How Cooperation can be Harnessed to Achieve Sustainability

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outline

1. sustainability often requires cooperation
2. how cooperation evolves
3. how sustainability evolves
4. how to harness cooperation for sustainability

Sustainability often requires **cooperation**.

What is “sustainability?”

[vacuous term]

The Daly Rules
(*human use of environmental resources*)

1. Renewable resources (fish, soil, and groundwater) must be used no faster than they regenerate.
2. Nonrenewable resources (minerals and fossil fuels) must be used no faster than renewable substitutes for them can be put into place.
3. Pollution and wastes must be emitted no faster than natural systems can absorb them, recycle them, or render them harmless.

- Herman Daly, 1996

sustainable?

Forest
San Luis
Puntarenas
Costa Rica

sustainable?

Oil Refinery
Richmond
California
United States

sustainable?

[Europe]

We need to know:
when sustainability happens.

[hint: cooperation]

The Tragedy of the Commons

Hardin (1968)

…can be solved by

cooperation

What is “cooperation?”

[context-dependent]

A Tragedy of the Commons

—

A Social Dilemma

(unresolved)

Social Dilemma

Prisoner's Dilemma

Player A \ Player B	Cooperate	Defect
Cooperate	2 , 2	0 , 3
Defect	3 , 0	1 , 1

When does sustainability require cooperation?

In social dilemmas!

1. Resources (common pasture, forest, fisheries, water, air)
2. Pollution
3. Biodiversity Protection
4. Climate Change

(e.g. In the hardest and most important cases!)

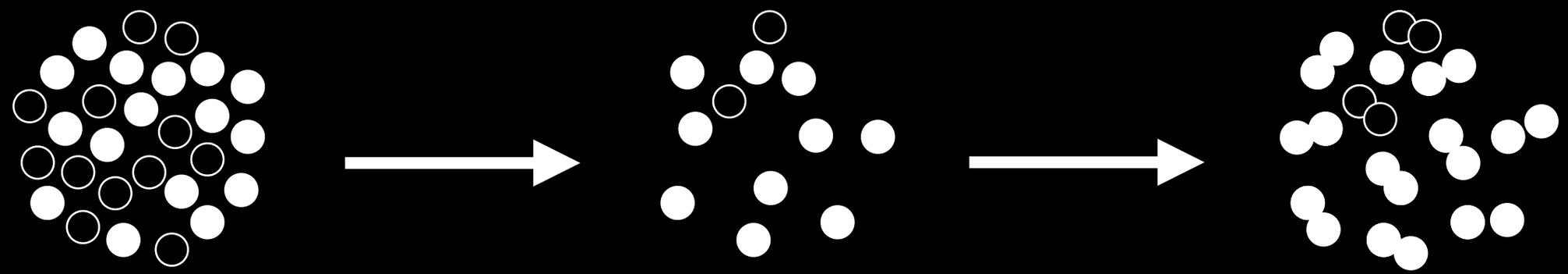
Sustainability
often requires
cooperation
because:

sustainability challenges
often involve
social dilemmas.

So how does cooperation work?

How cooperation evolves.

