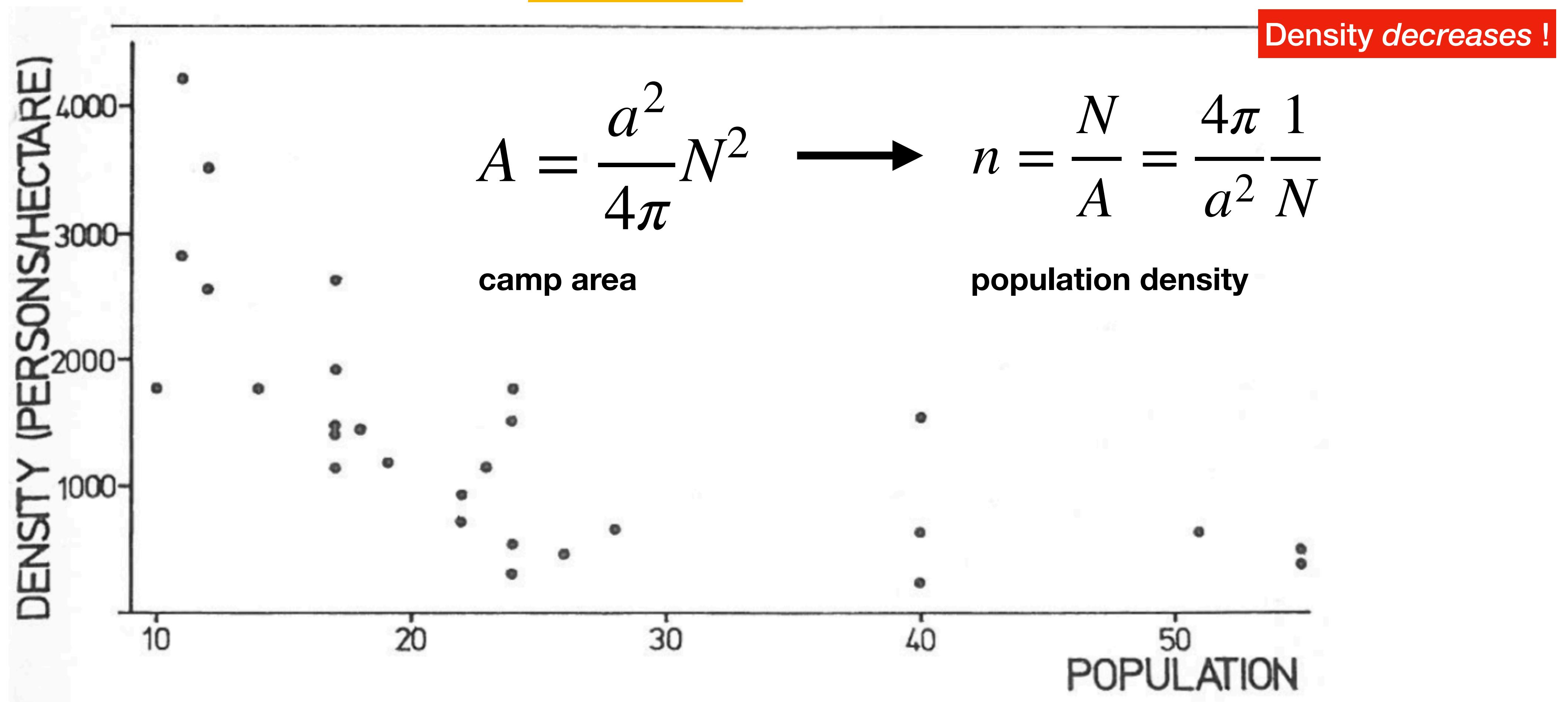
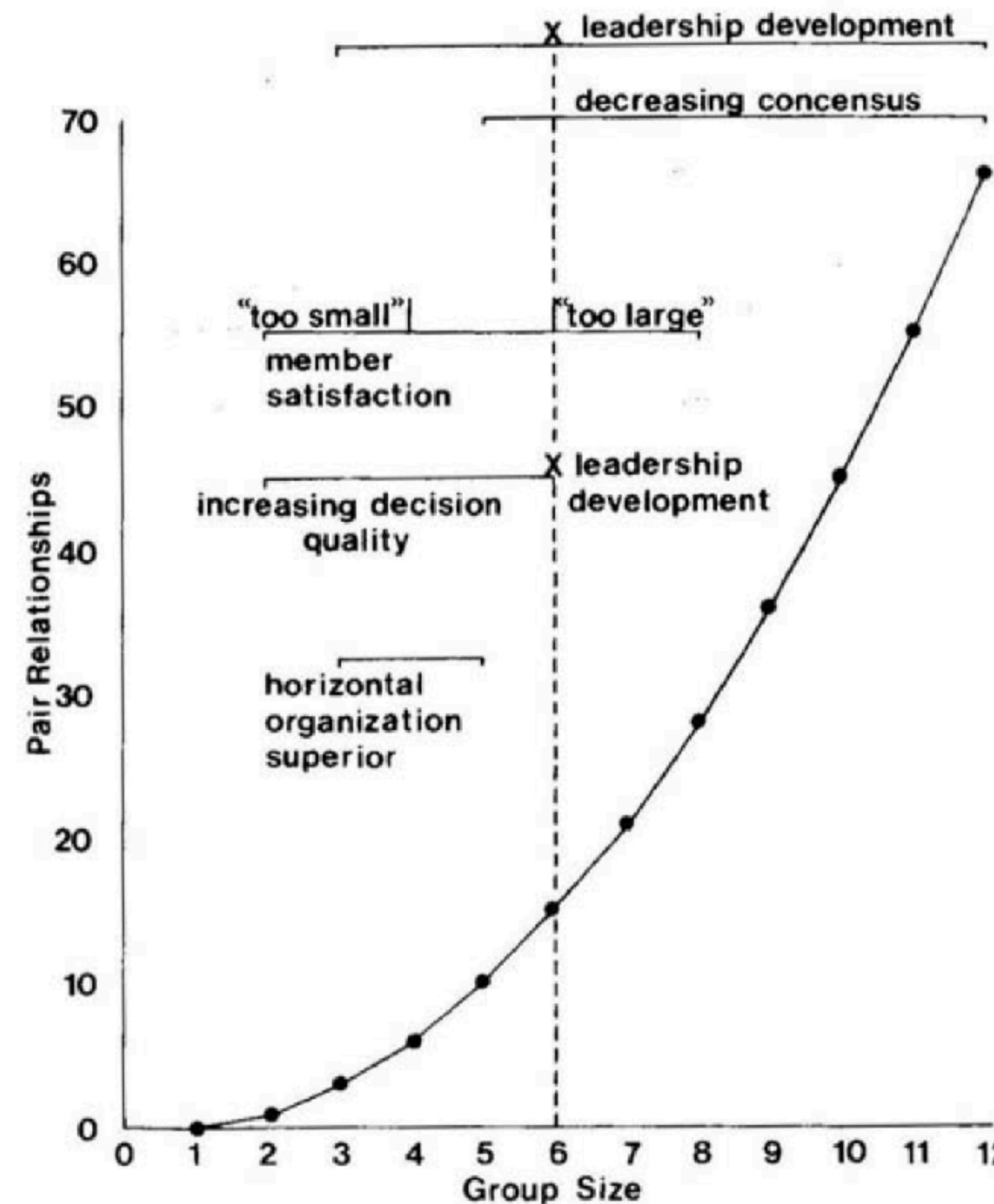


