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

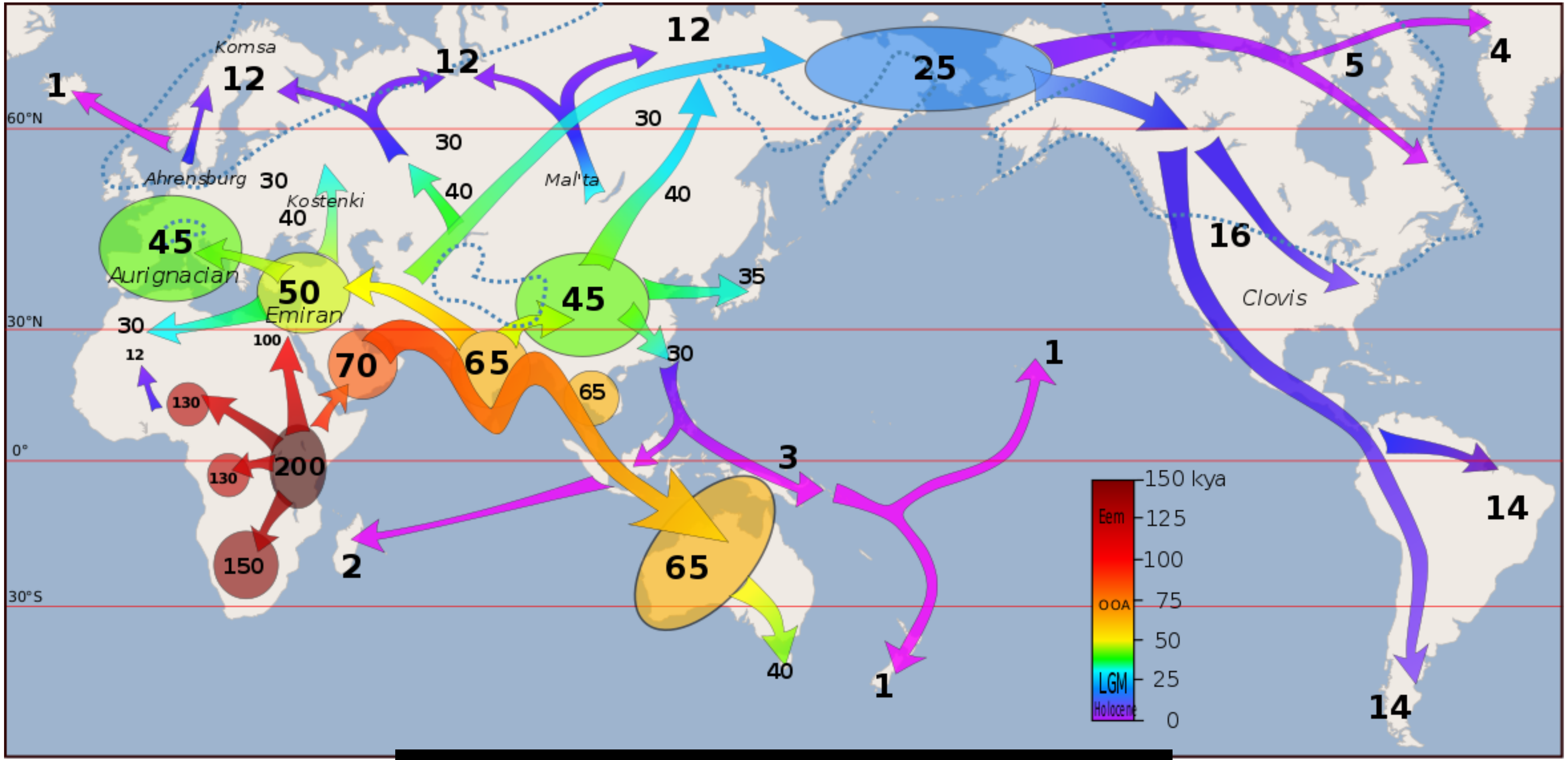
From Wikipedia, the free encyclopedia

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.

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”

mobile

sedentary

“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.”

https://www.cambridge.org/core/books/lifeways-of-huntergatherers/119FA31DAC04B7A4787D1C6B0248AFEE