Evolution Refresher



variation + selection + inheritance

= adaptation

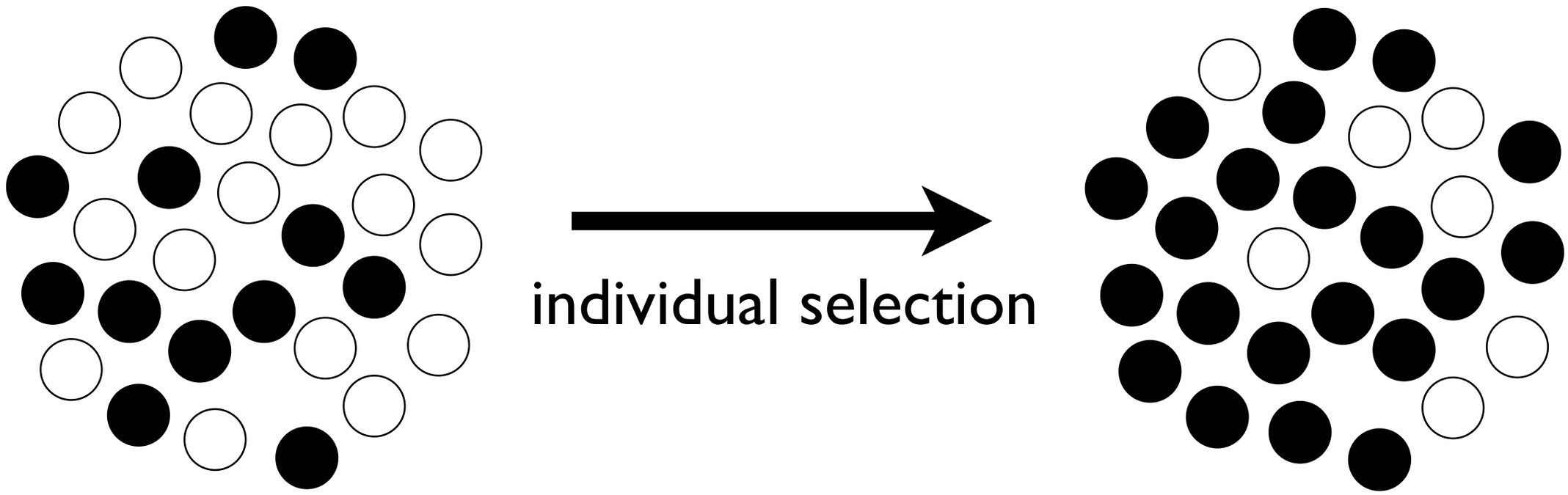
Cooperation Evolves

- Kin selection
- Reciprocity
- Group selection

Nowak, M. A. (2006). Five Rules for the Evolution of Cooperation.
Science

cooperative

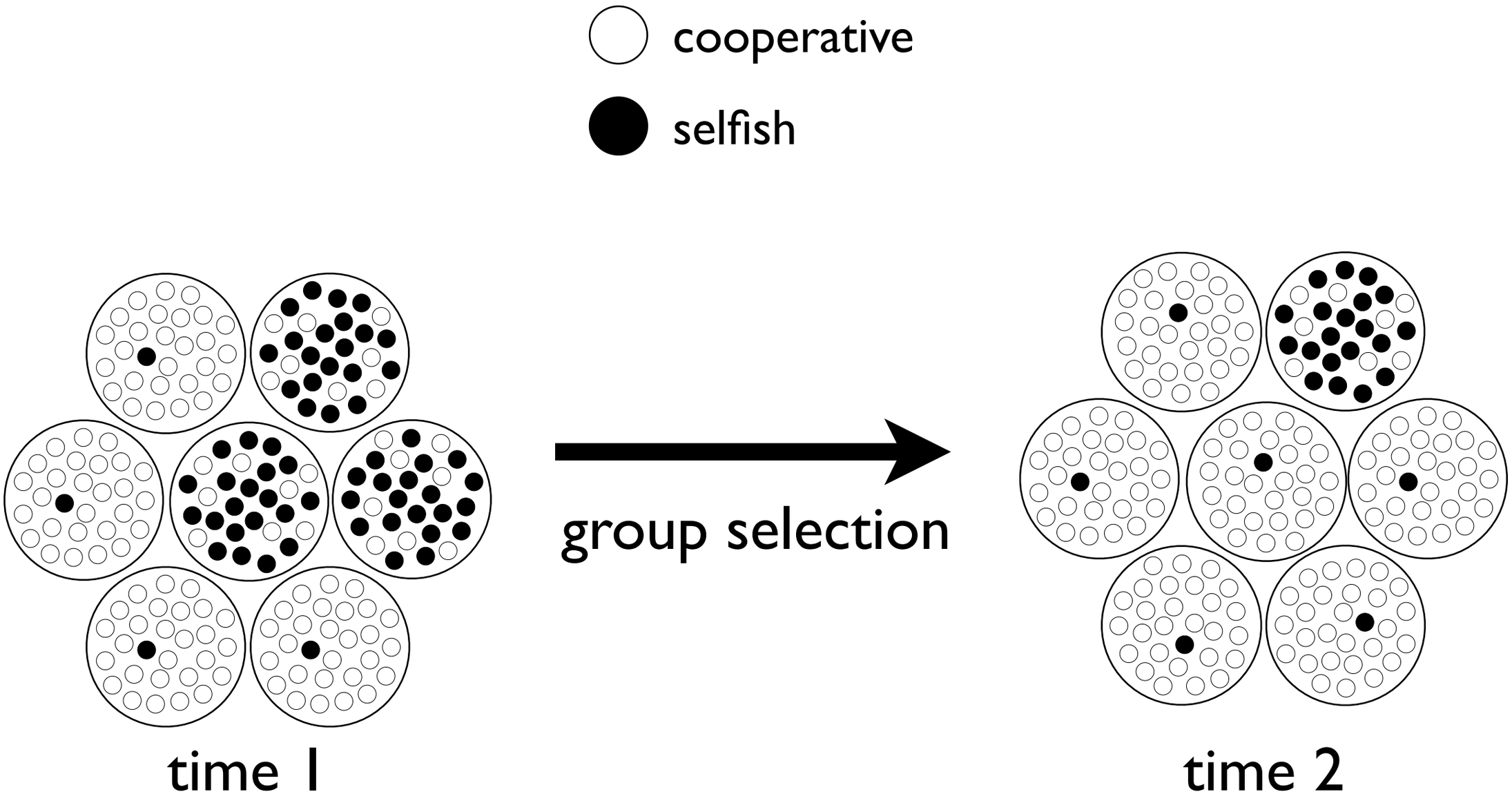
selfish



time 1

time 2

Individual selection in a social dilemma favors selfish individuals



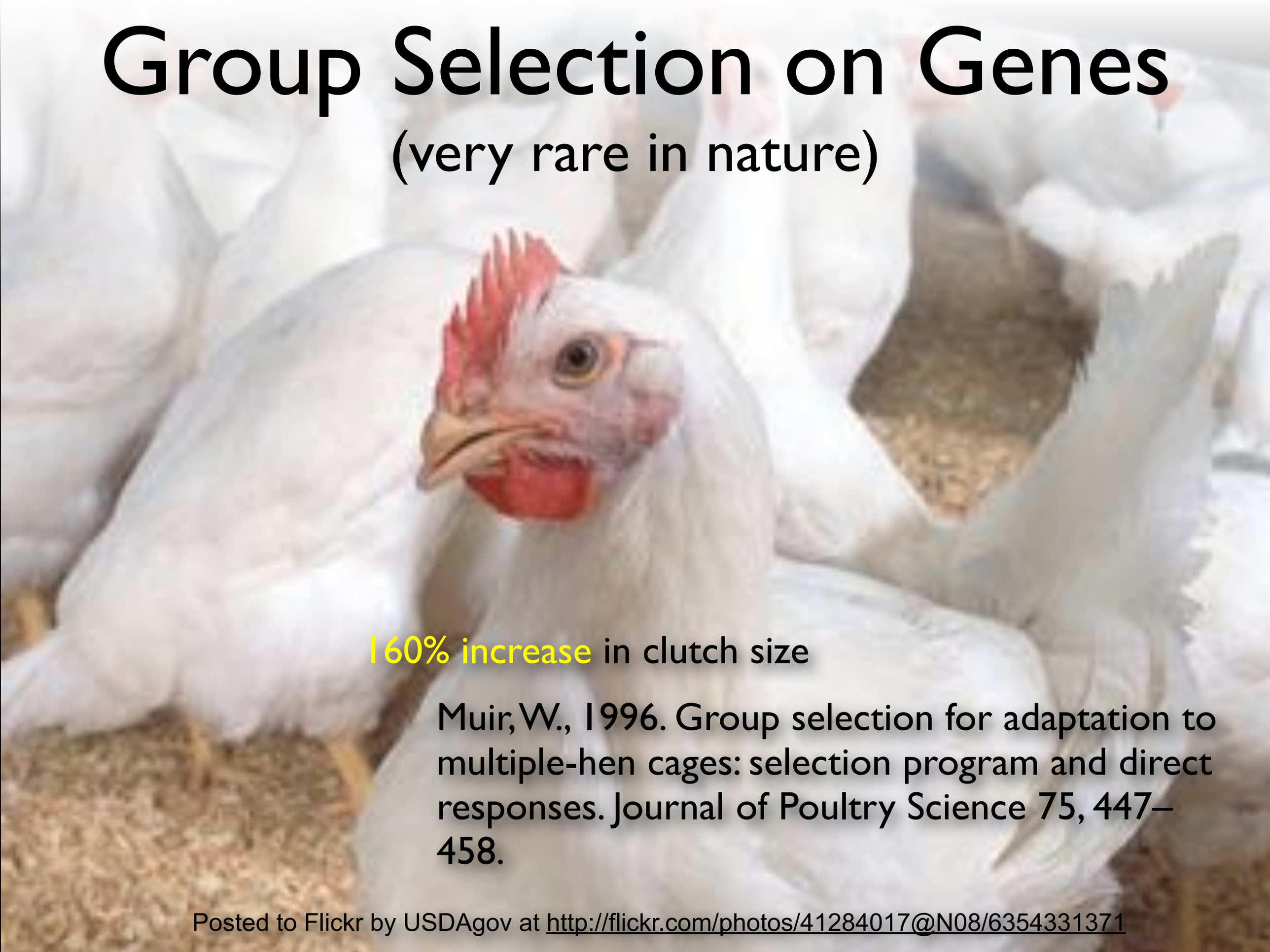
Group selection in a social dilemma favors groups of cooperative individuals

cooperation evolves

in genes…

Group Selection on Genes

(very rare in nature)



160% increase in clutch size

Muir, W., 1996. Group selection for adaptation to multiple-hen cages: selection program and direct responses. Journal of Poultry Science 75, 447–458.