Figure 6: San camp population and density.

credit: T. Whitelaw

Scalar Stress

a network theory of conflict



Like Metcalfe's law, but for conflict

Figure 21.2. Scalar stress in small groups.

credit: Johnson 1982

TABLE 21.4
Estimating Scalar Stress in !Kung Camps

Camp: /Xai/xai	Population = 100		Population = 150	
	Unit frequency	Scalar stress	Unit frequency	Scalar stress
Basal units				
Extended families	8.7	33.5	13.1	79.2
Nuclear families	29.2	411.7	43.7	933.0
Social units	33.8	554.3	50.7	1259.9
Adults (.63)	63.0	1953.0	94.5	4417.9
Adults (.71)	71.0	2485.0	106.5	5617.9
Population	100.0	4950.0	150.0	11,175.0
Like Metcalfe's law, but for conflict				
Camps: Dobe and Mahopa	Population = 40		Population = 60	
	Unit frequency	Scalar stress	Unit frequency	Scalar stress
Basal units				
Extended families	3.5	4.4	5.2	10.9
Nuclear families	11.7	62.6	17.4	142.7
Social units	13.5	84.4	20.3	195.9
Adults (.63)	25.2	304.9	37.8	695.5
Adults (.71)	28.4	389.1	42.6	886.1
Population	40.0	780.0	60.0	1770.0

stress increases with camp size

“The primary results of this analysis are that first, the number of extended families is the best (and quite accurate) predictor of relative dispute frequency.”

