Human Ecology I
May – June, 2012

Introduction
Basic Concepts

May 11 Ecology and Human Ecology/ Ecology of diseases

May 18 Methods for nutritional survey
Methods for demographic survey (Dr. Umezaki)

May 25 Methods for behavioral survey (Dr. Umezaki)

June 1 Human Ecology in International Health
Prof. Kazuhiko MOJI (Research Institute for Humanity and Nature)

June 8 Methods in environmental health

June 15 Human Ecology of urban population

June 22 Sustainability and health

Brief self-introduction

人類生態学・毒性学　＝　環境⇔人間
Human ecology . toxicology
＊　ラボ：*experimental*
周産期における化学物質への曝露が発達におよぼす影響
Effects of prenatal heavy metal exposure on developing organism
・重金属　　微量元素の欠乏
Selenium deficiency and neurodevelopment, mercury toxicity, arsenic toxicity
・甲状腺ホルモンとの関係 *effects on thyroid hormones/*
・遺伝的要因の影響 *genetic susceptibility*

＊　フィールド：　*field studies*
途上国における環境問題
subsistence transition and transition in chemical environment in rural Asian communities.
・バングラデシュ・ネパールの砒素中毒
As problems in Bangladesh and Nepla
・インドネシアの農薬使用
pesticides in West Java

BASIC CONCEPTS

* ***Ecology:*** **Population – environment, ecosystem**

* ***Adaptation and human-ecosystem***

____– adapted and adapting - Biological vs cultural

human vs animal – cultural adaptation

– consequences of cultural adaptation >

adaptability, environmental change

– change in world view - change in world to which we adapt

- gene-culture co-evolution, self-domestication

rapidity of the change – objective and OK, I feel it!

* ***Time*** **matters - history matters– major events & 3 phases**

Barker hypothesis (DOHaD) and thrifty gene hypothesis

*** dynamic vs static aspects – chain of events >> closed loop?**

* ***Context:*** **"cultural" context and "biological" context**

– appropriate vs inappropriate in behavior/physiology/genetics

*** Genetics (result of org-env interaction) and environment – interdependence**

POM-polymorphism, HbS,

*** universality vs diversity**

* ***Finite world*** **- closed vs opened: island – urban - earth**

does it make difference?

– competition over finite resources – which curve we will go? –R/D for specific diseases

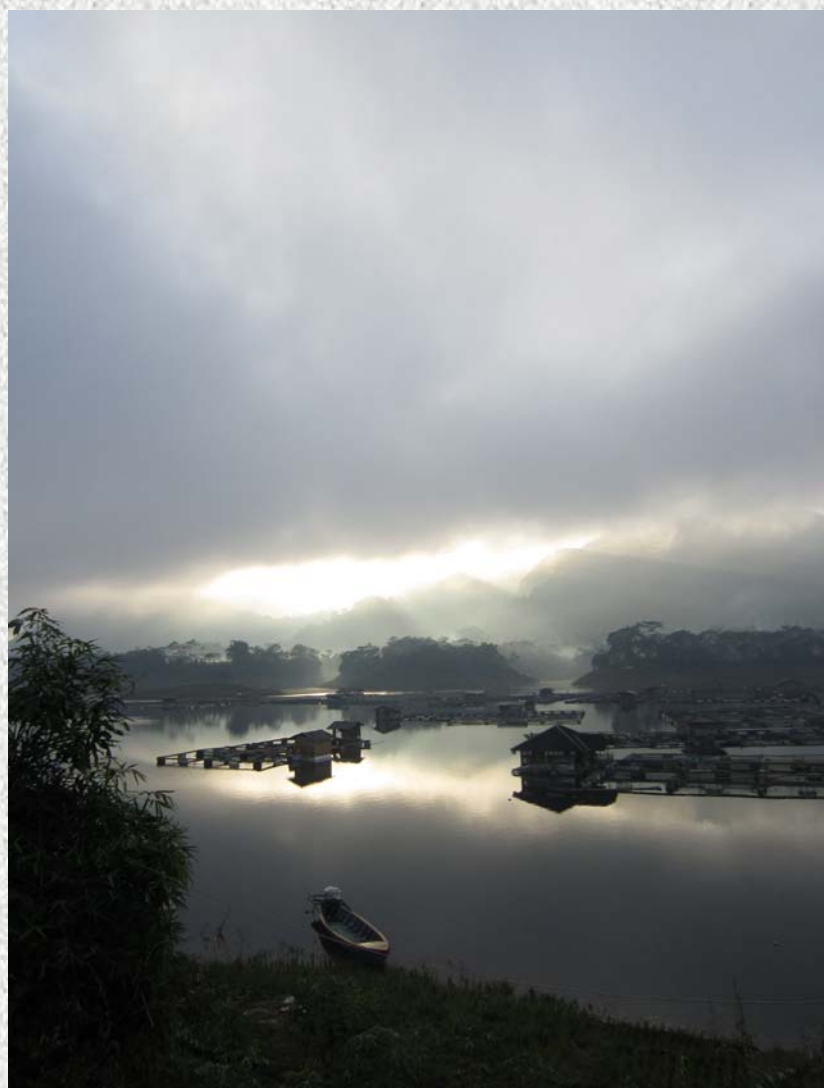
- connectedness of each component - procure-utilize-waste

INTERFACE OF “HOMO” AND THE ENVIRONMENT

*** man-made environment or human-ecosystems:**
urban, cropland, road

*** food – nutrition – energetics**
*** technologies – risk & benefit**
in terms of survival/health
*** health and diseases**

*** behavior / information**



definitions

- Ecology

(Haeckel) - examining the relation between animals and their environment

(Begon) – the subjects = living organism AND environment;

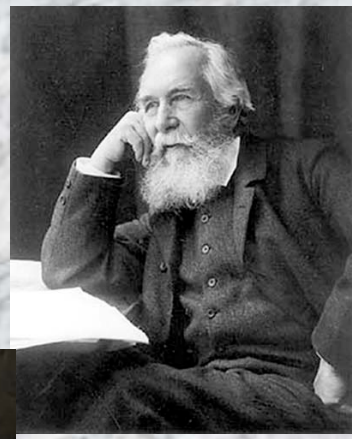
goal = to understand the relationship between the two.