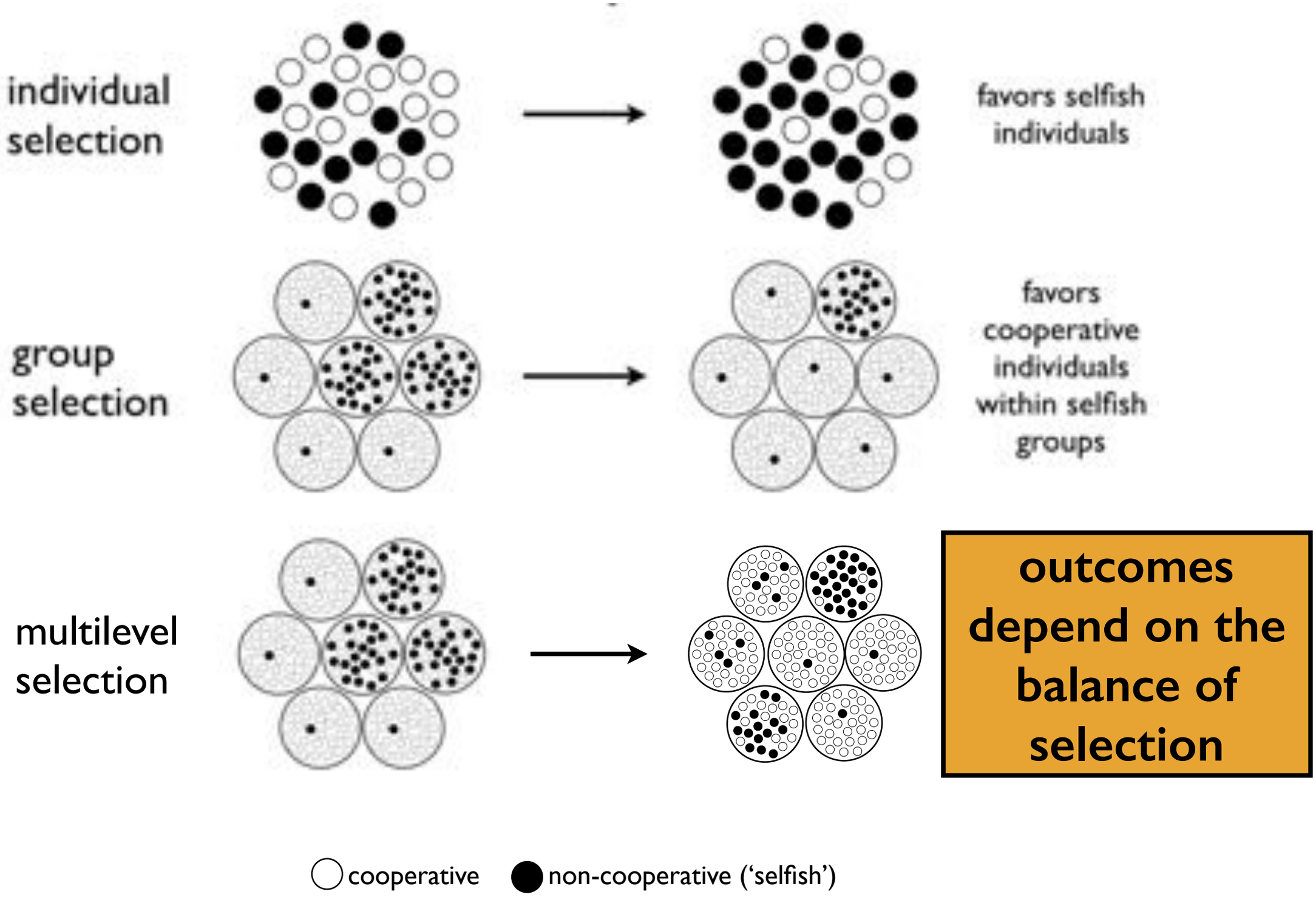
Posted to Flickr by USDAgov at http://flickr.com/photos/41284017@N08/6354331371

Things that accelerate the evolution of cooperation

(via group selection)

- small group size
- punishment of non-cooperators
- reciprocity
- homogeneity
- competition between groups

Social Dilemmas are
Conflicts between Levels of Selection



So, group selection *CAN* help solve sustainability dilemmas!

BUT

- The balance of forces may favor selfishness. (deer)
- It can evolve bad things too! (corporate strategy)

Group Selection on Genes

Human cooperation is group-centric

Apicella, Marlowe, Fowler & Christakis, (2012) Nature 481, 497–501.

Humans are naturally cooperative.

[within groups]

The Battle of Agincourt.

Choi, Bowles, 2007. **The coevolution of parochial altruism and war**. *Science* 318, 636–640.

Biological adaptations to group life

- docility, prosociality
- specialization
- language
- cooperative breeding
- technology
- conformity
- reputation
- social marking
- ethnocentrism
- xenophobia