But, meanwhile, on larger scales

Total Foraging Areas are sublinear

$$A_f = aN^\beta$$

Table 1. Summary of scaling relations for area of space used as a function of group size

Model	Coefficient	β	SE	95% CL	C_0	SE	95% CL	r^2
All foragers	β_N	0.70	0.07	0.57–0.84	4.44	0.47	3.51–5.37	0.24
	β_{upper}	0.80	—	—	—	—	—	—
	β_{lower}	0.77	—	—	—	—	—	—
Hunters	β_H	0.90	0.10	0.71–1.10	4.46	0.66	3.14–5.78	0.52
	β_{upper}	0.76	—	—	—	—	—	—
	β_{lower}	1.06	—	—	—	—	—	—
Gatherers	β_G	0.64	0.10	0.44–0.84	4.61	0.66	3.30–5.92	0.22
	β_{upper}	0.83	—	—	—	—	—	—
	β_{lower}	0.60	—	—	—	—	—	—
Aquatic foragers	β_A	0.78	0.11	0.56–1.00	3.24	0.79	1.65–4.83	0.31
	β_{upper}	0.32	—	—	—	—	—	—
	β_{lower}	0.91	—	—	—	—	—	—
Terrestrial foragers	β_T	0.79	0.08	0.63–0.96	4.17	0.56	3.05–5.28	0.29
	β_{upper}	0.83	—	—	—	—	—	—
	β_{lower}	1.01	—	—	—	—	—	—
Mixed model	β_{MLM}	0.76	0.04	0.68–0.84	-9.16	4.38	-9.23 to -30.31	0.86

Data is shown for all hunter–gatherer societies in the data set (row 1), for subsets of these data based on foraging niche (rows 2–5), and for the complete mixed model that adjusts for variables that affect rates of resource supply (row 6). CL, confidence limits.

Density is usually scale dependent

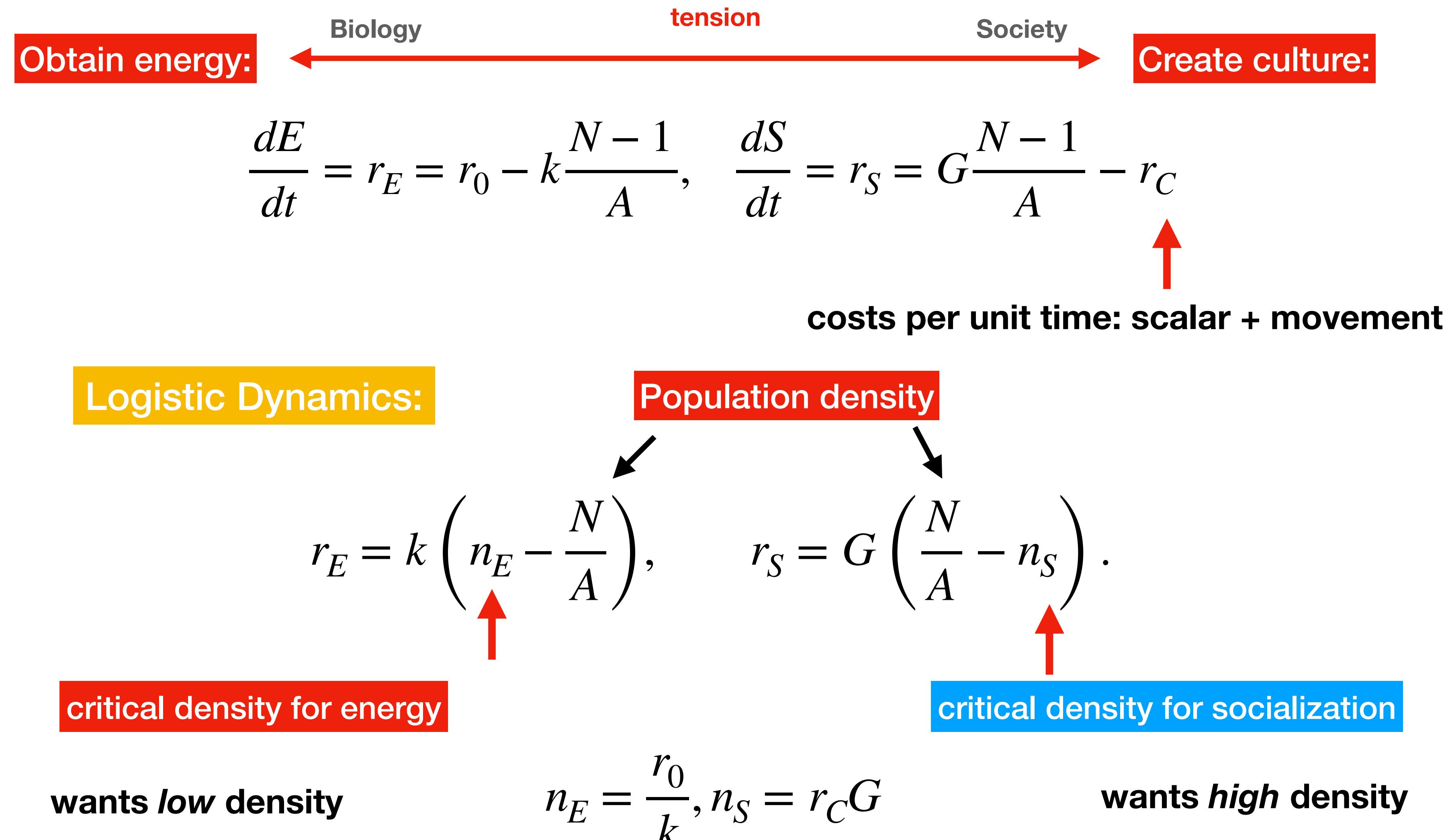
For Hunter-Gatherer's it is increases at large scales