–to answer the question "what is human?", or, "what is the nature/characteristics of human

through examining

the structure of human body. -- ??

the functions of human body. ---



Definition by others

* Human ecology (Schutkowski, 2005)

"Human ecology comes in various guises … from the narrow focus of human household economics to the global issue of humans. …. Human Ecology … the study of human populations and their interrelationships with the characteristics and properties of their environment. "

- emphasizing on Cultural aspects and biological aspects

* Human Ecology (Marten, 2001) "the science of interrelationship between people and the environment"

What's human ecology?

•*Predecessors of human ecology (Suzuki, 1970)*

first used by Park & Burgess (1924)

• *Marston Bates' summary on origin of human ecology*
- medicine: diseases and environment
- geography: human geography, bioclimatology
- sociology: [esp. American sociology] community structure
- behavioral science: language
- anthropology: humans in place of animals in animal ecology by Ernst Haeckel

>> Haeckel's definition of ecology: examining the relation
btwn animals and their environment

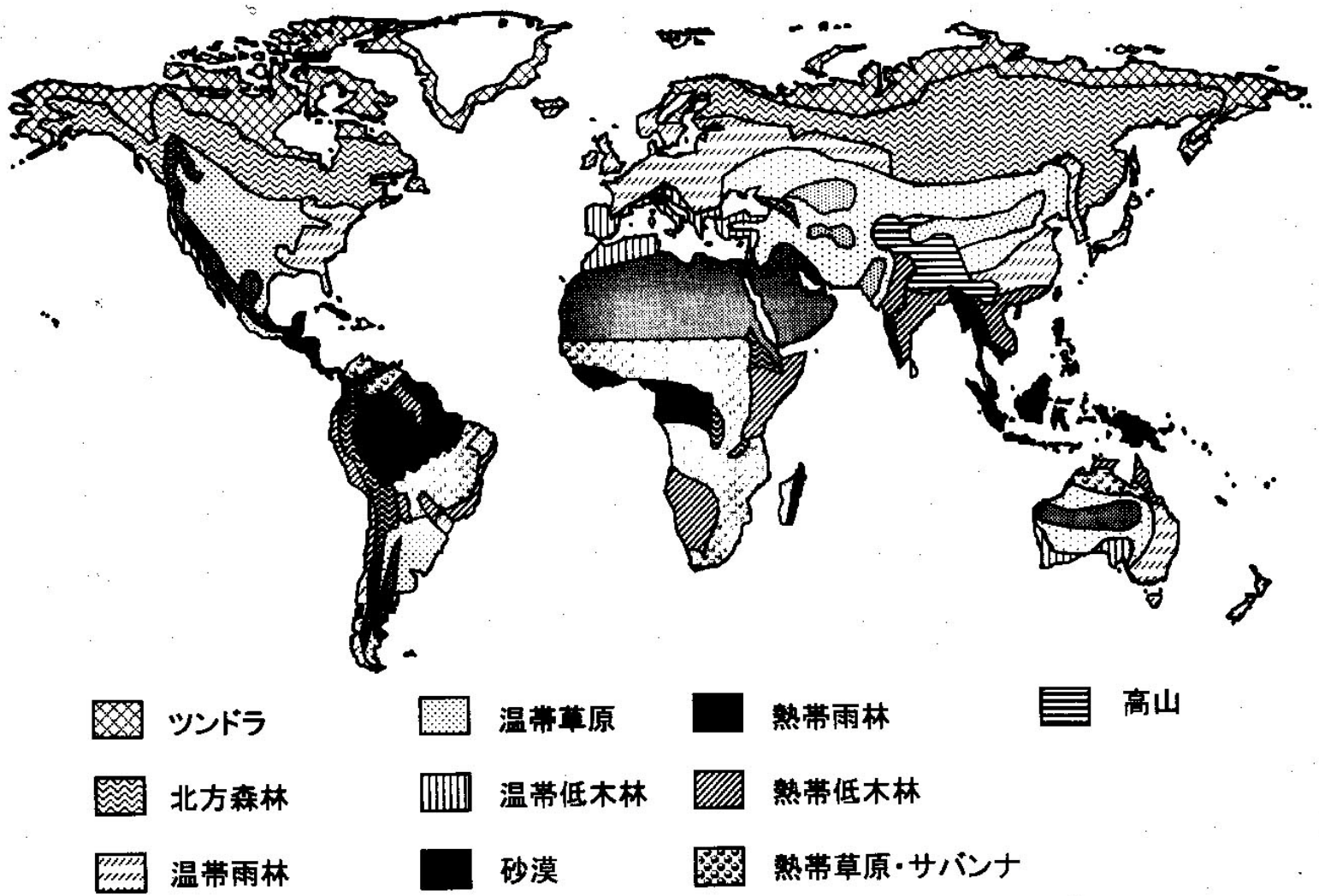


図 1-4　10 に分類されたバイオームの地球上の分布 (Odum, 1971)