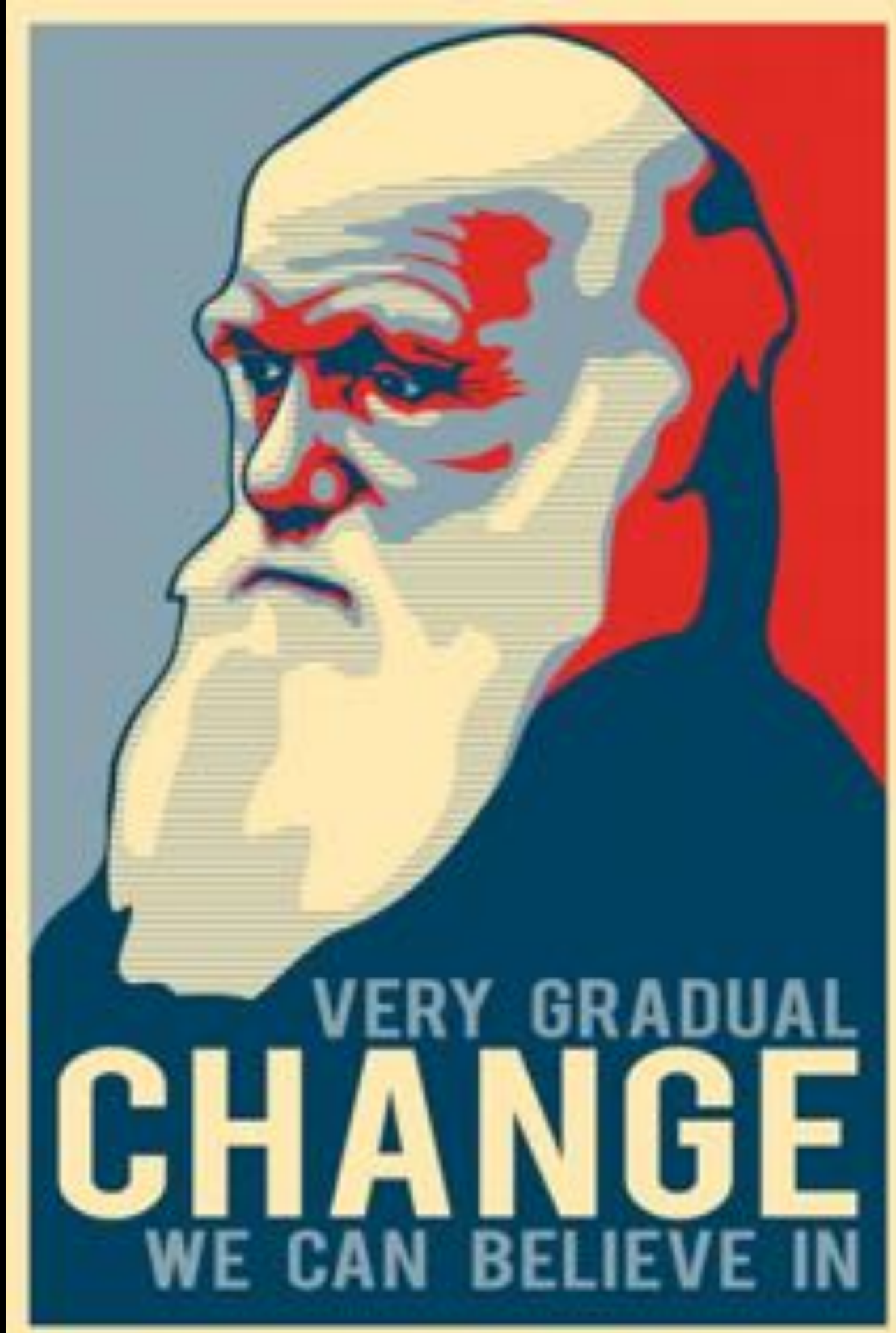
} negative factors

Cooperation evolves culturally, too.

[thankfully]

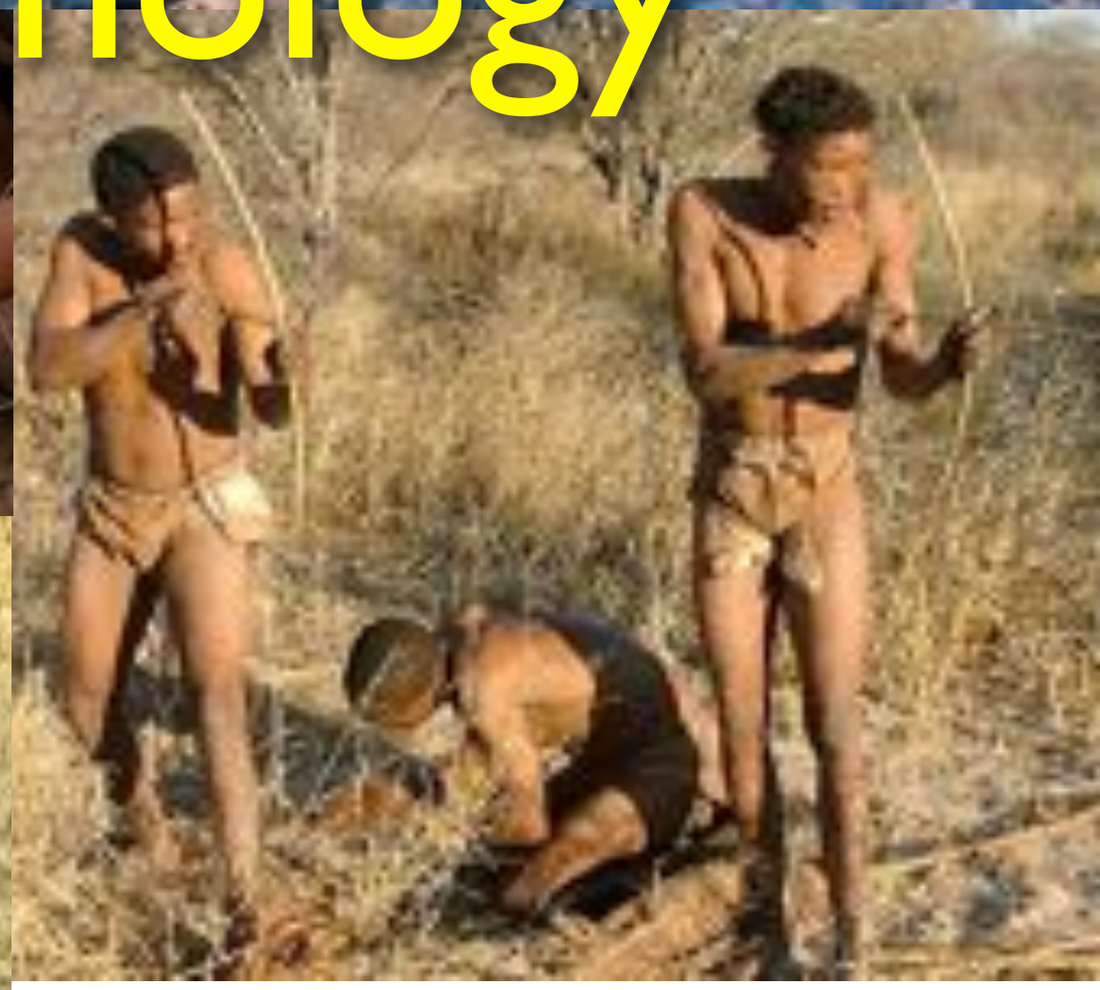
Cultural evolution is Darwinian.