Gwayasdums / Gwaestums (Gilford Island)

credit: George MacDonald

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

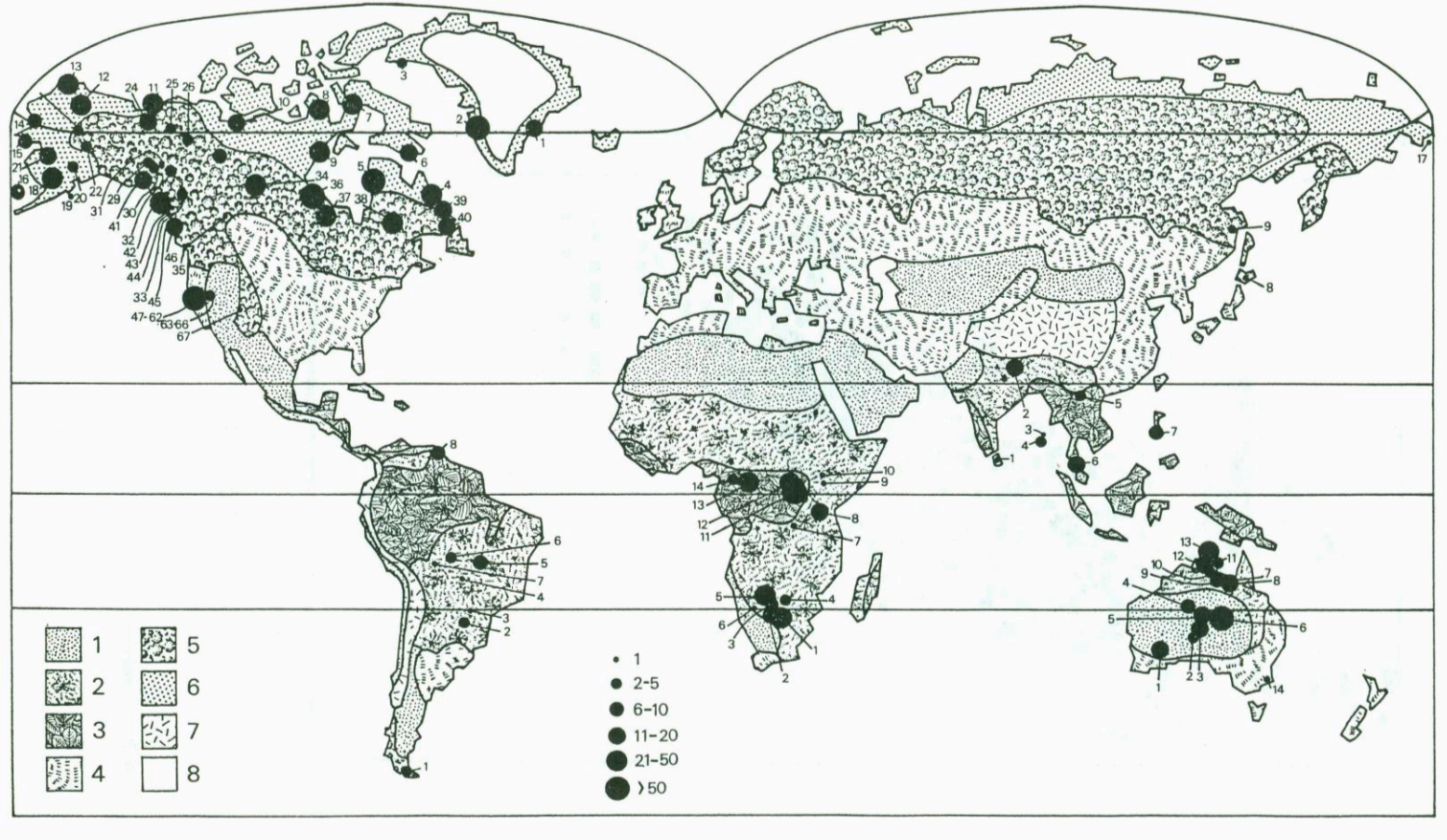
Limited conflict resolution

No elaborate construction, walls, limited food storage

Characteristic Social Patterns of Fission and Fusion in Space-Time

foraging single-family units ↔ **larger social “camps”**