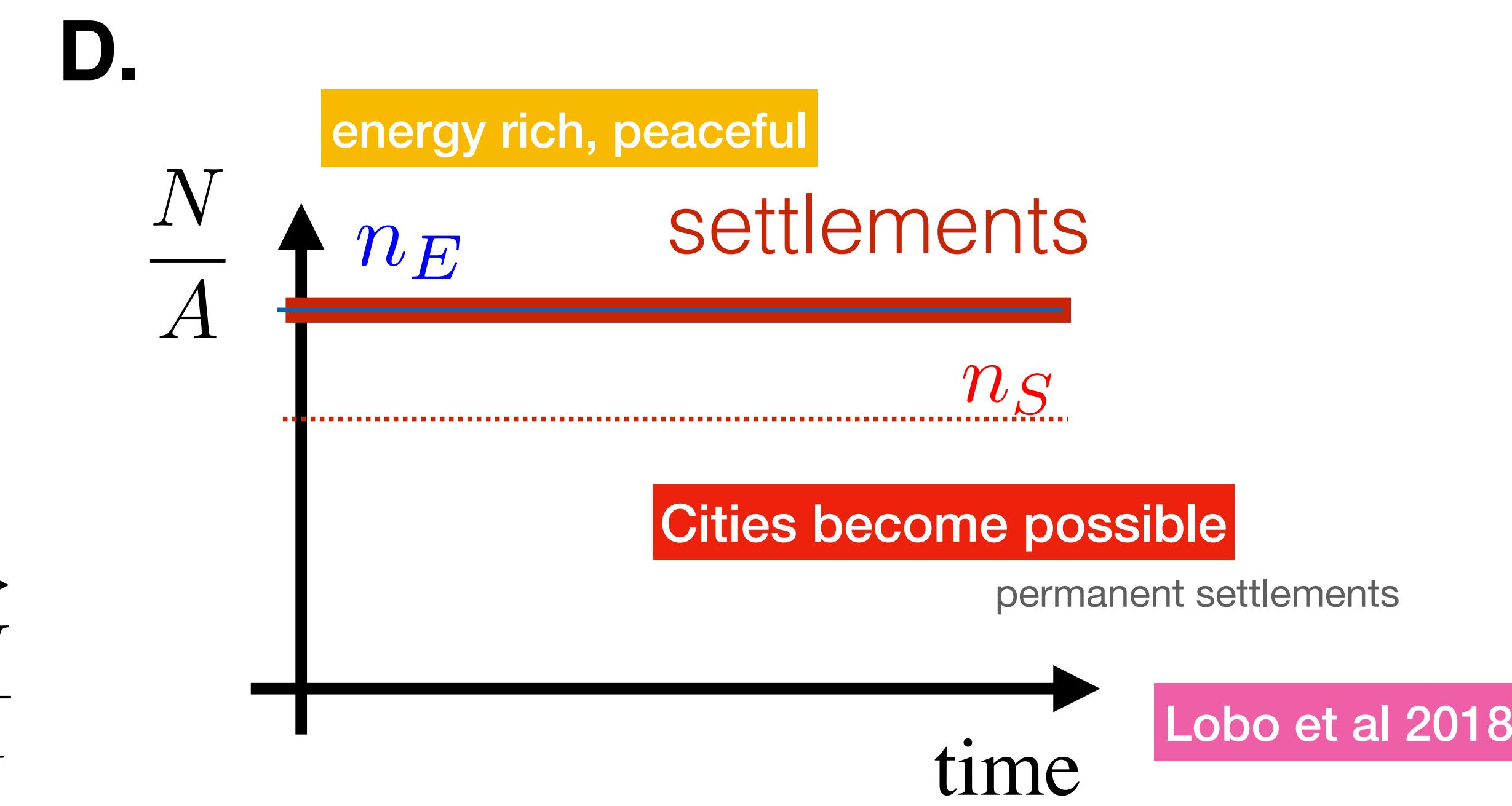
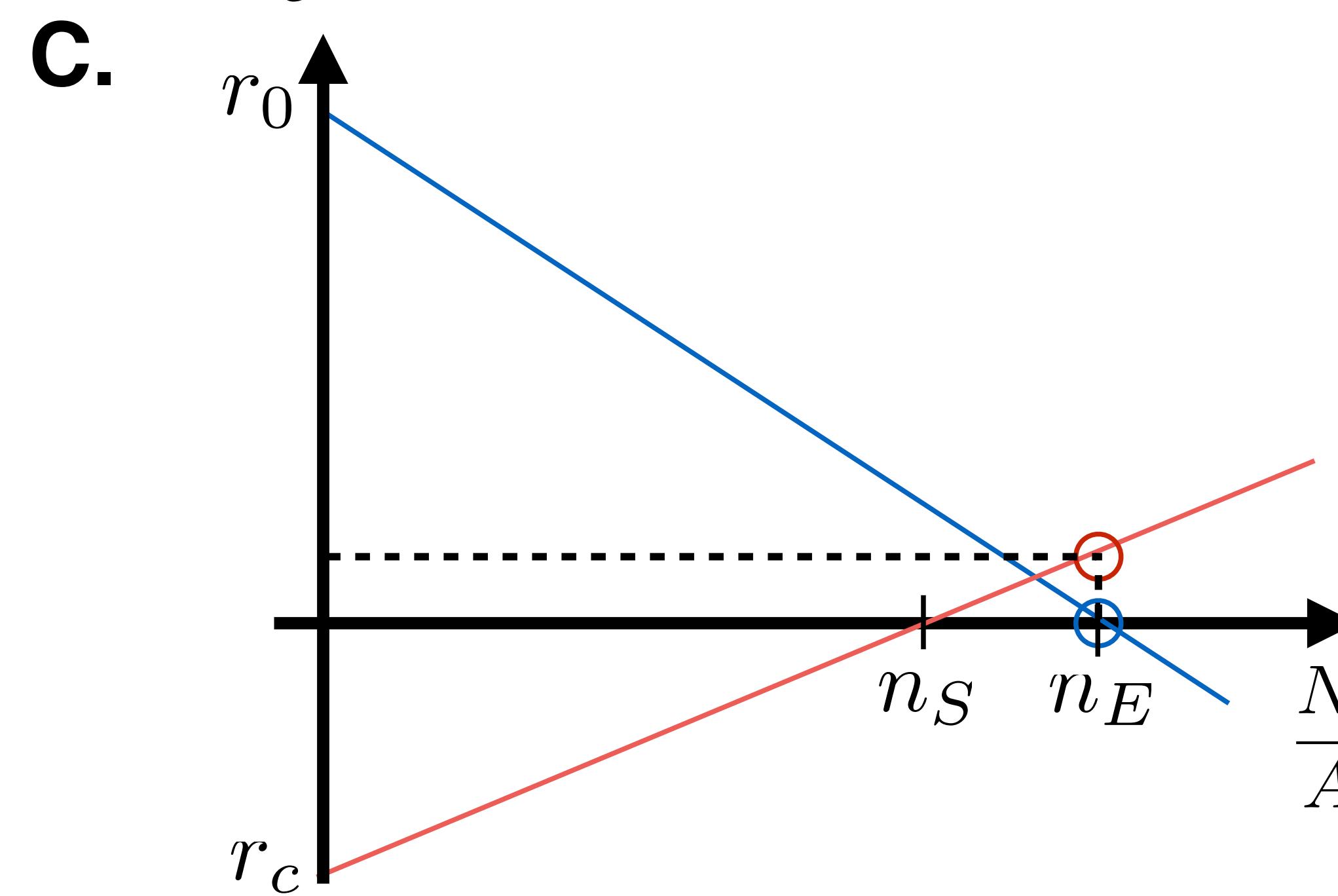