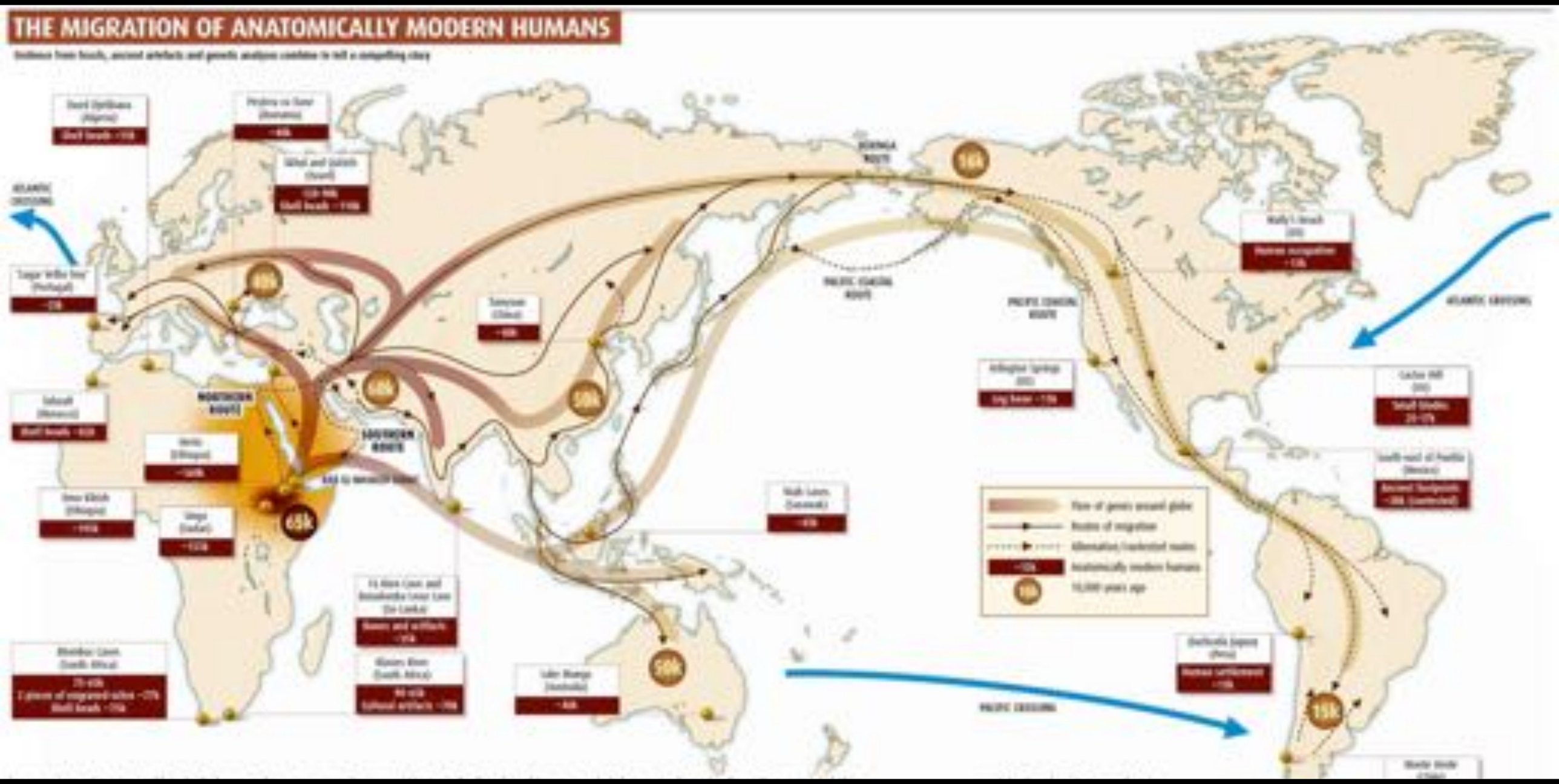
behavior
beliefs
institutions



Inuit technology

!kung technology





Going global: How humans conquered the world

The New Scientist, 2007

Cultural Group Selection

1. Proliferation, extinction, success of groups
2. Imitation between groups
3. Migration between groups

Henrich, J. (2004). Cultural group selection, coevolutionary processes and large-scale cooperation. *Journal of Economic Behavior and Organization*, 53(1), 3–35.

Group selection selects for group-functional behaviors and institutions

Molly Hayden, U.S. Army Garrison Grafenwoehr Public Affairs

Things that accelerate the evolution of cooperation

(via cultural group selection)

- small group size
- punishment
- reciprocity
- homogeneity
- competition between groups
- learning between groups
- supporting institutions

in summary…

- Sustainability problems are often social dilemmas.
- Social dilemmas are solved through cooperation.
- Group selection breeds cooperation.
- Humans are adapted for in-group cooperation.
- Cooperation, institutions can also evolve culturally.

How sustainability evolves.

Institutional Design Principles

1. Clear social boundaries
2. Fair rules
3. Collective-choice
4. Monitoring
5. Graduated sanctions
6. Conflict resolution
7. Self determination
8. Nested governance

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press.