Biome：　地域特性を植物相（*flora*）で分類

→　動物相（*fauna*）も対応

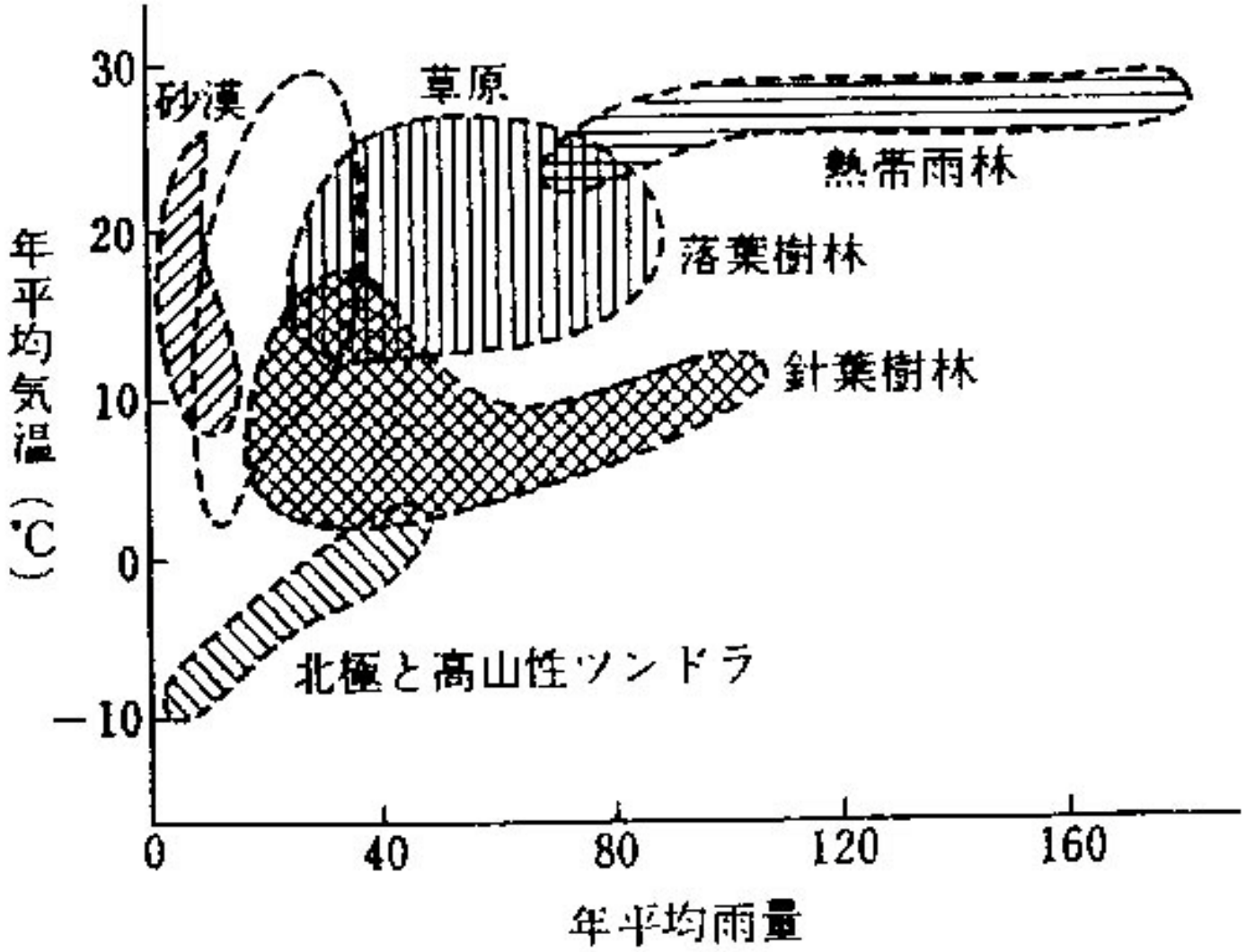
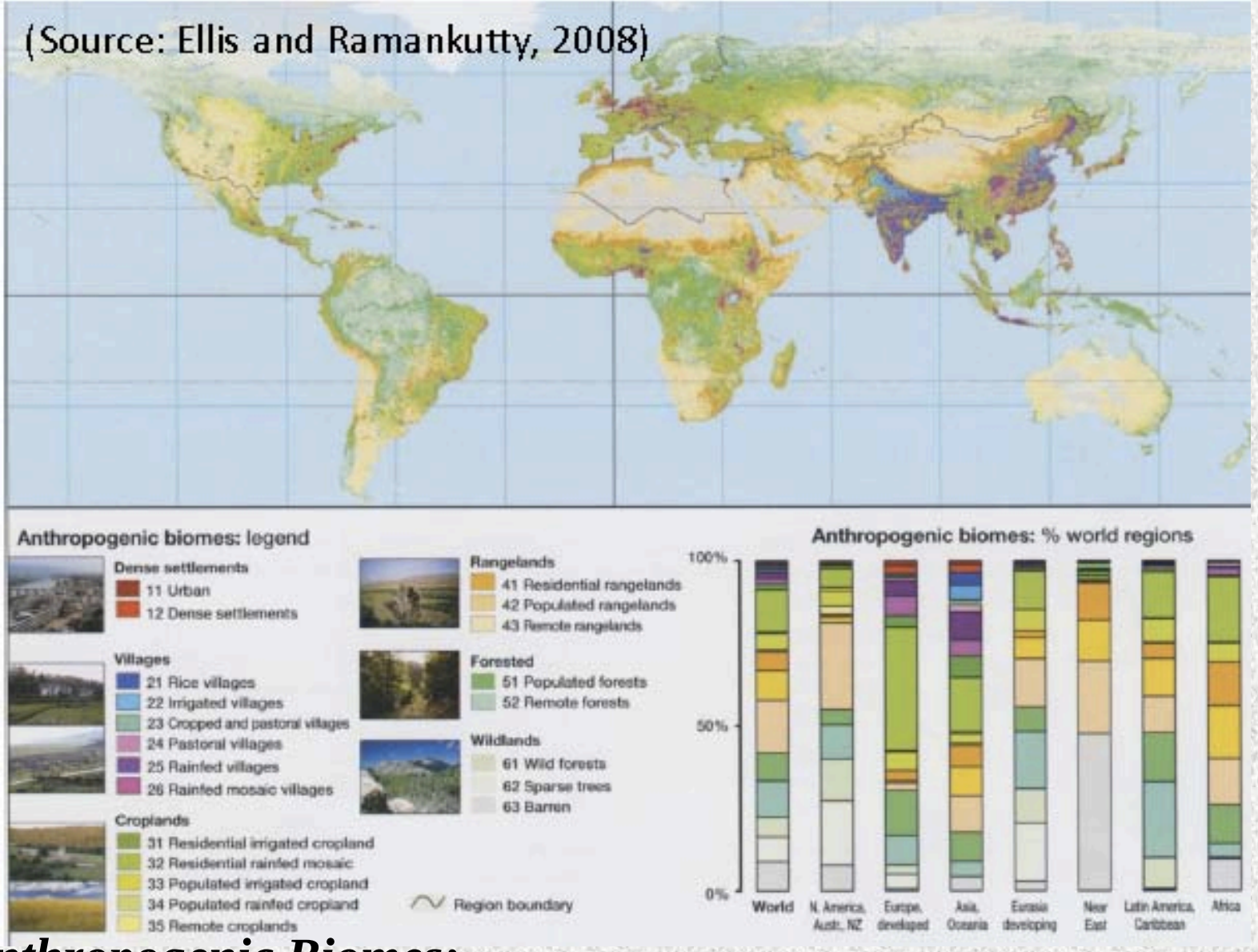