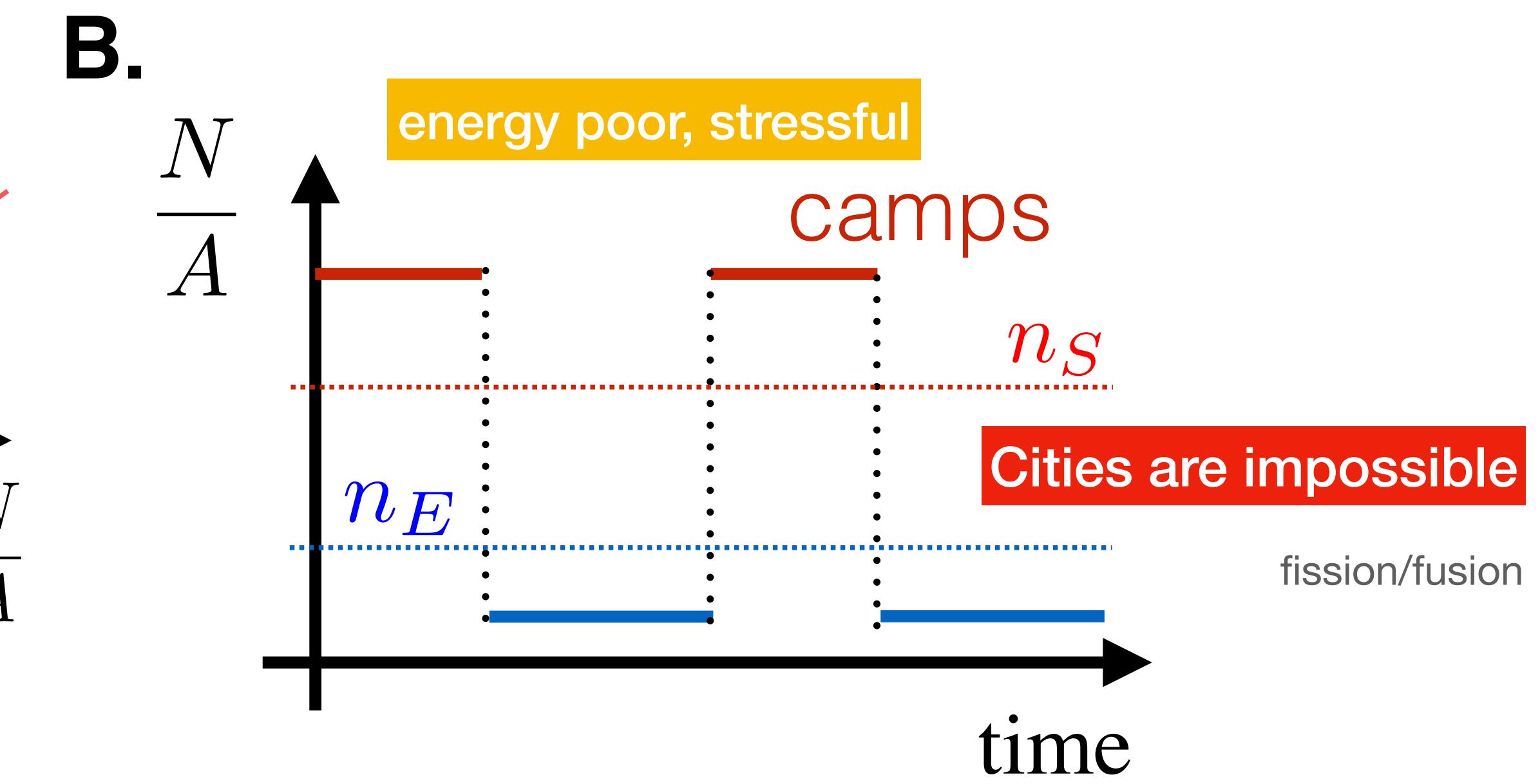