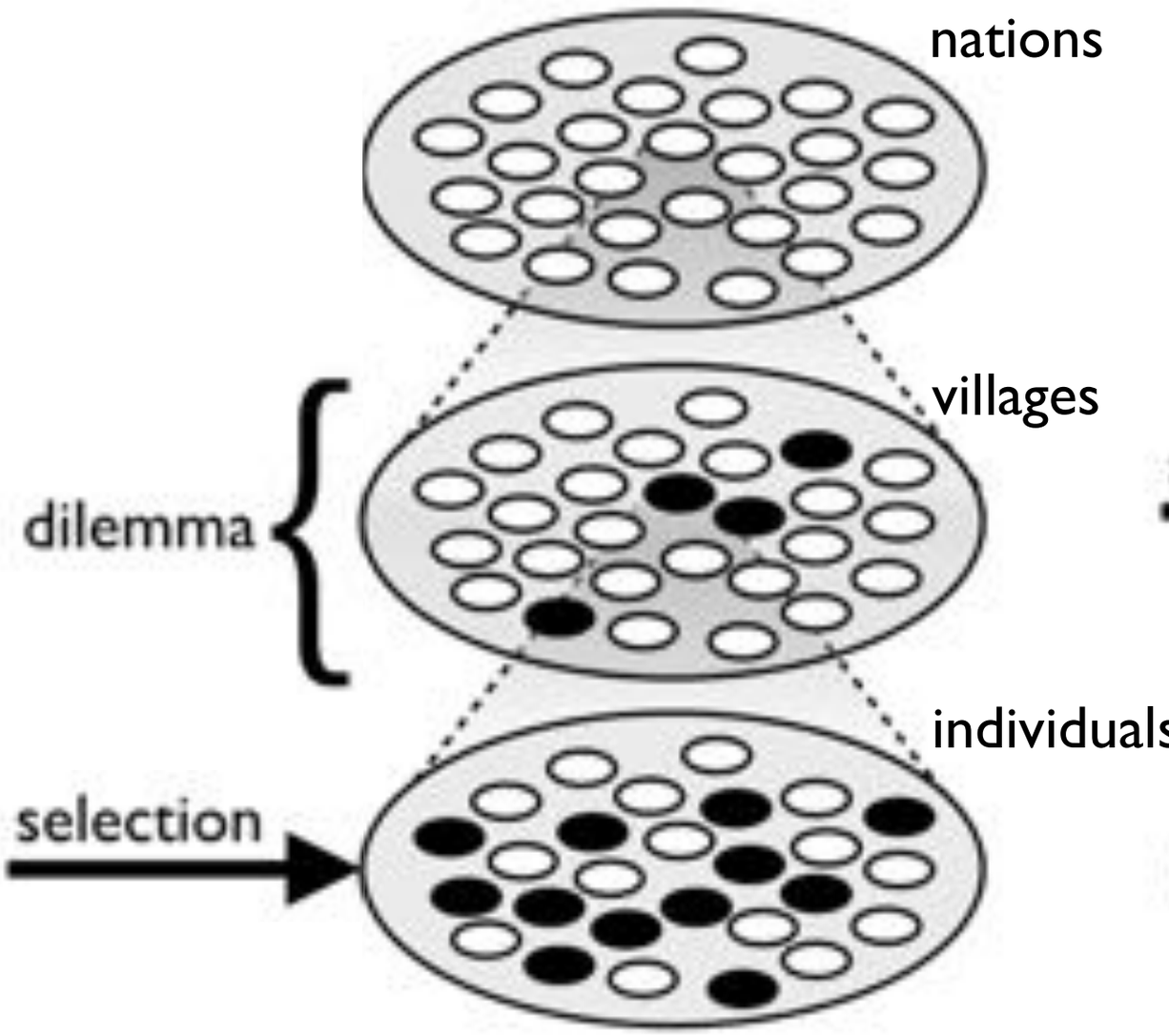
Elinor Ostrom

Courtesy of Indiana University


An example

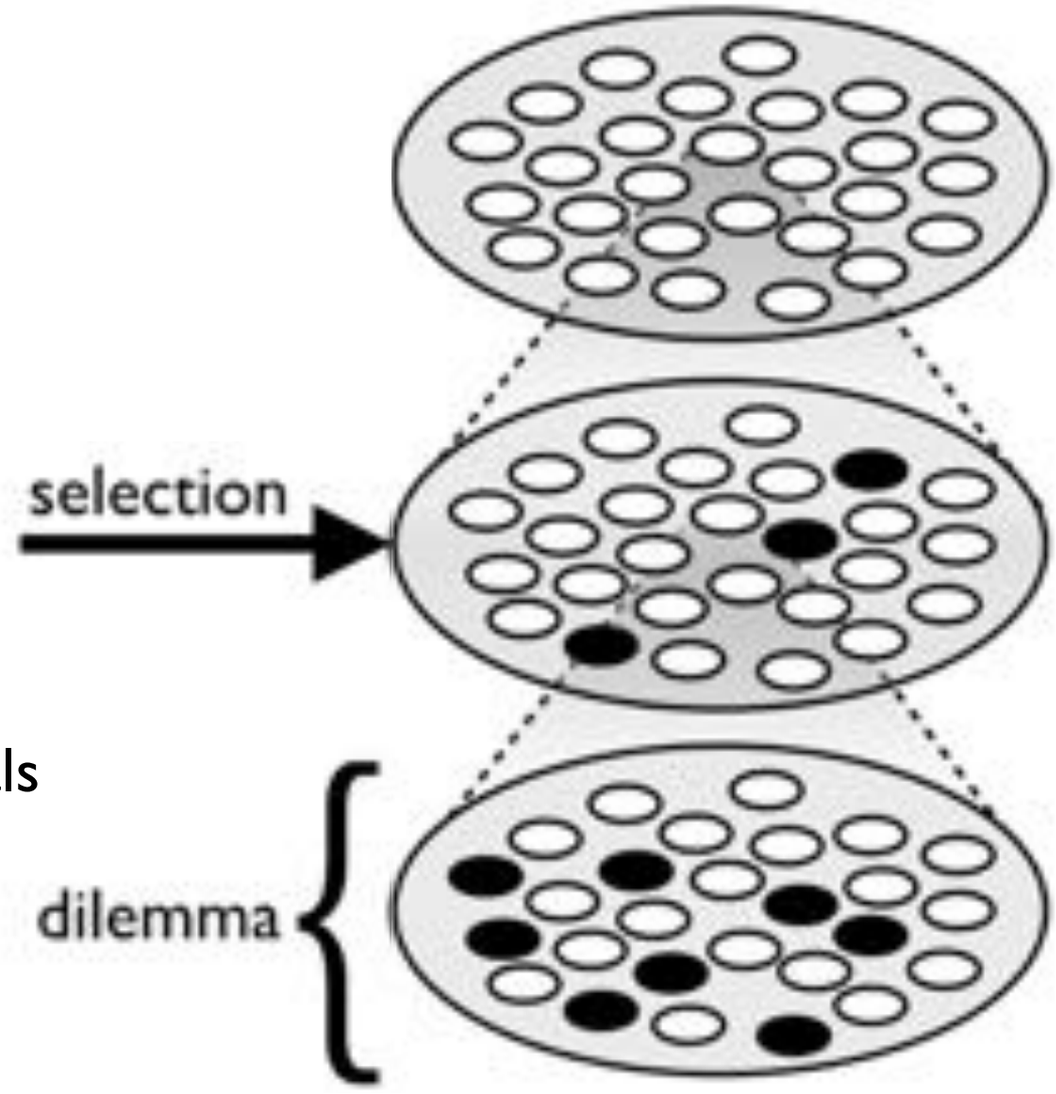
How does environmental cooperation evolve?

