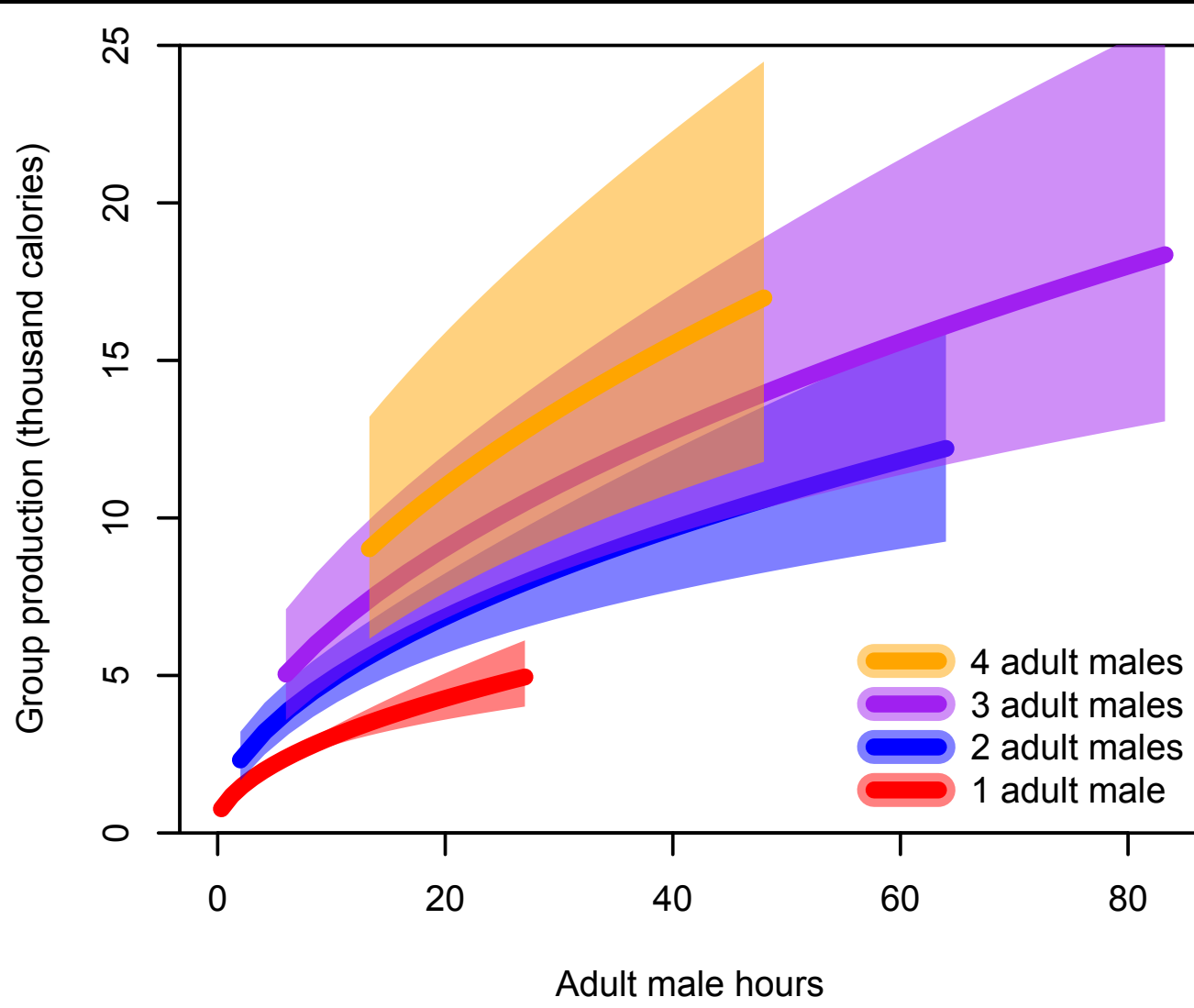


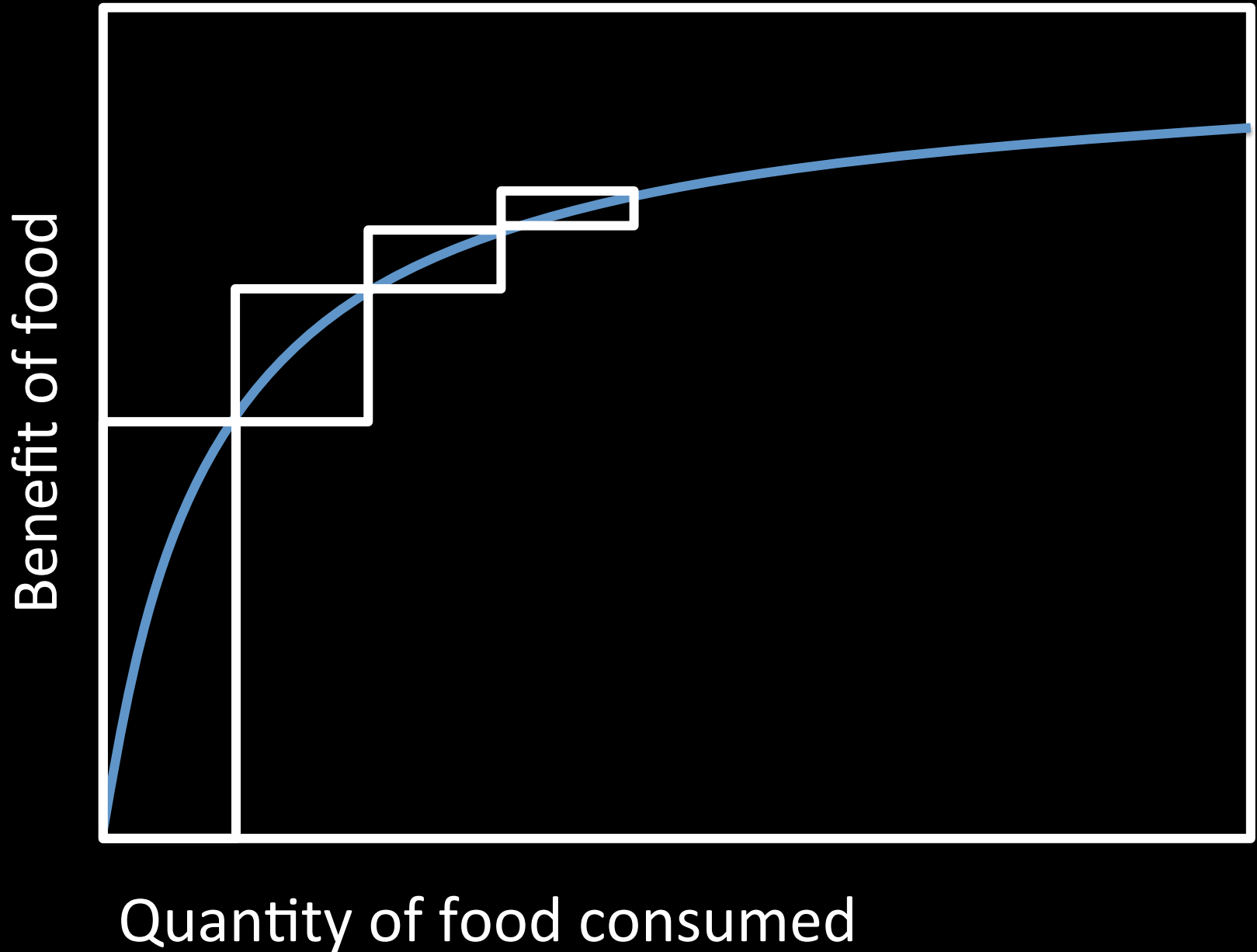
Research Question 1

**WHAT MOTIVATES THE FORMATIONS
OF COOPERATIVE RELATIONSHIPS?**