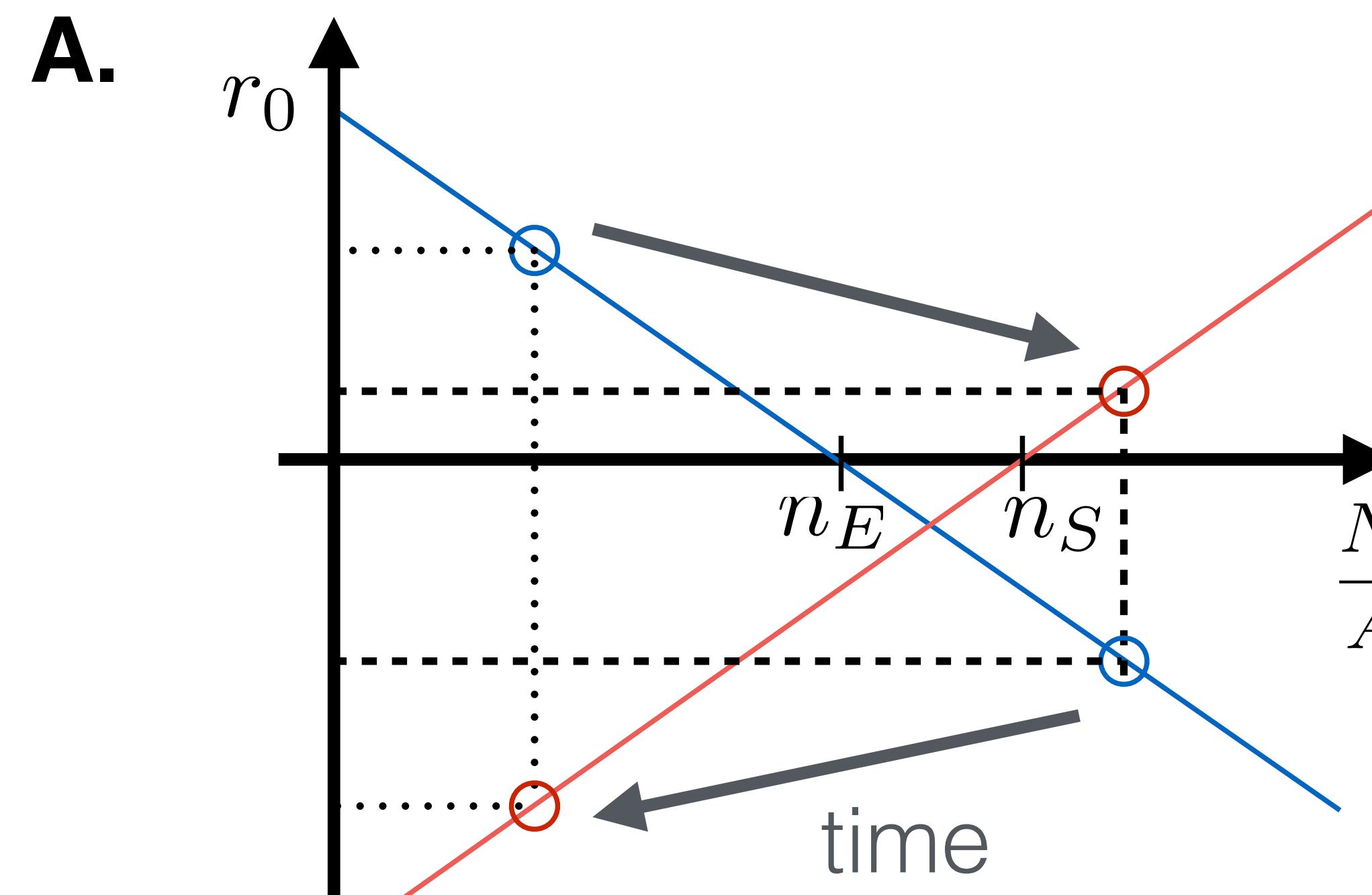
Hamilton et al 2007