Multi-village Forest



Selection favors non-cooperation

Village Irrigation System



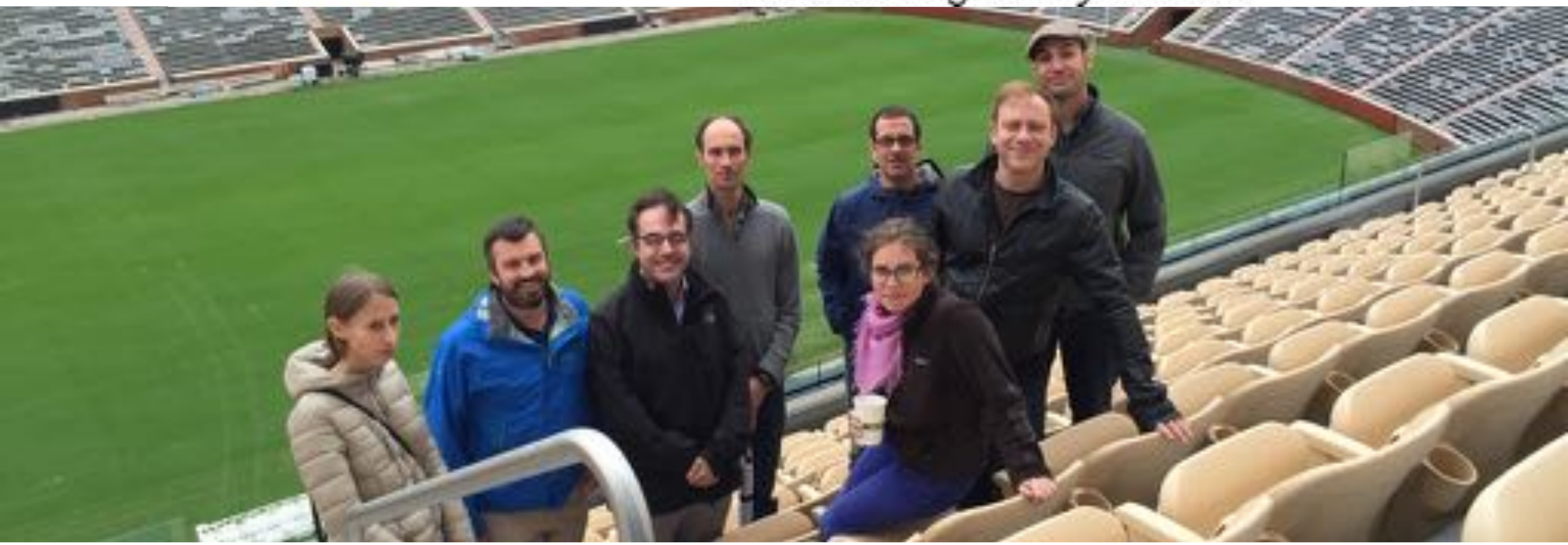
Selection favors cooperation

Research Questions

1. (theory) When does cultural group selection accelerate the emergence of behaviors and institutions of sustainable resource management?
2. (empirics) Can we find evidence in case studies?
3. (application) Can we design interventions for an applied science?

NIMBioS

National Institute for Mathematical and Biological Synthesis



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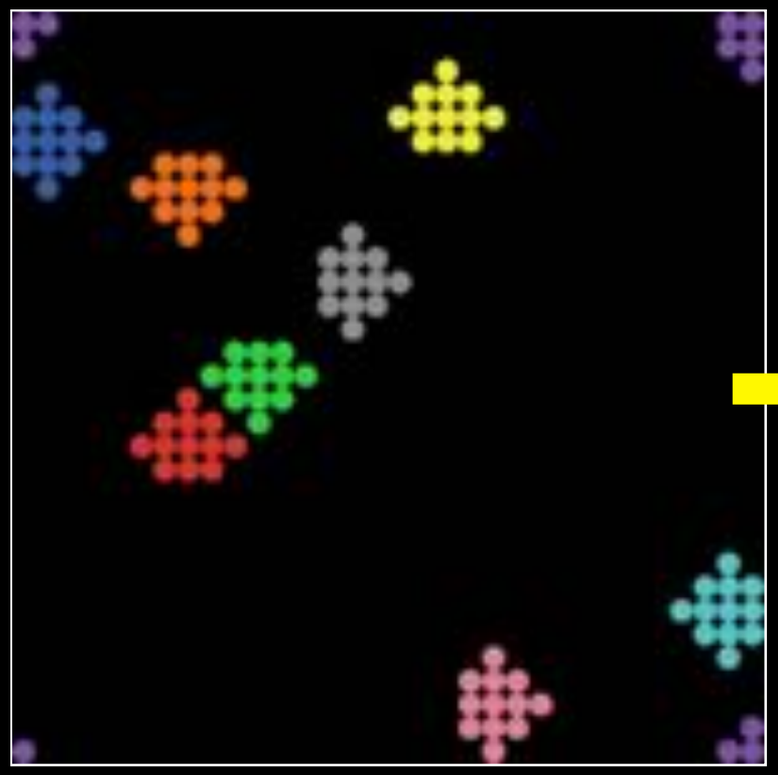
Karolina Safarzyńska, Warsaw University
Marco Janssen, Arizona State University

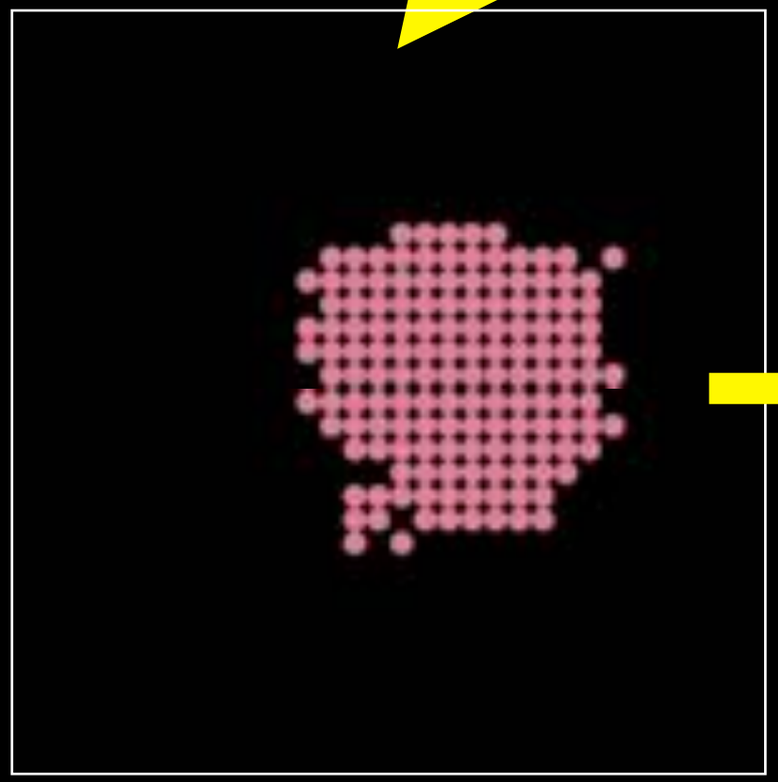
nimbios.org/workinggroups/WG_sustainability

Can sustainable societies evolve by cultural group selection?