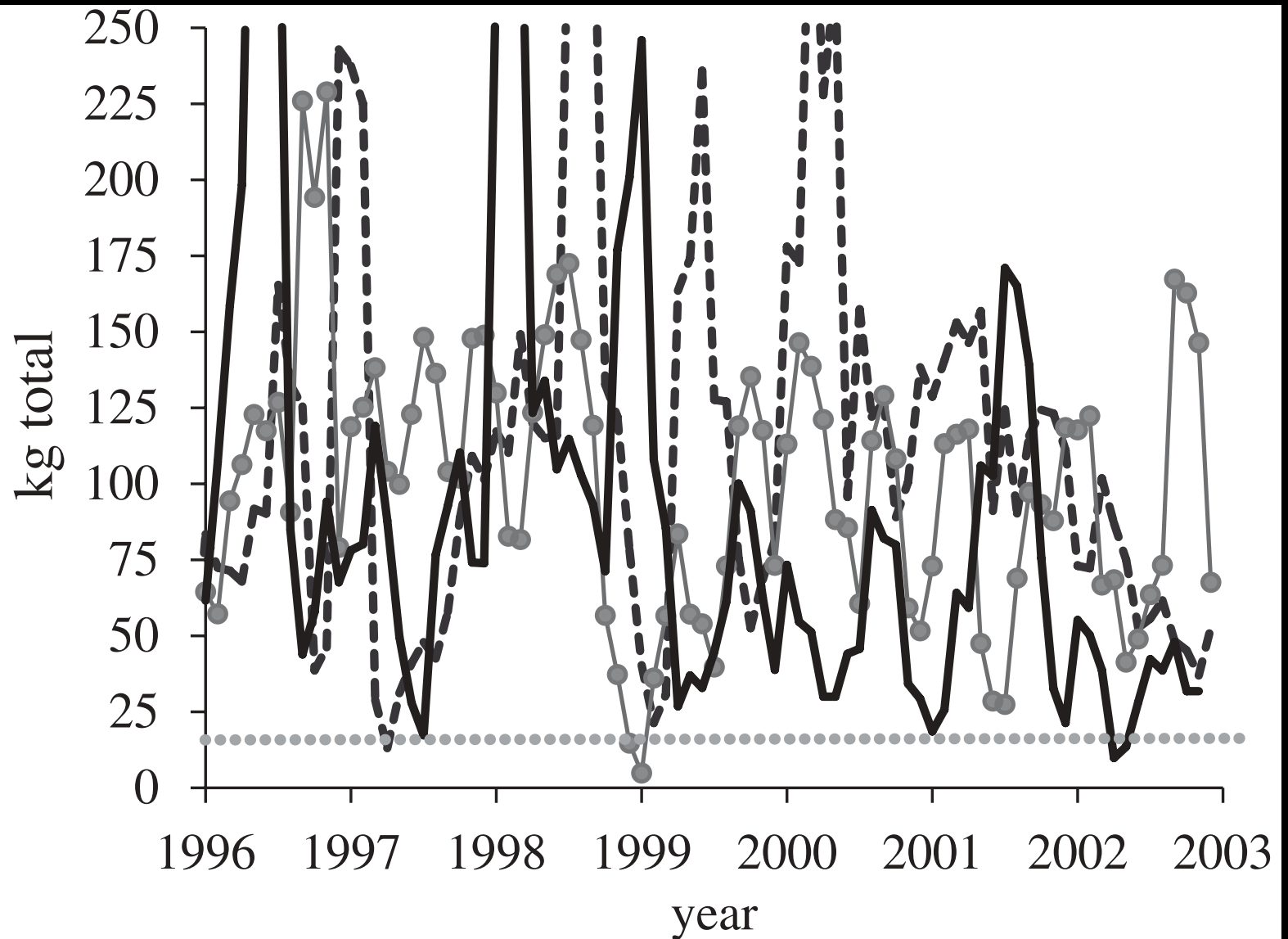
Returns to scale in Tsimane hunting



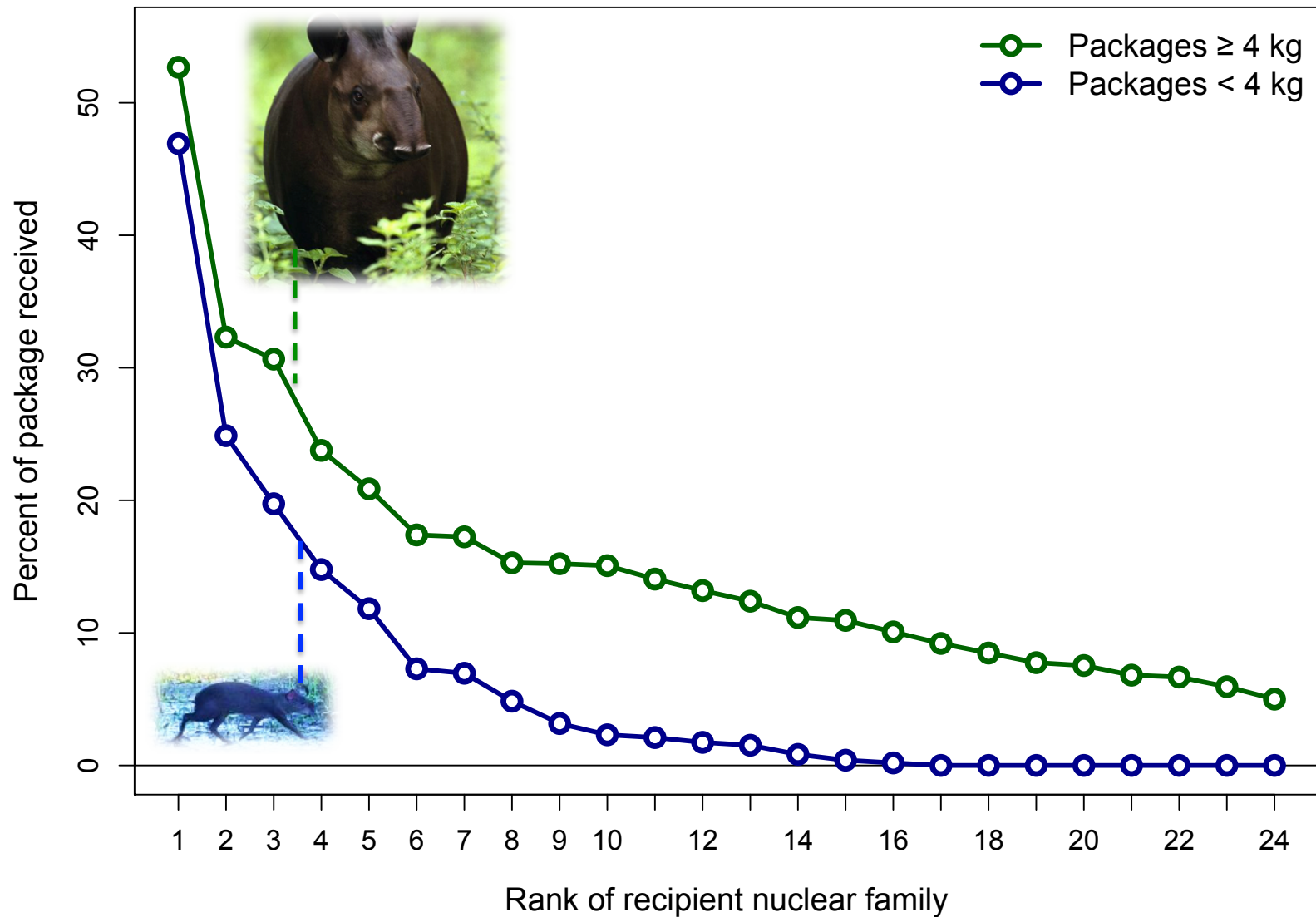
Diminishing returns to consumption motivate risk reduction