<https://www.pnas.org/doi/10.1073/pnas.0611197104>

Better Model

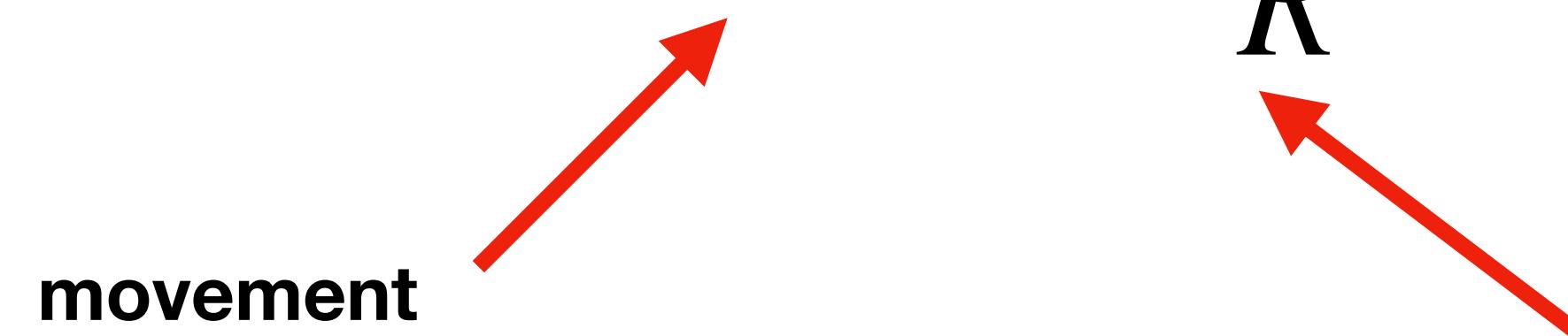
advantages of socialization+scalar stress+kin-structure+energy





Simple model for costs of socialization

$$r_C(R) = \epsilon R + \rho \frac{\ell(N)}{R}.$$



leads to:

$$G \frac{N}{R^2} = \epsilon R + \rho \frac{\ell}{R} \rightarrow R^3 + R_*^2 R - \frac{G}{\epsilon} N = 0$$