図 2-5　生態系の主要な六つのバイオームと気温・雨量との関係（Hammond, 1972）

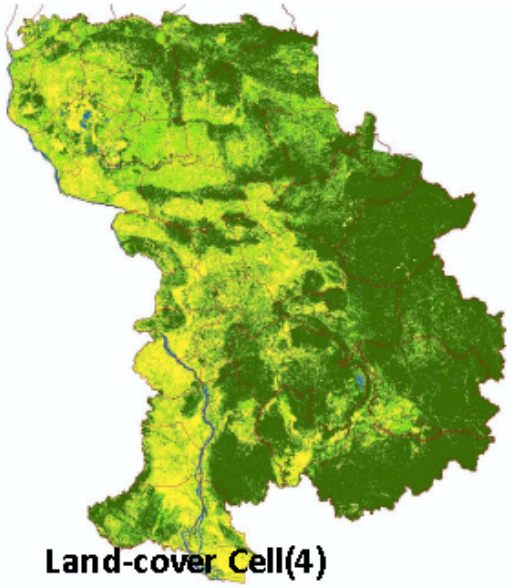


Anthropogenic Biomes:

1. place wit/without human activity 2. population density

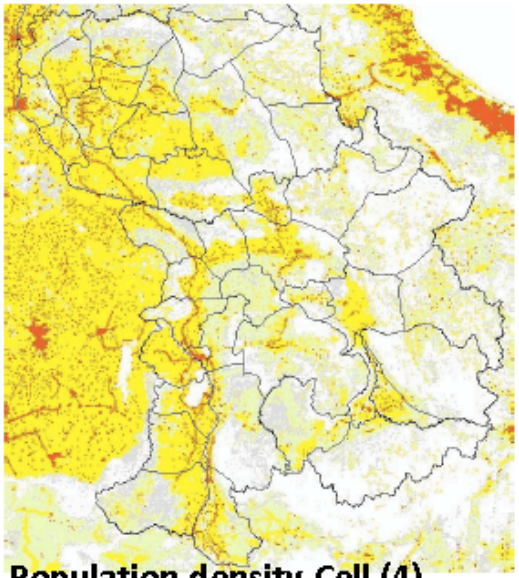
⇒clustering; a mosaic distribution emerged.

"Anthropogenic Biomes" (3) Two Spatial Data into One



Land-cover Cell(4)

+



Population density Cell (4)

Water

Wild Cell (0 persons/km²)

- Closed Forest → Wild Forest
- Open Forest → Wild Woodland
- Bare Earth → Barren

Semi-Wild Cell (<1 persons/km²)

- Closed Forest → Semi-Wild Forest
- Open Forest → Wild Woodland
- Bare Earth → Barren

Remote Cell (1-10 persons/km²)

- Closed Forest → Remote Forest
- Open Forest → Remote Woodland
- Bare Earth → Remote Area

Populated Cell (10-100 persons/km²)

- Closed Forest → Populated Forest
- Open Forest → Populated Woodland
- Bare Earth → Populated Area

Residential Cell (>100 persons/km²)

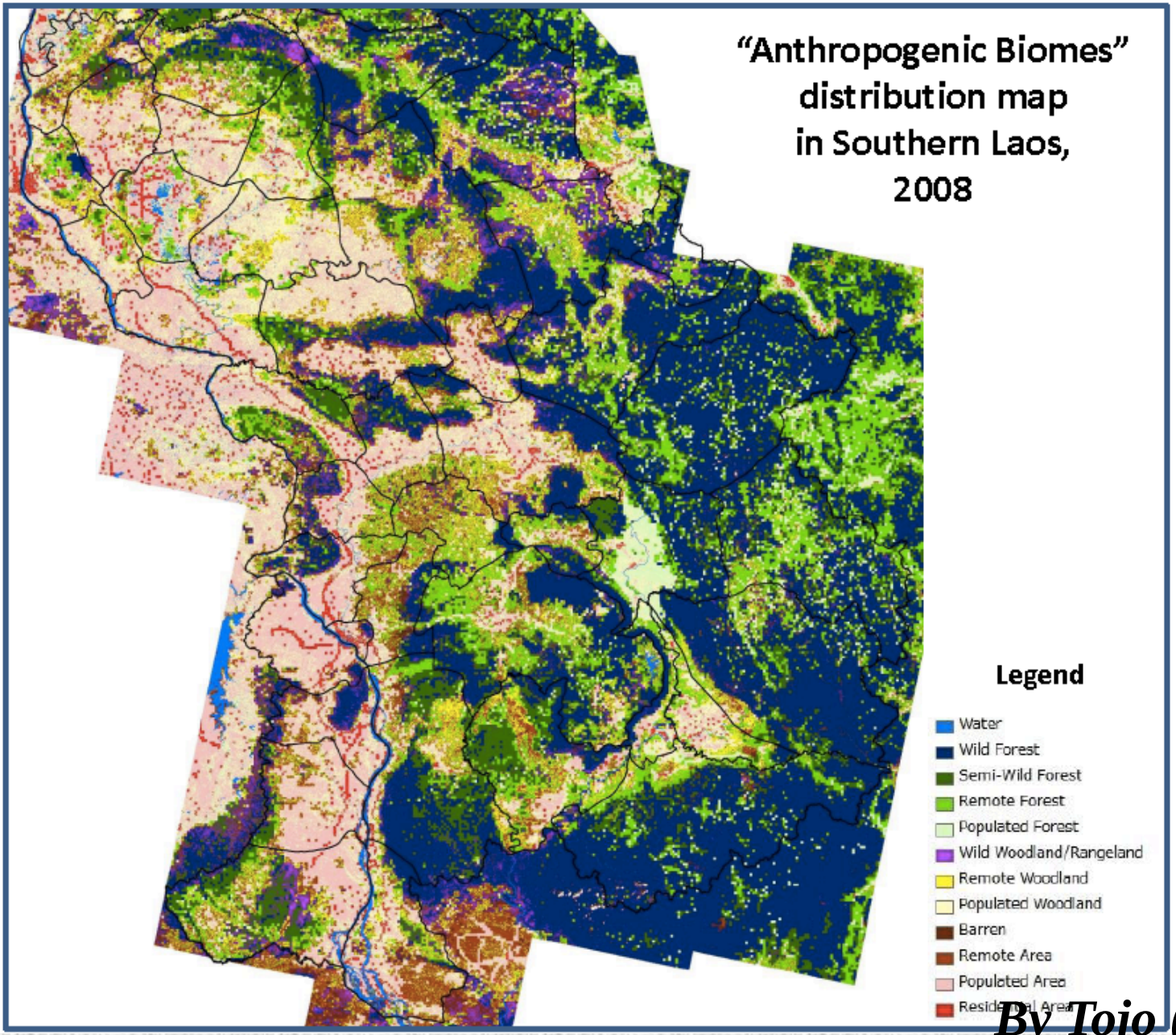
- Closed Forest → Populated Forest
- Open Forest → Populated Woodland
- Bare Earth → Residential Area