Variability in Ache hunting return rates creates returns to sharing as risk reduction

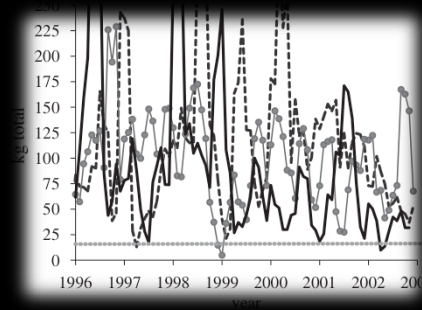
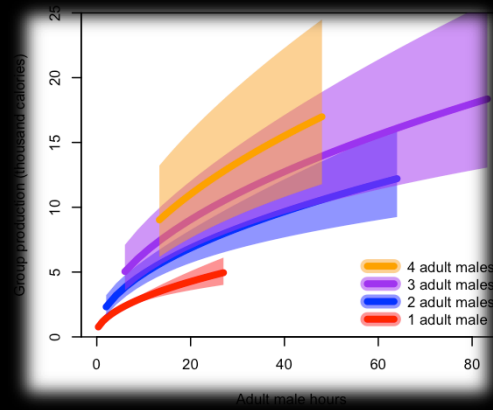


Extent of Ache sharing depends on the size of prey



Specialized roles among Tsimane forager-horticulturalists





Variability in
returns

Package
size

1. Returns to
scale in acquisition

2. Gains from risk
reduction

3. Returns to