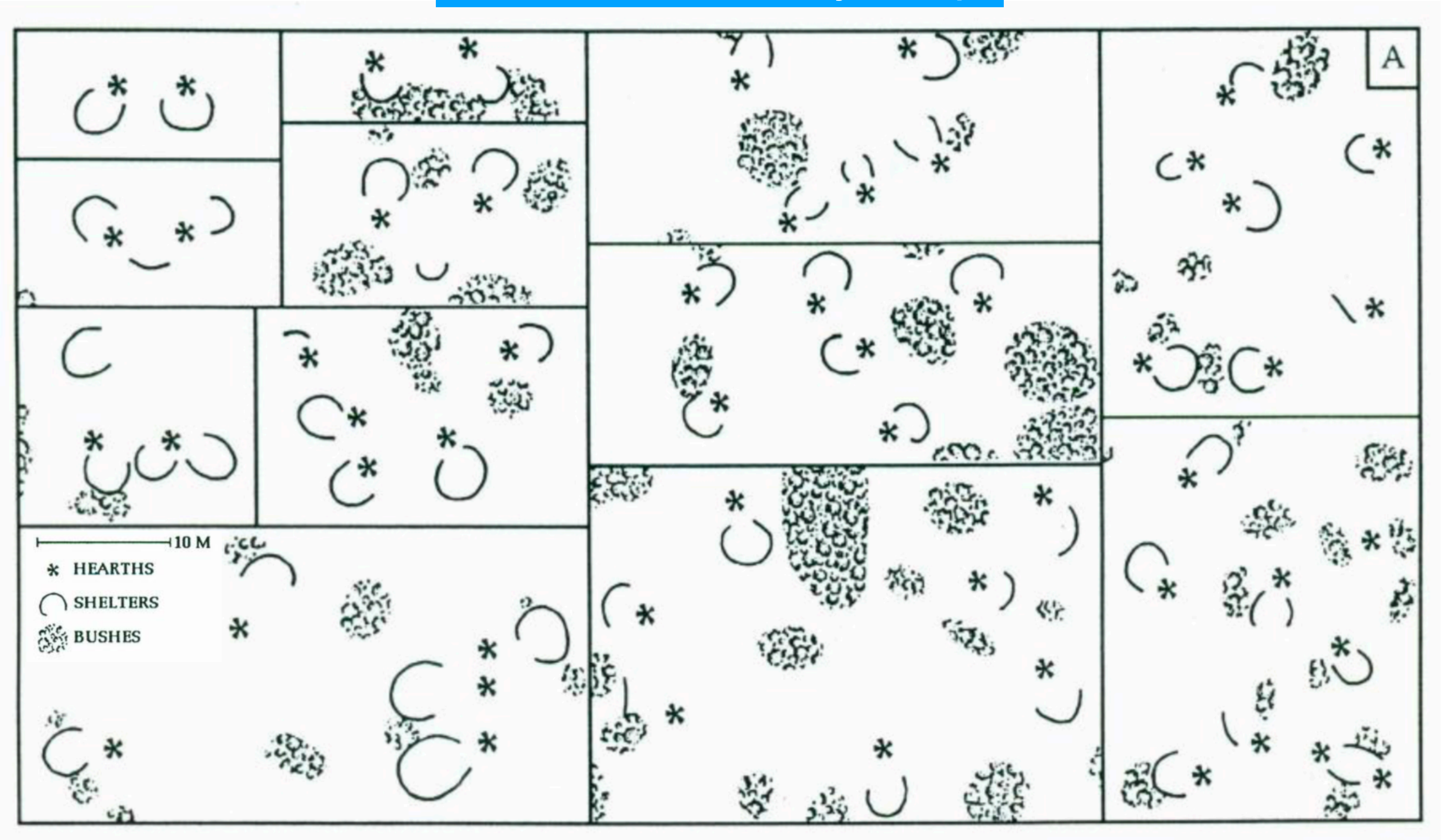
Large worldwide survey of Hunter-Gatherer Camps



credit: T. Whitelaw 1989

https://www.repository.cam.ac.uk/handle/1810/272725

Small “Extended Family” camps



credit: T. Whitelaw

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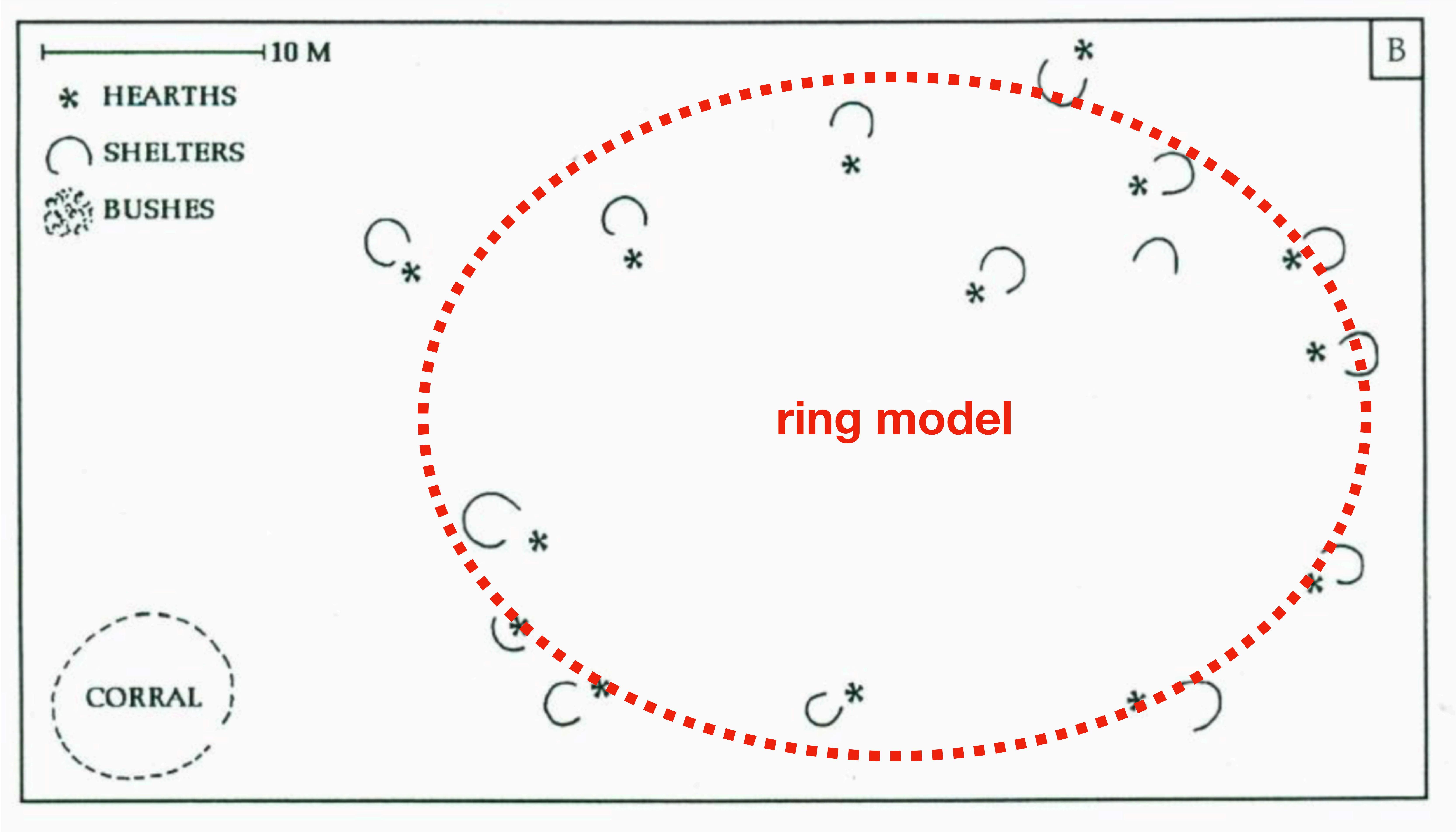
Large rainy-season camp