New Category of "Landscape" As "Anthropogenic Biomes"

- Water
- Wild Forest
- Semi-Wild Forest
- Remote Forest
- Populated Forest
- Wild Woodland/Rangeland
- Remote Woodland
- Populated Woodland
- Barren
- Remote Area
- Populated Area
- Residential Area

Each Land-cover cell is re-classified following overlaying population density cell value, which is classified into 4 classes, wild (no populated), semi-wild, remote, and Residential (over 100 persons/km²).

“Anthropogenic Biomes” (4) “Anthropogenic Biomes” Map



This kind of “Anthropogenic Biomes” distribution shows some typical Landscape or ecological sub-group, which reflect certain type of relationship between human and environment.

It is very interesting ,if we can find some threshold between Malaria prevalence and “Anthropogenic biomes” as a approximate of “Landscape”...

By Tojo (2012) [yet to be]

Planetary stewardship

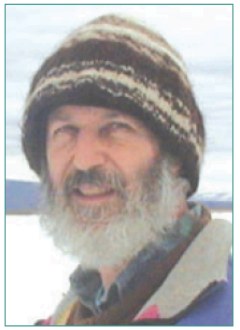
Now "natural" Ecologists Start to look at ourselves very seriously

Over the next decade or two, society has a narrow window of opportunity to radically redefine our relationship with the planet, so as to reduce risks of dangerous global changes that could otherwise seriously degrade Earth's life-support systems. As current President and President-Elect of the Ecological Society of America (ESA), we call for *planetary stewardship* as a framework for science and society to rapidly reduce anthropogenic damage to the biosphere. Ecologists and the ESA must collaborate with other natural and social scientists – as well as with practitioners, resource harvesters, land managers, decision makers, and other concerned citizens – to explore solutions. Humankind's past actions have already committed the planet to a substantially altered future; the task ahead is to find creative and scientifically defensible actions that minimize risks of further resource or ecosystem degradation and maximize opportunities to sustain and restore natural ecosystems and the services they provide.

Planetary stewardship requires that decision makers and stakeholders be well-informed about how global change is likely to affect households, resources, livelihoods, and quality of life. They must also learn how local actions and reactions to change could feed back to influence the trajectory of planetary change. To provide this information, ecologists must redouble their efforts to understand and forecast ecosystem changes across multiple scales.

The ESA is well positioned to lead this effort because the collective interests and expertise of its 10 000 members encompass a tremendous range of ecological skills and perspectives. These interests range from global biogeochemical cycles to regional and local populations and ecosystems, and include, increasingly, the ways that current and past human cultures have responded to and shaped natural ecosystems and landscapes. More than ever, we must address urgent questions that span these areas and scales of interest. How will responses to climate change by particular species and size classes of plants at particular landscape positions affect hydrology and redistribution of moisture back to the atmosphere? How can indirect effects in food webs trigger surprises as ecosystems respond to change? What types of environmental change did aboriginal human cultures create and endure? What practices did they use to sustain resources and ecosystems, especially through periods of environmental change? What mistakes did they make?