divisions of labor

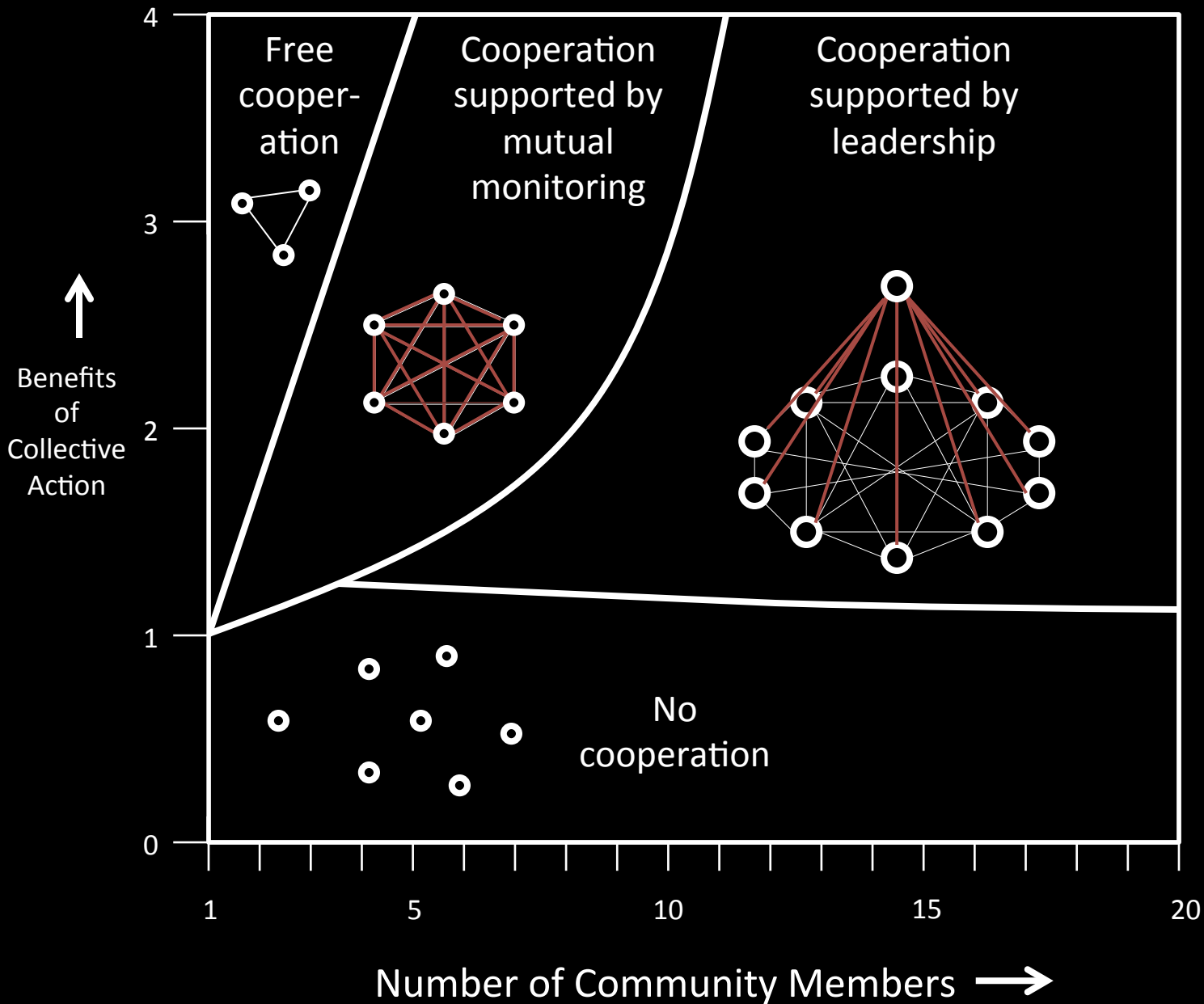
Cooperative food sharing



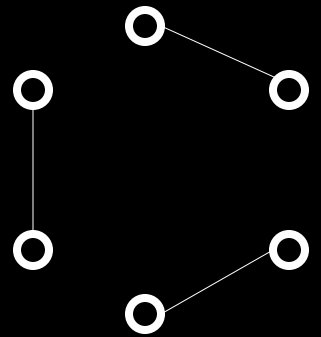
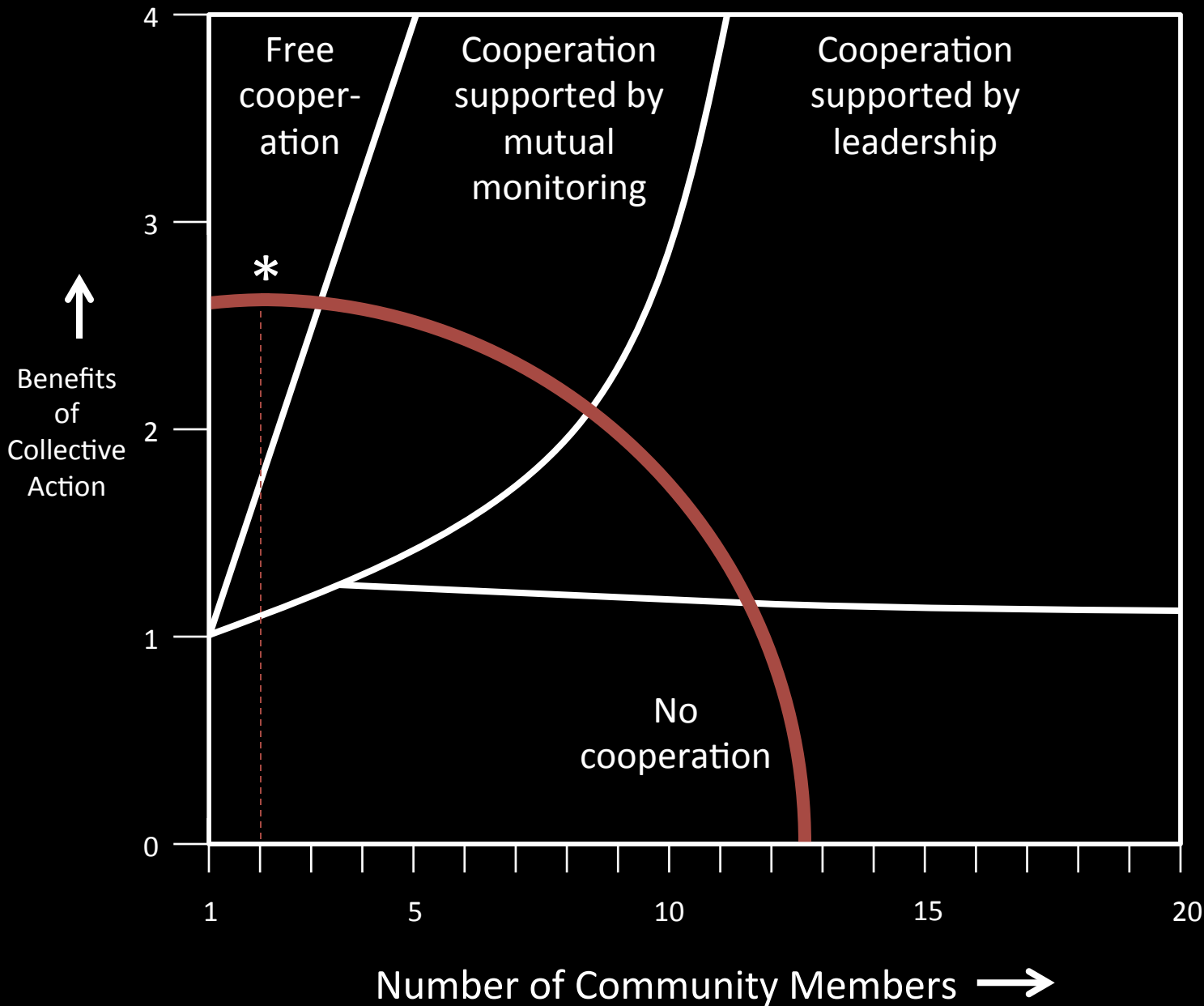
Research Question 2

**WHAT DRIVES TRANSITIONS IN SOCIAL
ORGANIZATION FOR COLLECTIVE
ACTION?**

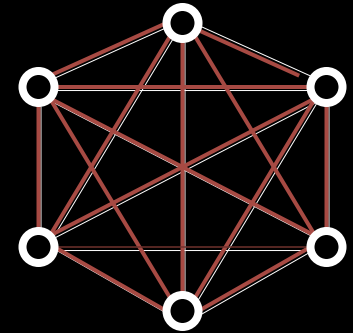
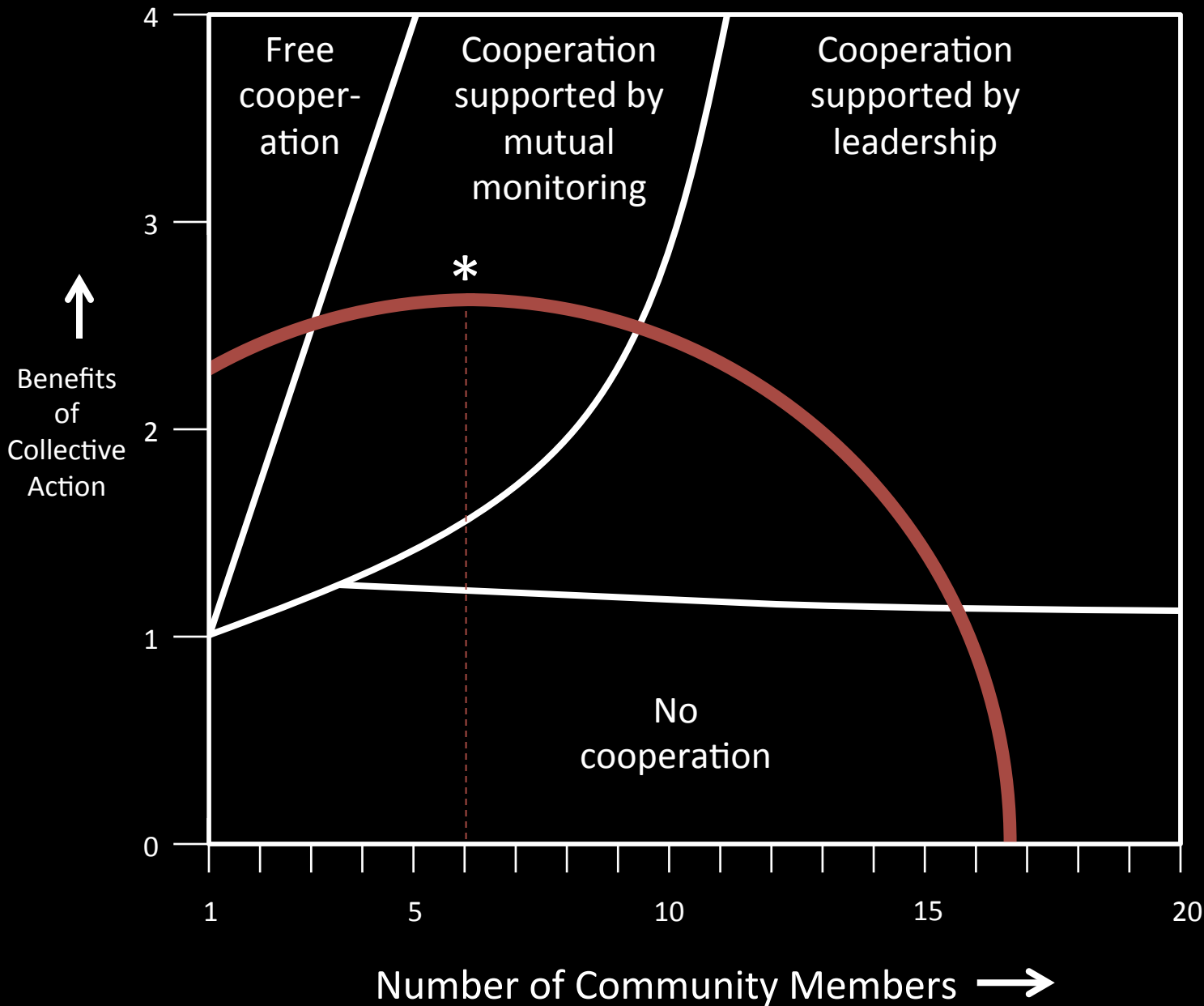
Transitions in equilibrium organization with variation in conditions