credit: T. Whitelaw

https://www.repository.cam.ac.uk/handle/1810/272725

Ring Model for H/G Camps

families camp along the *perimeter* of a common area

area

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

circle

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

perimeter

Area is *superlinear* on Population !!!

P Wiessner 1974

https://www.cambridge.org/core/journals/american-antiquity/article/abs/functional-estimator-of-population-from-floor-area/5345979420D340EEA82F3AF53D2743F2

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
constant	1.225	1.846	1.955	1.476
	(0.132)	(0.124)	(0.132)	(0.121)
β	***1.698***	***1.533***	***1.505***	***1.631***
	(0.034)	(0.031)	(0.034)	(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
estimation method	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

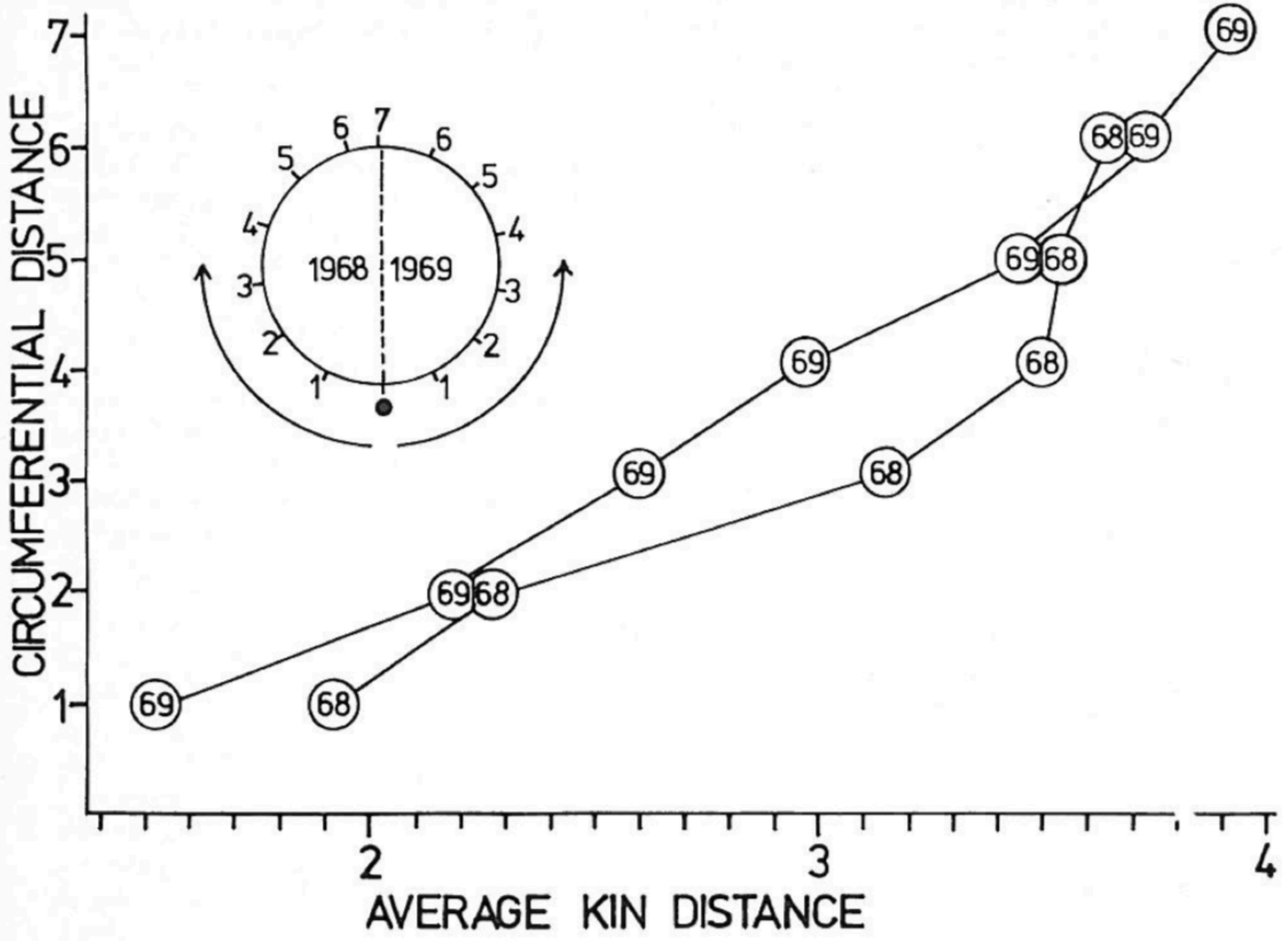
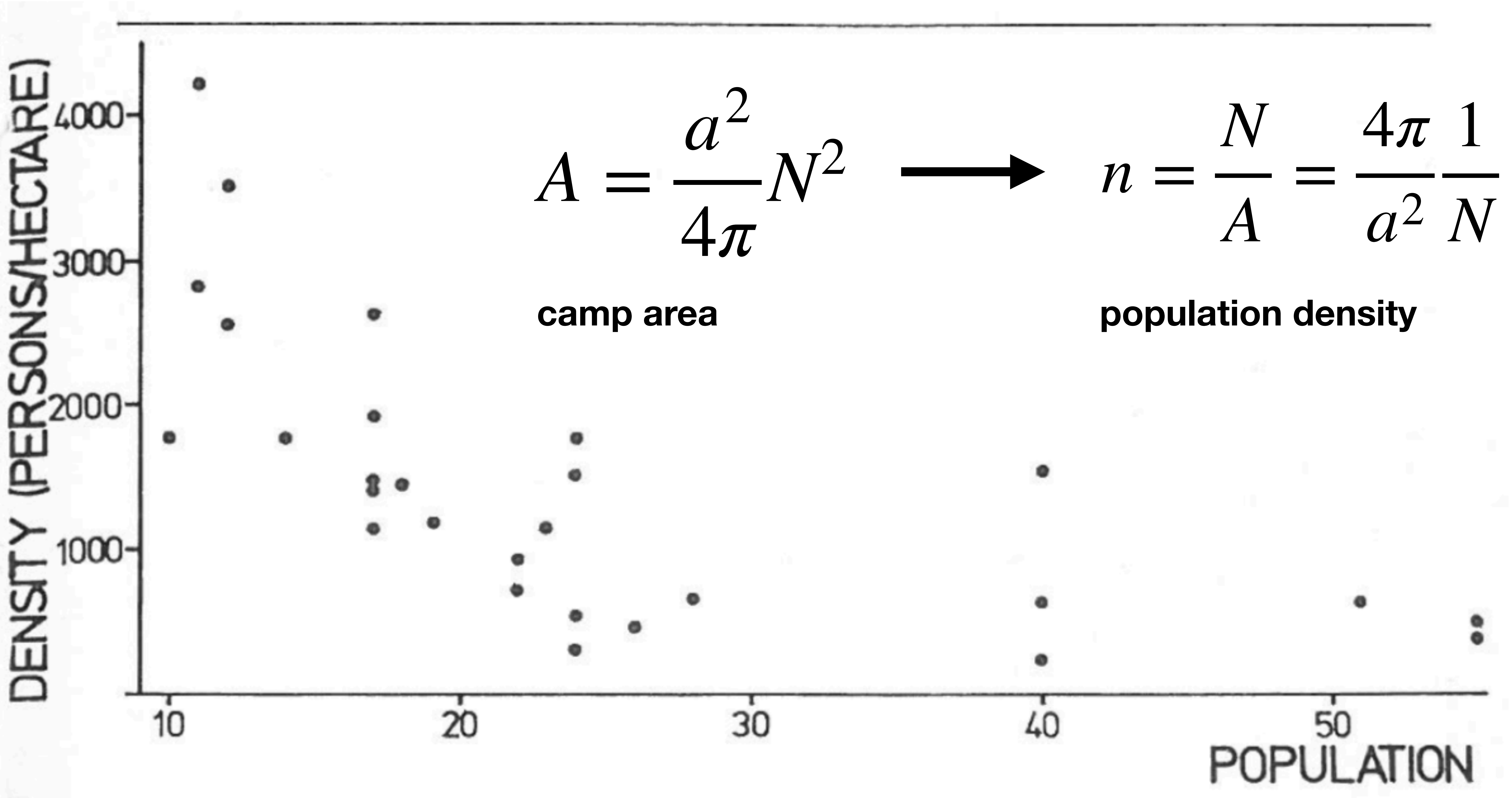