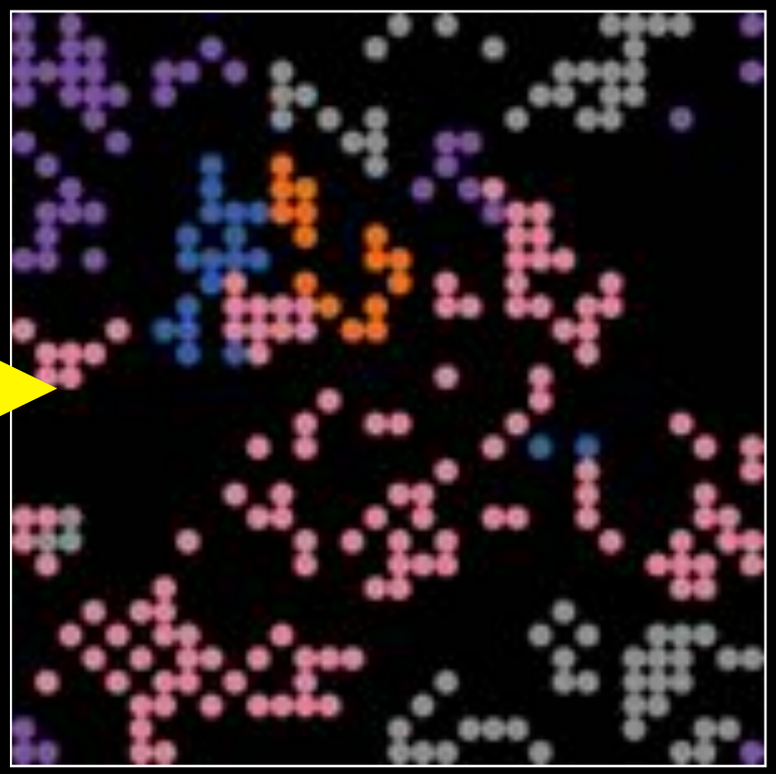
empty world

full world
resource crash
90% die



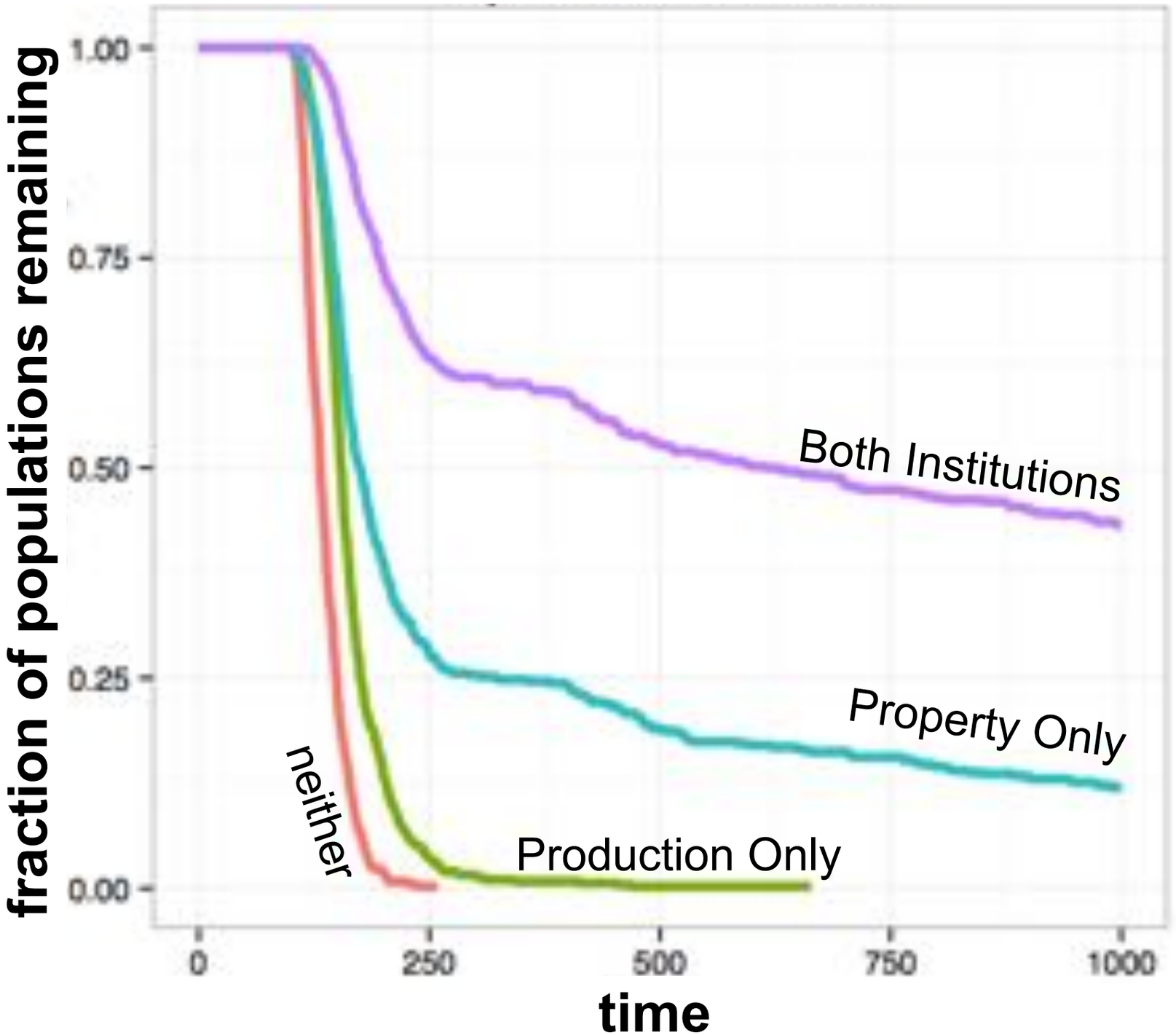
rare surviving society

long run
sustainability



Institutions determine population survival

(sustainability)



Populations survive when they limit resource consumption via the evolution of supporting institutions (such as Ostrom's principles).

proof of concept

sustainable societies (cooperation, institutions)
evolve via cultural group selection when:

1. the resource dilemma impacts group level most,
2. groups learn from failure, and
3. groups learn from each other.

Timothy M. Waring, Goff, S.H., & Smaldino P.E. (2017) ***The coevolution of economic institutions and sustainable consumption via cultural group selection***. *Ecological Economics*, 131 524–532

Research Questions

1. (theory) When does cultural group selection accelerate the emergence of behaviors and institutions of sustainable resource management?
2. (empirics) Can we find evidence in case studies?
3. (application) Can we design interventions for an applied science?

SESYNC

Jeremy Brooks, Ohio State University
Tim Waring, University of Maine

sesync.org/project/ventures/evolution-of-sustainability

lobster gangs learn from each other:

- territorial defense
- harvest limits
- legal strategies
- conservation practices

blueberry industry

Producers cooperated:

- **voluntary research tax**
- **inspection system**

(But only after statewide industry crises)

Sam Hanes

Bhutan

Ethnic diversity within Bhutan

Research Questions

1. (theory) When does cultural group selection accelerate the emergence of behaviors and institutions of sustainable resource management?
2. (empirics) Can we find evidence in case studies?
3. (application) Can we design interventions for an applied science?

How to harness cooperation for sustainability.

[finally]

sustainable institutions evolve…

(via cultural group selection)

1. Group-level environmental dilemmas
2. High stakes
3. Learning from failure
4. Learning between groups
5. Peaceful competition

a recipe to grow sustainability

1. A social dilemma for environmental resources.
2. A type of group that can solve the dilemma locally.
3. A population of those groups.
4. Within groups
    - 4.1. High stakes for successful management
    - 4.2. Strong group culture & institutions (Ostrom's rules)
    - 4.3. Reward cooperation, punish exploitation.
5. Between groups
    - 5.1. Peaceful competition to protect & enhance resources
    - 5.2. Strategy imitation

problems

1. global commons (climate change)
2. ethnocentric "solutions" too easy

Paper:

Waring et al. (2015) **A multilevel evolutionary framework for sustainability analysis**. *Ecology and Society*, 20 (2): 34

DOWNLOAD PDF:

timwaring.wordpress.com

What about Costa Rica?

What about Monteverde?

Thanks!

timwaring.wordpress.com