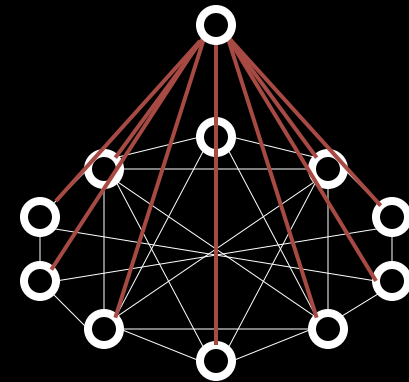
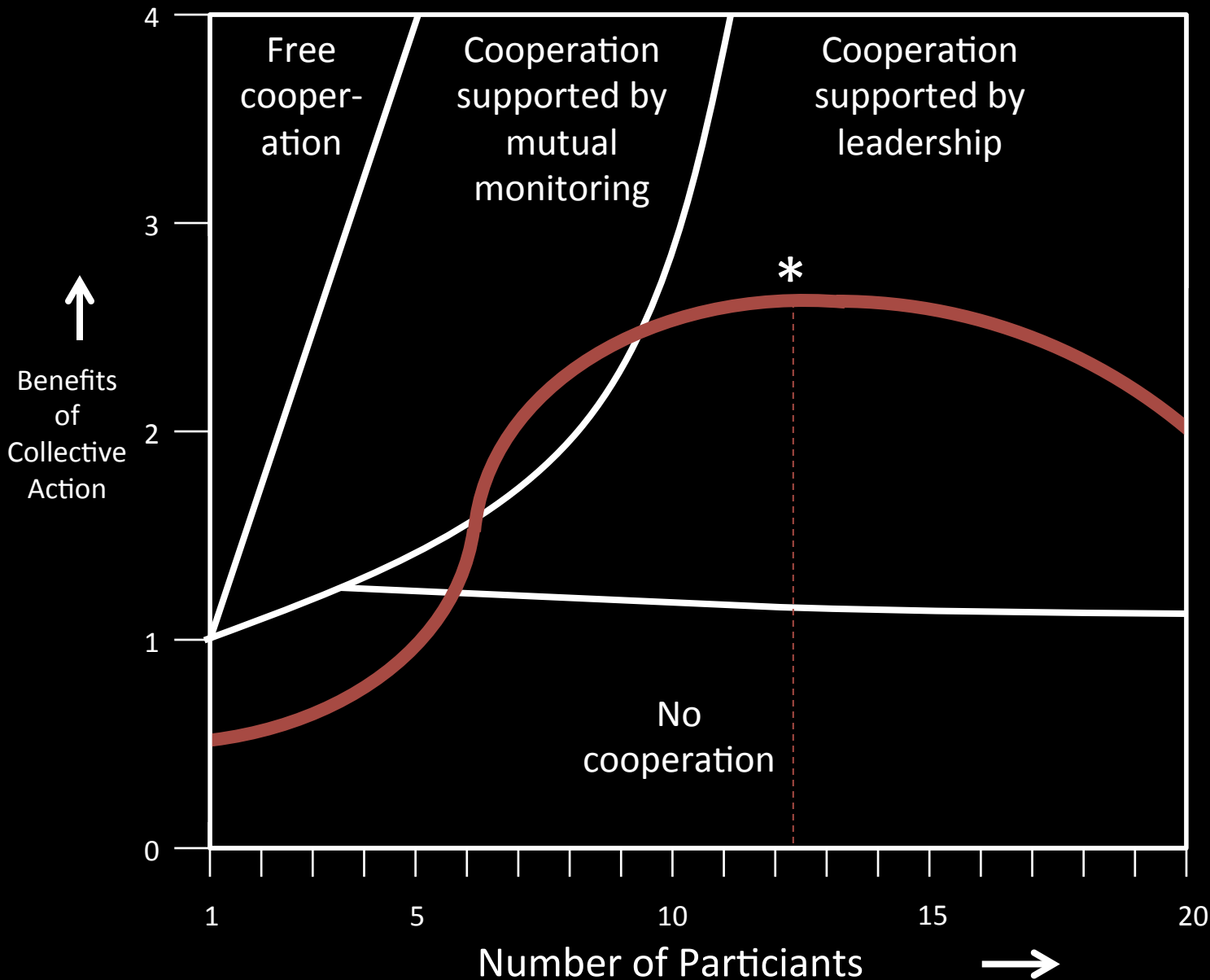
Transitions in equilibrium organization with variation in conditions



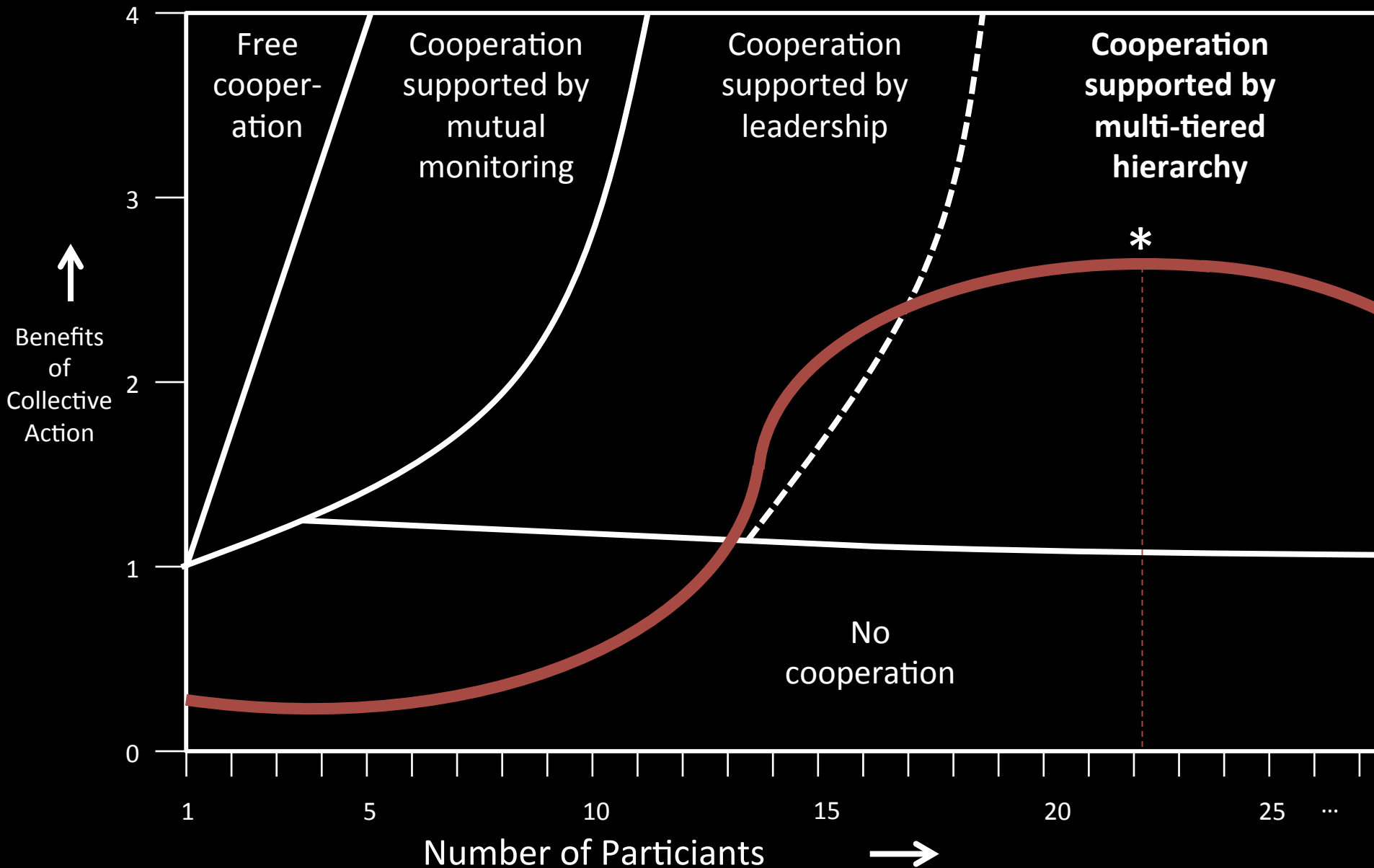
Transitions in equilibrium organization with variation in conditions