Figure 2: Dobe dry season camps, average kinship distance for each hut position.

credit: T. Whitelaw

superlinear



$$A = \frac{a^2}{4\pi} N^2 \longrightarrow n = \frac{N}{A} = \frac{4\pi}{a^2} \frac{1}{N}$$

camp area

population density

Figure 6: San camp population and density.

credit: T. Whitelaw

Scalar Stress

a network theory of conflict

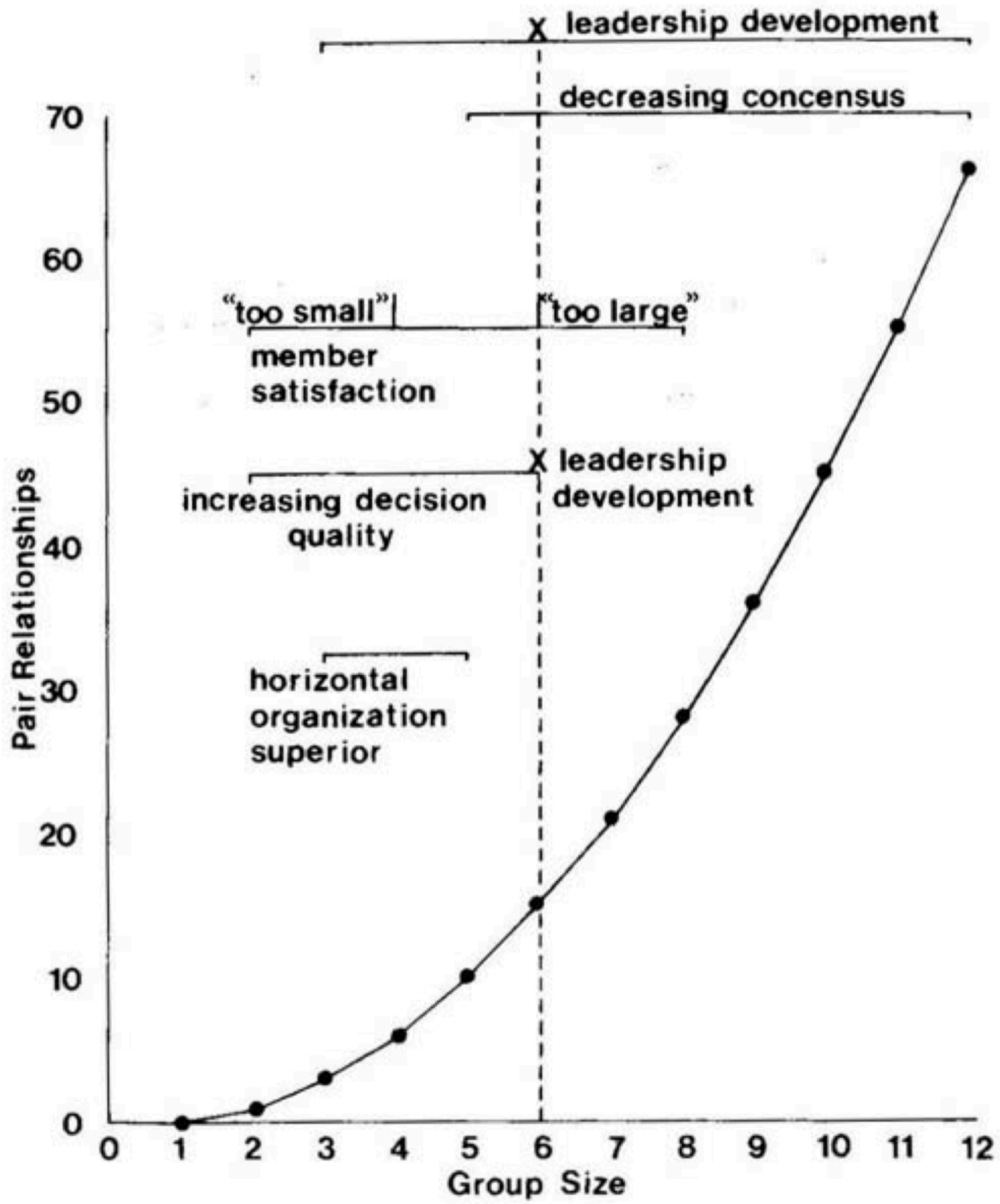


Figure 21.2. Scalar stress in small groups.