Mary E Power
ESA President, University of California, Berkeley, CA



F Stuart Chapin III
ESA President-Elect, University of Alaska, Fairbanks, AK

生産者 *producer*
消費者 *consumer*
分解者 *decomposer*

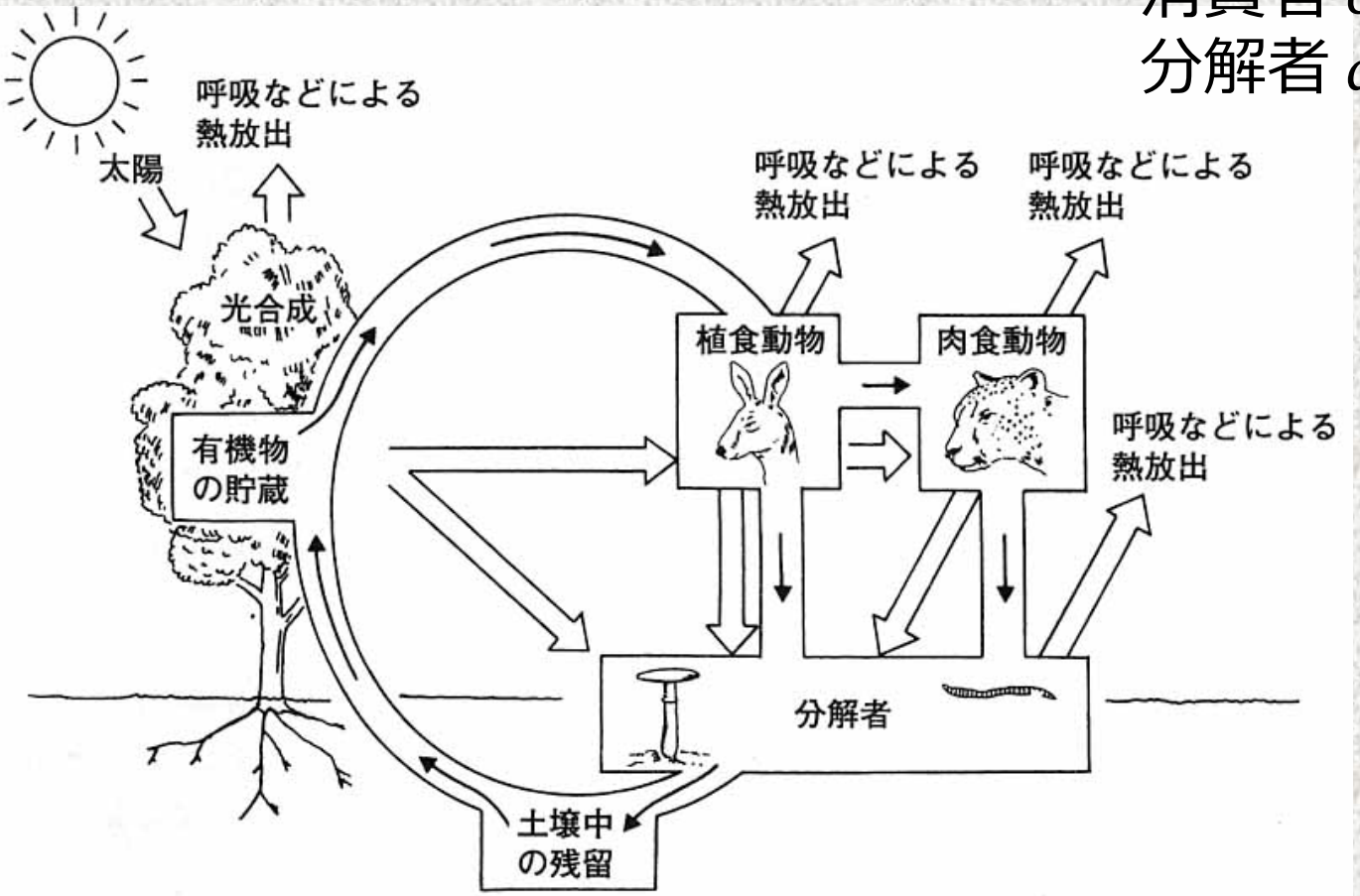


図 1-2　自然生態系における物質循環とエネルギーの流れの模式図(Smith, 1972)
細い矢印が物質の移行，太い矢印がエネルギーの移行を示す．

大塚ら　人類生態学*(2002)*に

"Elucidating the *function* of human-ecosystem" means ・・・

- ***function of a system:***
  - depends on how you would like to look/measure
  the system

function of car ?

function of individual (human, body) ?

function of an ecosystem ?

function of a human-ecosystem ?

Functions of a human-ecosystem

※ *as an energy (food) production/consumption system*

animal/plant resources — production and procurement technology

— resource management/distribution rules — nutritional status/health

※ *as a population maintaining system*

rules for mating / strategies for partner finding

— strategy for reproduction. Childcare, including social institutions

— nutritional status・SES

— patterns of diseases and death - migration (in/out) and survival

※ *as a system of material flow*

technology and rules for consumption/preservation/management of resources (forest, fishery, mining, land ownership)

— utilization of the "materials" and accompanying benefits and risks

— impact caused by utilization and dumping of materials (incld. Chemicals)

Adaptation as the key concept

Process in which organism exert an adjustment which would be beneficial for the group that the organism belongs in response to the environment.

Usually, the adjustment would be initiated when the organism is challenged by environmental stress, resulting either in a change of biological characteristics, or in a change of its environment
(*Suzuki*, *1990*)

Adaptation is one measure to maintain survival when a change occurs.

Whether a trait is adaptive or not can be judged by the effect of that trait
Adaptation is one measure to maintain survival when a change occurs

Adaptation > Four types of adaptation in living organisms (Ellen, 1982)

1. *Phylogenetic* (*changes in genotypes by natural selection beyond a generation*)
2. *Physiological modification* (*changes in phenotypes, within a life-span of an individual*)
3. *Learning* (*adaptive behavior, achieved in a life-span*)
4. *Cultural modification* (*learning and culturally transmitted information*)