Transitions in equilibrium organization with variation in conditions



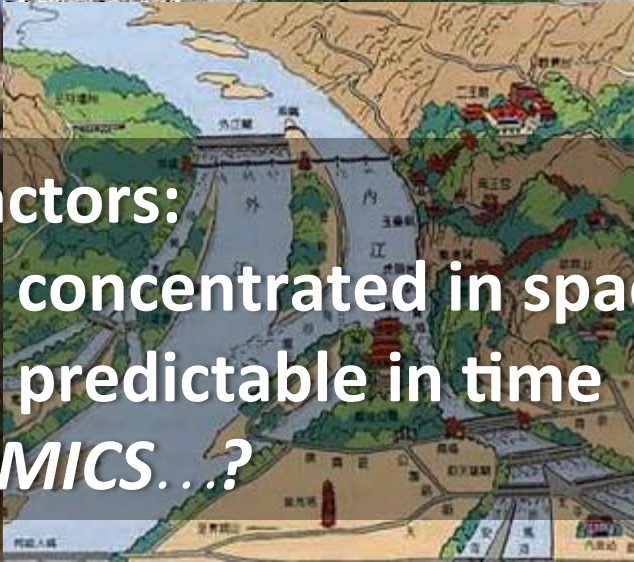
Transitions in equilibrium organization with variation in conditions



Research Question 3

**WHAT CONDITIONS FAVOR THE
EMERGENCES OF TERRITORIAL
COALITIONS AND HIERARCHY?**

Territoriality

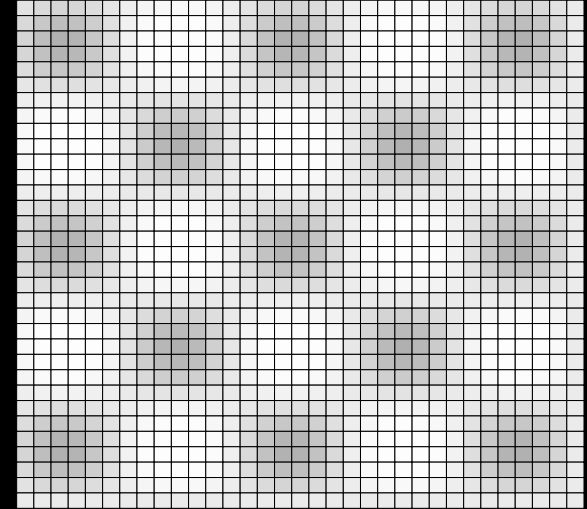


Ecological factors:
1. Resources concentrated in space
2. Resources predictable in time
DYNAMICS...?

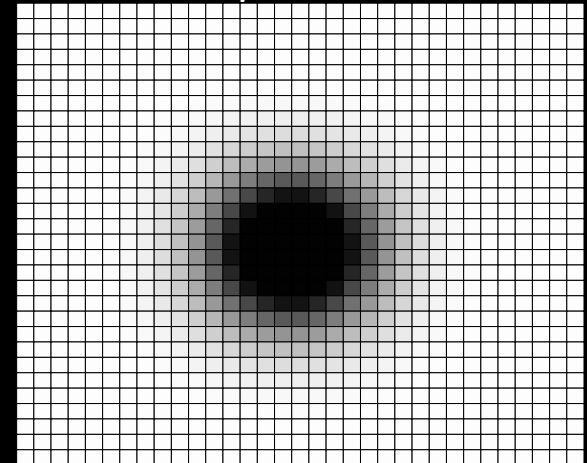
Simulated Territorial Competition

- Ecology varies in whether resources are:
 - dispersed and unpredictable, or
 - concentrated and predictable
- Ecology varies in whether coalitions:
 - increase fighting power, or
 - do not affect fighting power
- Hierarchy allows groups to maintain higher rates of cooperation within coalitions