credit: Johnson 1982

https://wiki.santafe.edu/images/3/3b/Johnson1984scalarstress.pdf credit: Johnson 1982

TABLE 21.4
Estimating Scalar Stress in !Kung Camps

	Population = 100		Population = 150	
Camp: /Xai/xai	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

	Population = 40		Population = 60	
Camps: Dobe and Mahopa	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."

https://wiki.santafe.edu/images/3/3b/Johnson1984scalarstress.pdf

But, meanwhile, on larger scales

Total Foraging Areas are sublinear

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.

Hamilton et al 2007

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

Better Model

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

$$\frac{dE}{dt} = r_E = r_0 - k\frac{N-1}{A}, \quad \frac{dS}{dt} = r_S = G\frac{N-1}{A} - r_C$$

costs per unit time: scalar + movement

Logistic Dynamics:

$$r_E = k\left(n_E - \frac{N}{A}\right), \qquad r_S = G\left(\frac{N}{A} - n_S\right).$$

critical density for energy

critical density for socialization

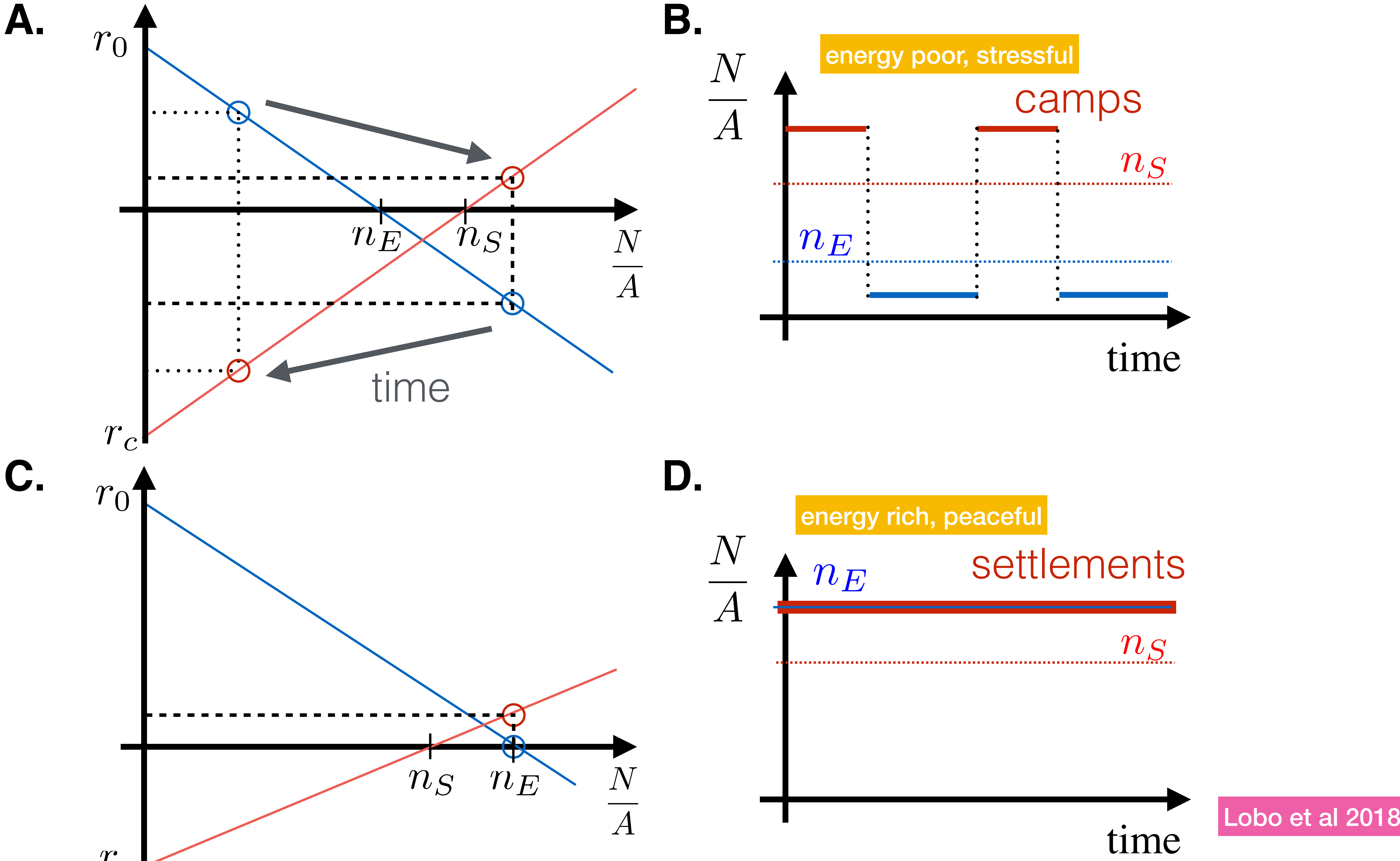
wants low density

$$n_E = \frac{r_0}{k}, n_S = r_C G$$

wants high density

Lobo et al 2018

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



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

Simple model for costs of socialization

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

movement

scalar stress

leads to:

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

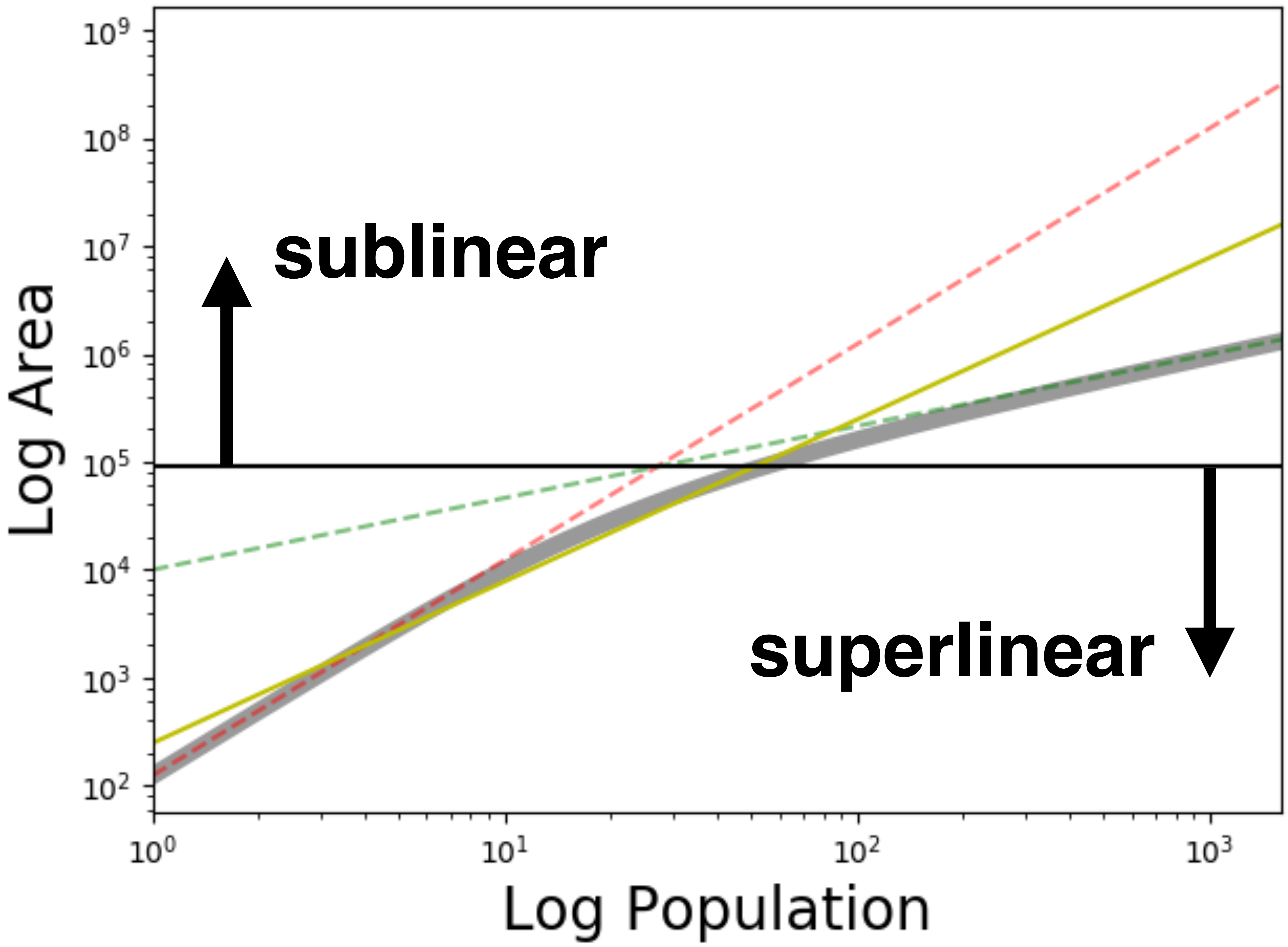
$$R_* = \sqrt{\frac{\rho \ell}{\epsilon}}$$

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

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



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

$\gamma \simeq 1/f, \quad f =$ **family size**

$f \simeq 4$

Hamilton et al 2007

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

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

distance between extended families

resulting in:

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

better !

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 Resources (food, energy)

Conflict resolution (solve “scalar stress”)

Low costs of interaction and transaction

Argument is that:

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

farming, irrigation, construction

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

“Urban Package”

These are still our problems today