Classification by Suzuki

PON1 catalysys

hydrolysis = detoxification

pesti cides

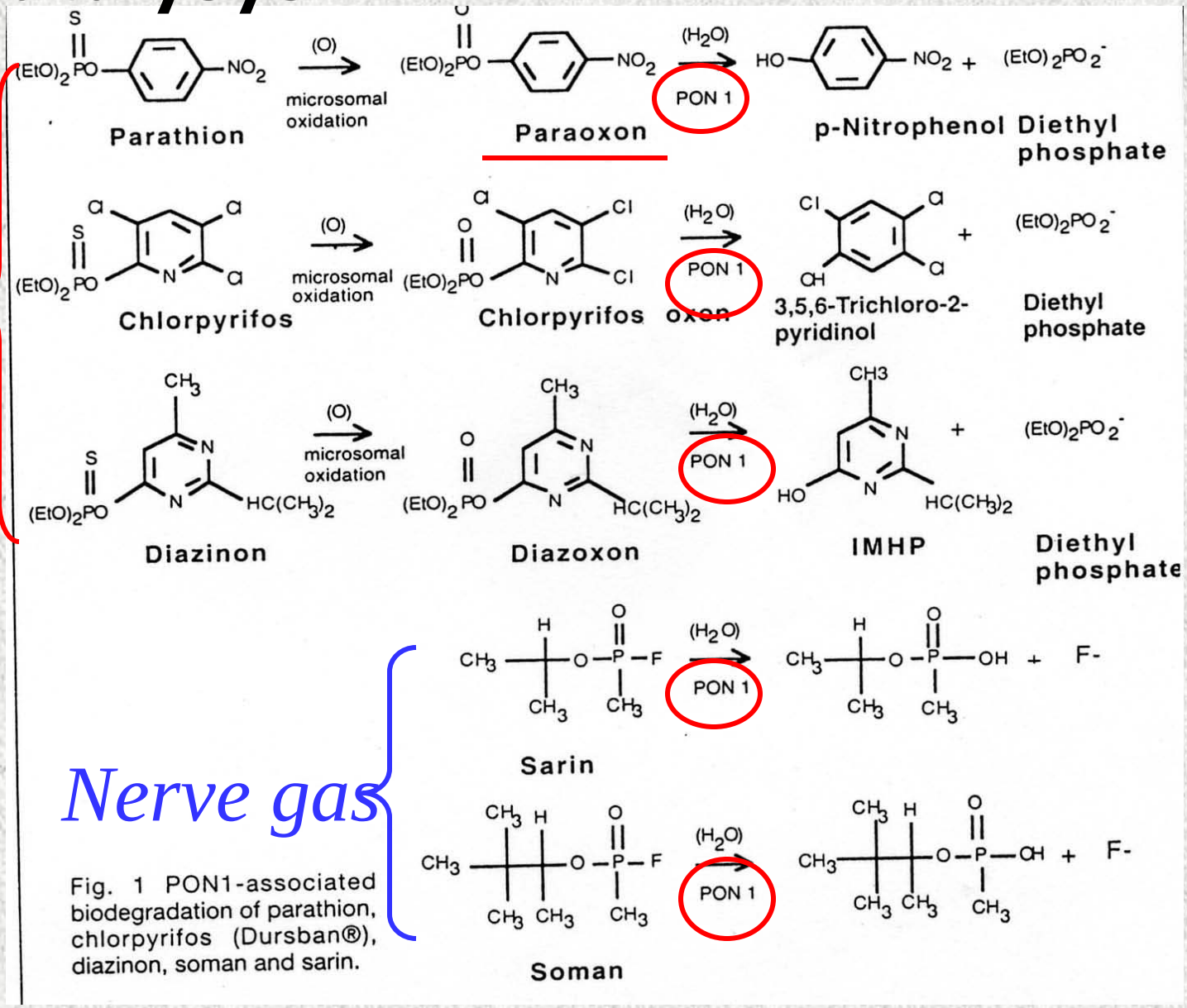


Fig. 1 PON1-associated biodegradation of parathion, chlorpyrifos (Dursban®), diazinon, soman and sarin.

PON 1 polymorphism Which is beneficial?