*Resources are dispersed
and unpredictable*



*Resources are concentrated
and predictable*



Darker patch = higher mean productivity

Simulated Territorial Competition



Nomad



Solitarily territorial



Coalitionary territorial

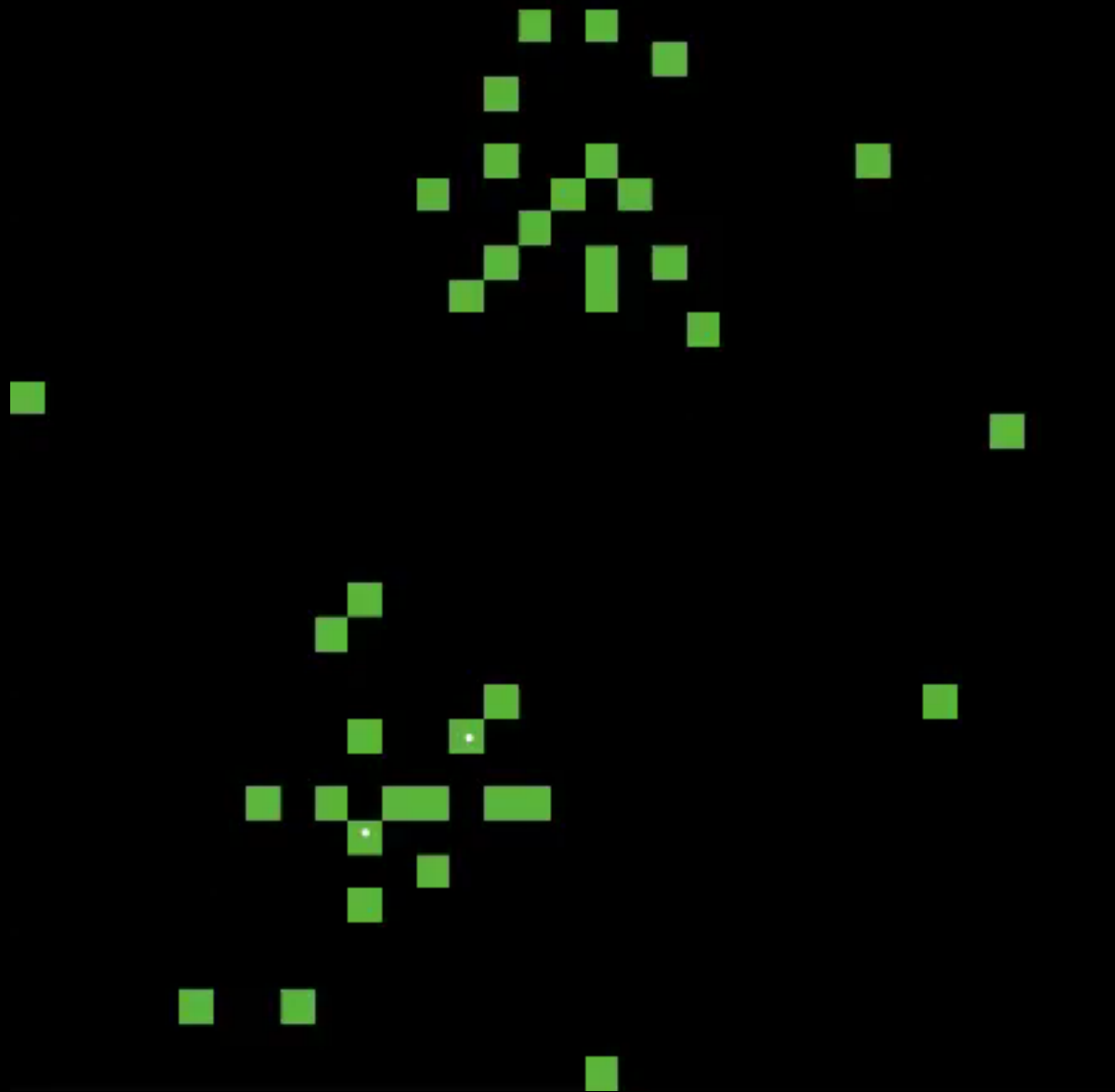


Hierarchical territorial

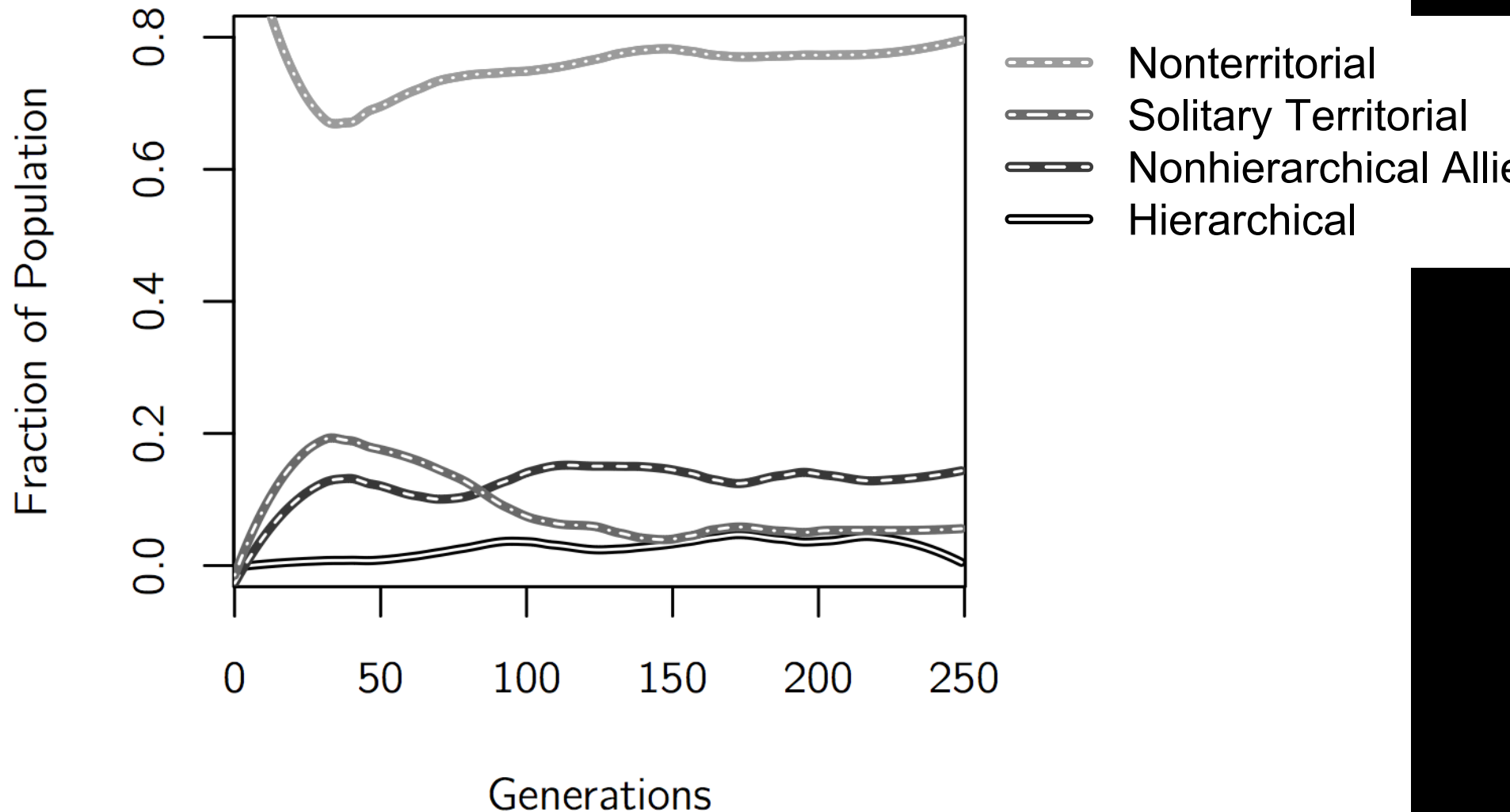


Coalitionary bond

ECOLOGY: Resources are dispersed and unpredictable

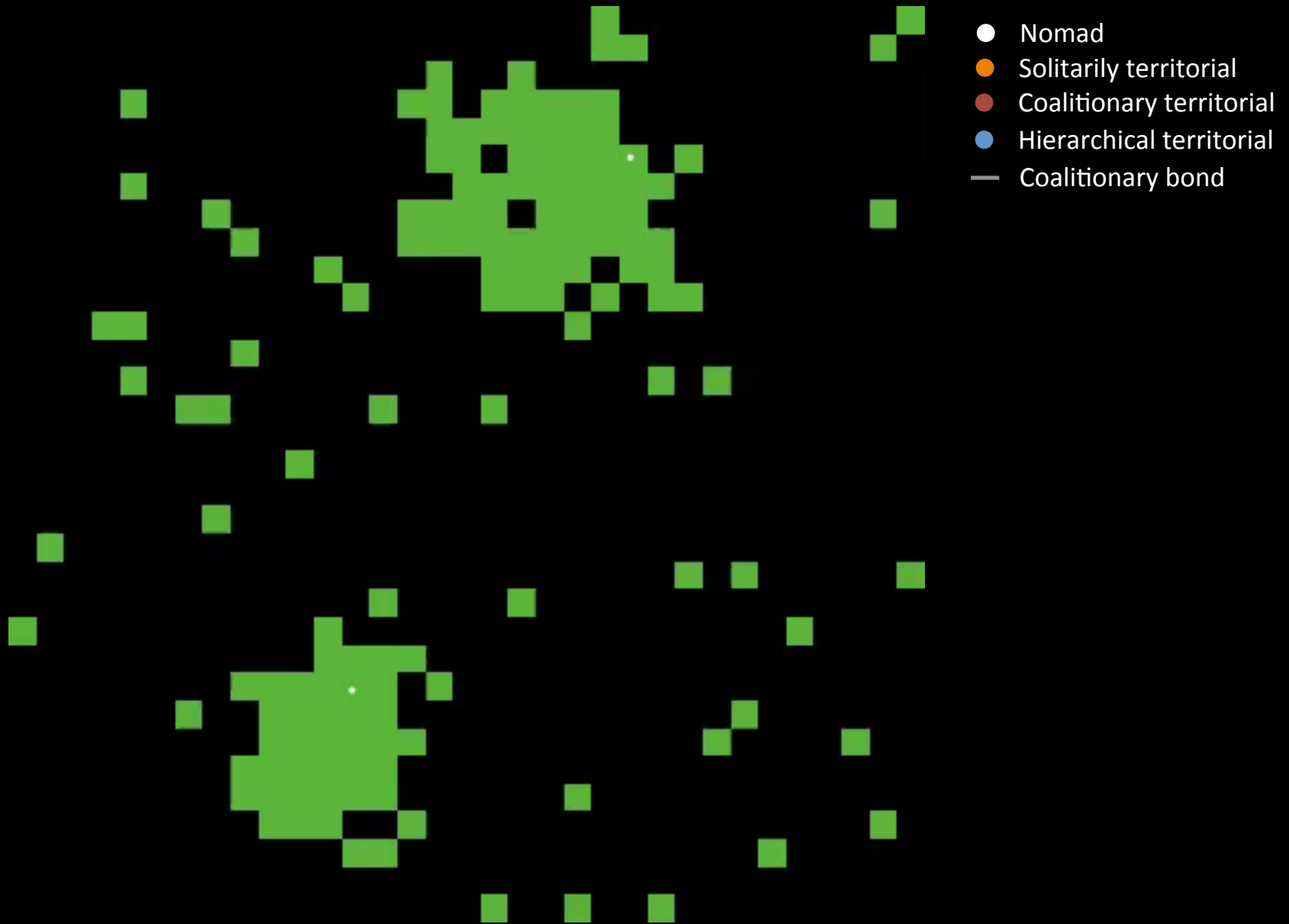


Low Patchiness

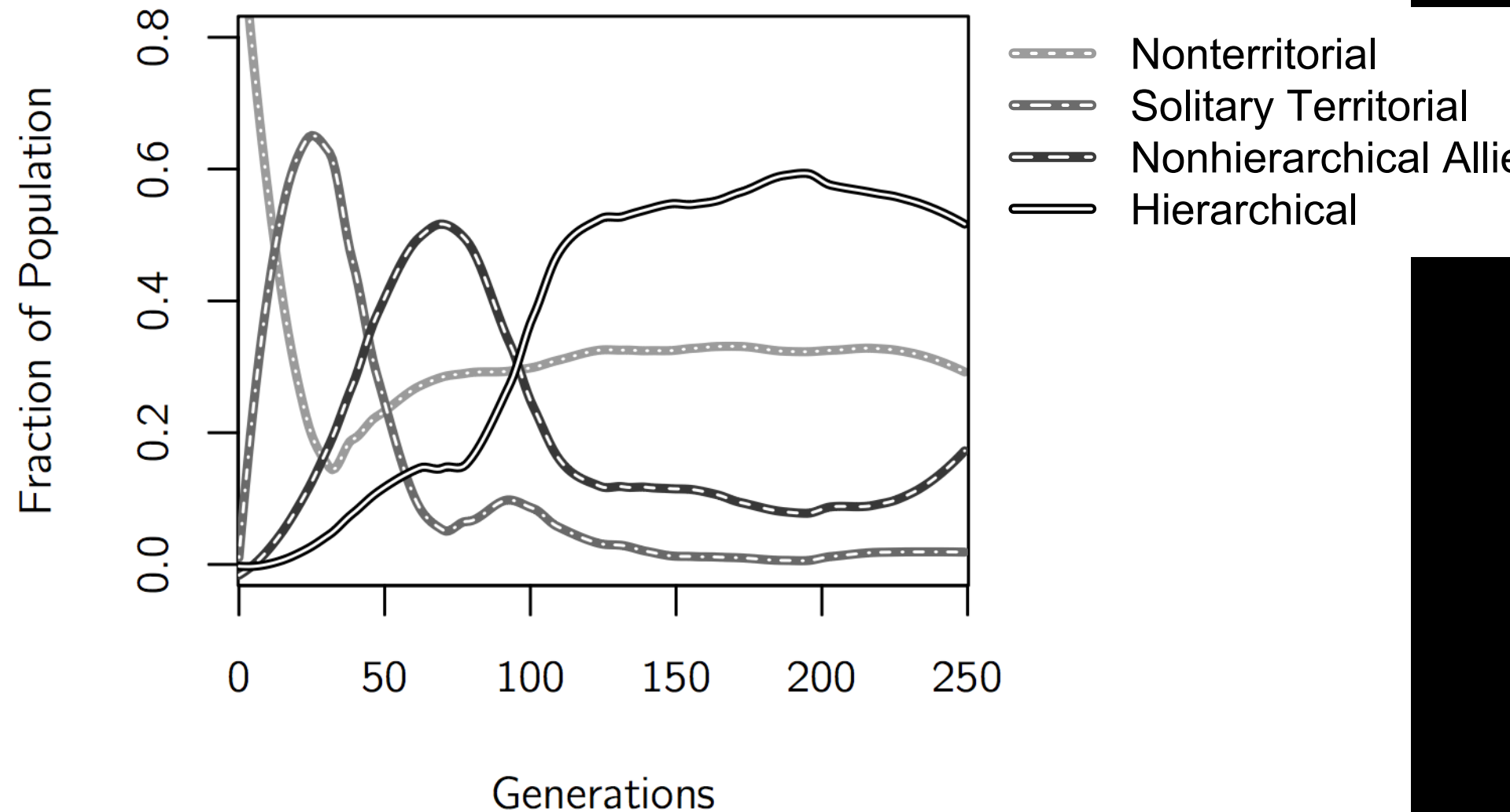


(A) An environment with low patchiness (i.e. low variance in the productivity of land, $\text{var}(\mu_k) = 0.005$) yet low social costs of alliances and hierarchy ($c^A = 0.05$, $c^C = 0.05$, $c^E = 0.05$, $d = 1$). Nonterritorial agents outcompete territorial strategies and maintain predominance in the population.

ECOLOGY: Resources are concentrated, and coalitions are effective



High Patchiness, Lower Cost of Hierarchy



(D) An environment with high patchiness ($\text{var}(\mu_k) = 0.055$) and relatively low costs of alliances and hierarchy ($c^A = 0.05$, $c^C = 0.05$, $c^E = 0.05$, $d = 1$). After initial invasions by solitary and alliance-forming territorial agents, hierarchical strategies dominate the population.

Lower Cost of Hierarchy