$$R_* = \sqrt{\frac{\rho \ell}{\epsilon}}$$

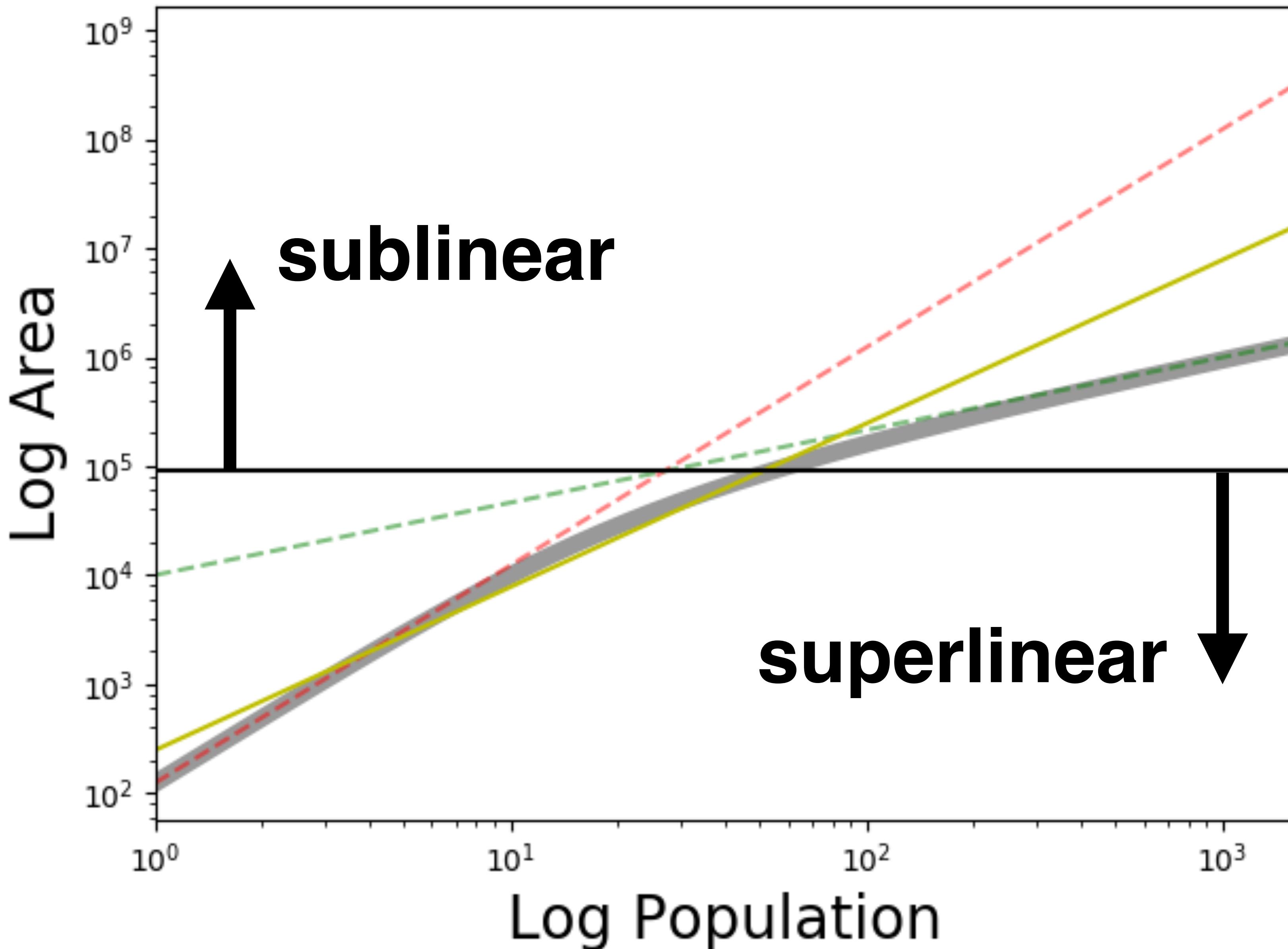
$$R \ll R_* : \quad R \simeq \frac{G}{\epsilon R_*^2} N \rightarrow A(N) = A_0 N^2$$

Camps

$$R \gg R_* : \quad R^3 \simeq \frac{G}{\epsilon} N \rightarrow A(N) = A_0 N^{2/3}$$

Foraging territories

Lobo et al 2018



Lobo et al 2018

<https://www.journals.uchicago.edu/doi/abs/10.1086/719234>

A simple model of kinship distance

$$k(N) = k_0 N^{-\gamma}$$

average kinship
in a population N



Hamilton et al 2007

<https://www.pnas.org/content/104/11/4765>

$$\gamma \simeq 1/f, \quad f = \text{family size}$$
$$f \simeq 4$$

$$\ell(N) = \ell_0 N^\gamma \sim 1/k(N)$$

distance between extended families

resulting in:

$$A(N) = \left(\frac{G}{\rho \ell} \right)^2 N^2 \simeq \left(\frac{G}{\rho \ell_0} \right)^2 N^{2-2\gamma} \sim N^{1.5}$$

Approximately right exponent

<https://www.journals.uchicago.edu/doi/abs/10.1086/719234>

Hunter Gatherer Camps are *not* like “small cities”: they are qualitatively different

For large human settlements and cities to develop it was necessary:

High density of resource production (food, energy)

Constant conflict resolution (solve “scalar stress”)

Low costs of interaction and transaction

Argument is that:

These are still our problems today

Food Production Technologies & Political, Organizational Innovation were *both* necessary

farming, irrigation, construction

private “property”, public goods, political structures, conflict resolution



“Urban Package”

~10,000 years ago (500 generations)