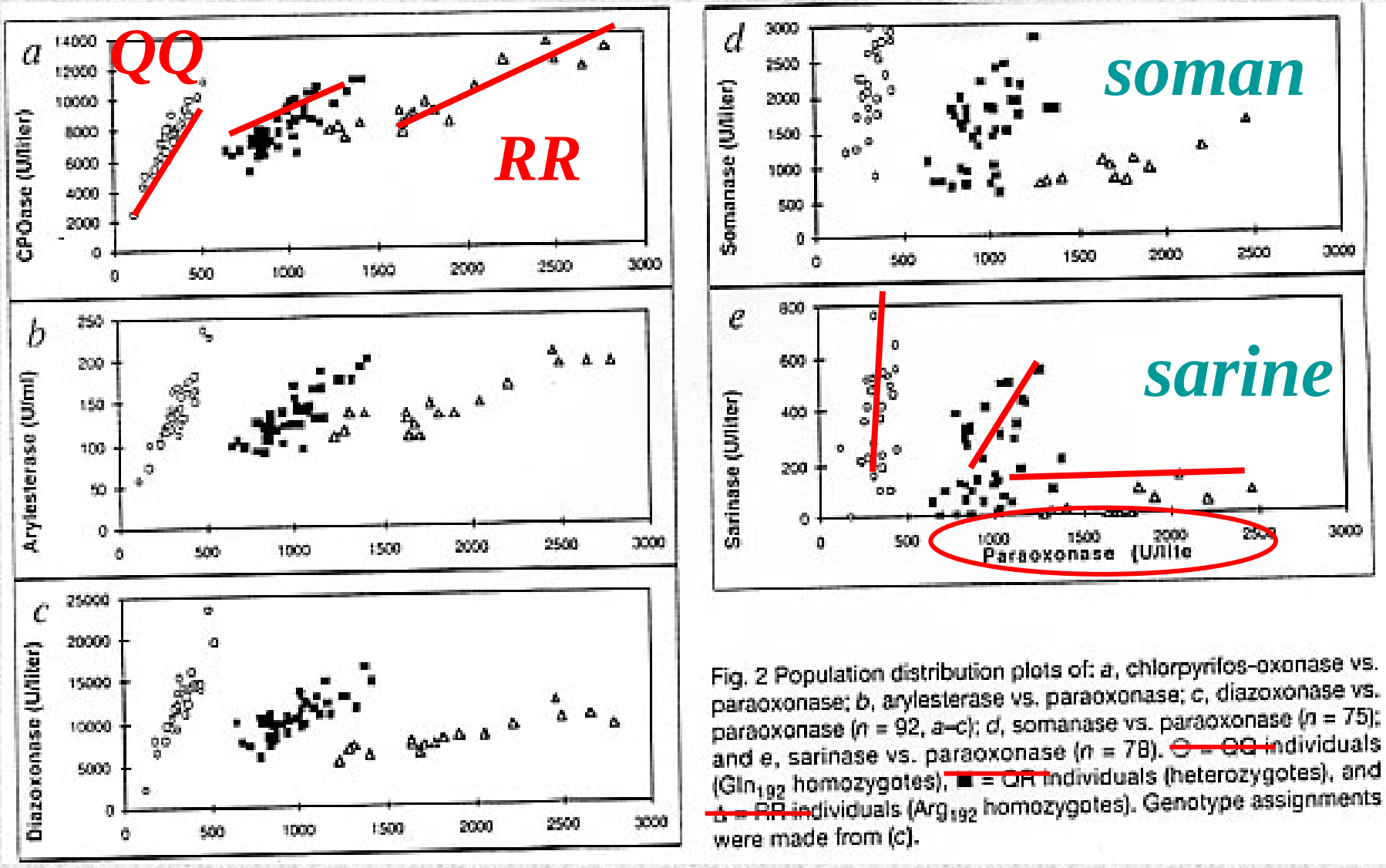


Fig. 2 Population distribution plots of: *a*, chlorpyrifos-oxonase vs. paraoxonase; *b*, arylesterase vs. paraoxonase; *c*, diazoxonase vs. paraoxonase (n = 92, *a*–*c*); *d*, somanase vs. paraoxonase (n = 75); and *e*, sarinase vs. paraoxonase (n = 78). ○ = QQ individuals (Gln_{192} homozygotes), ■ = QR individuals (heterozygotes), and △ = RR individuals (Arg_{192} homozygotes). Genotype assignments were made from (*c*).

What is “adaptation”? - fitness, Darwinian fitness

- *a certain genotype (or phenotype) individual’s offspring (who lives up to his/her reproductive age)*

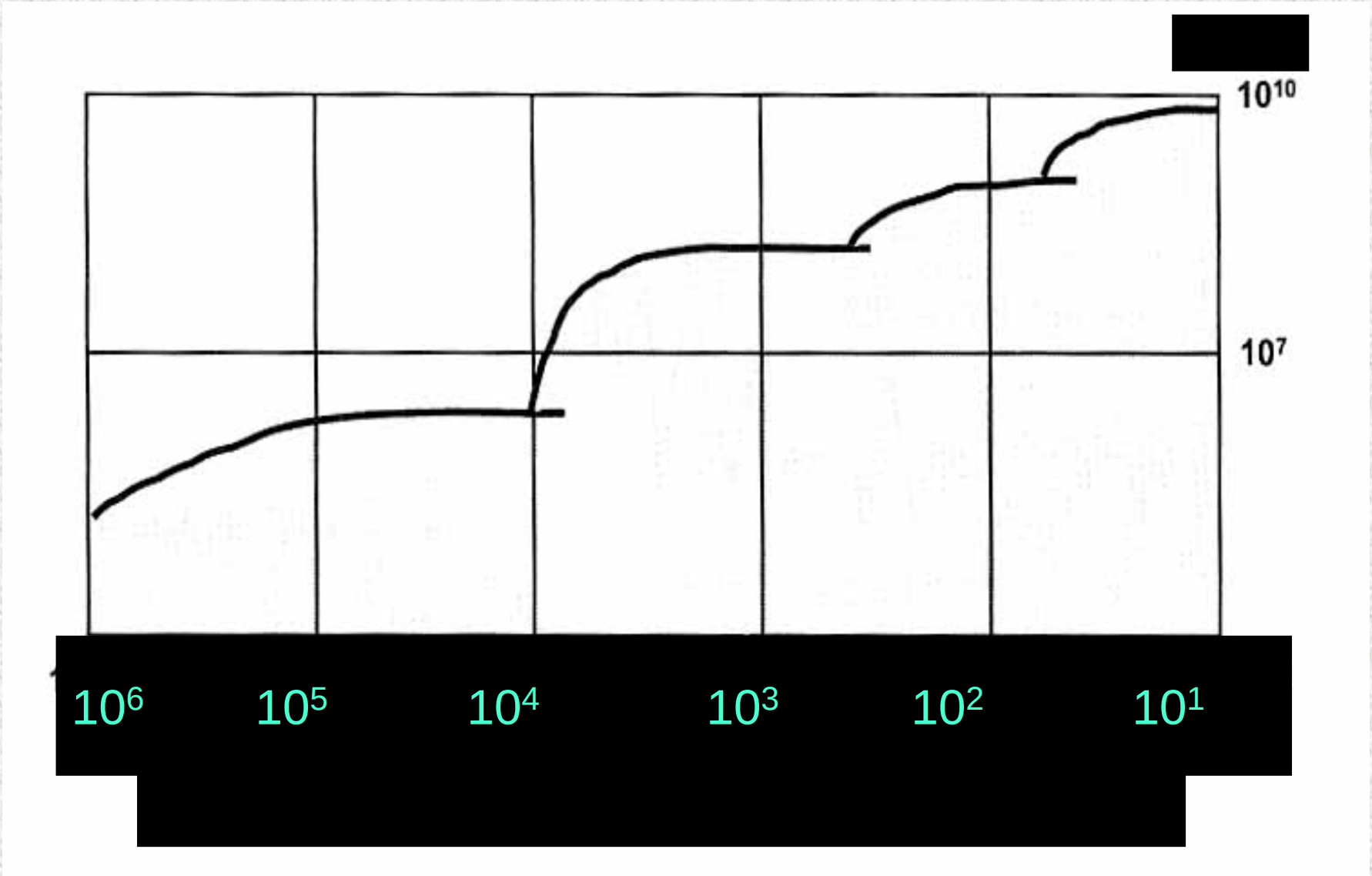
- *Ex) if “referent” genotype = 1, genotype of concern = 1.2*
  means the latter would have 20% more offspring than the referent
  → *here, non-genetic component is not considered (as a form)*
  in other words, non-genetic component is “given”

  c f . *Malaria and* H b S , *thrifty gene(s)*
  → *“adaptive” gene had been ALREADY available – is important*
  i.e., when malaria came, HbS had been there already!

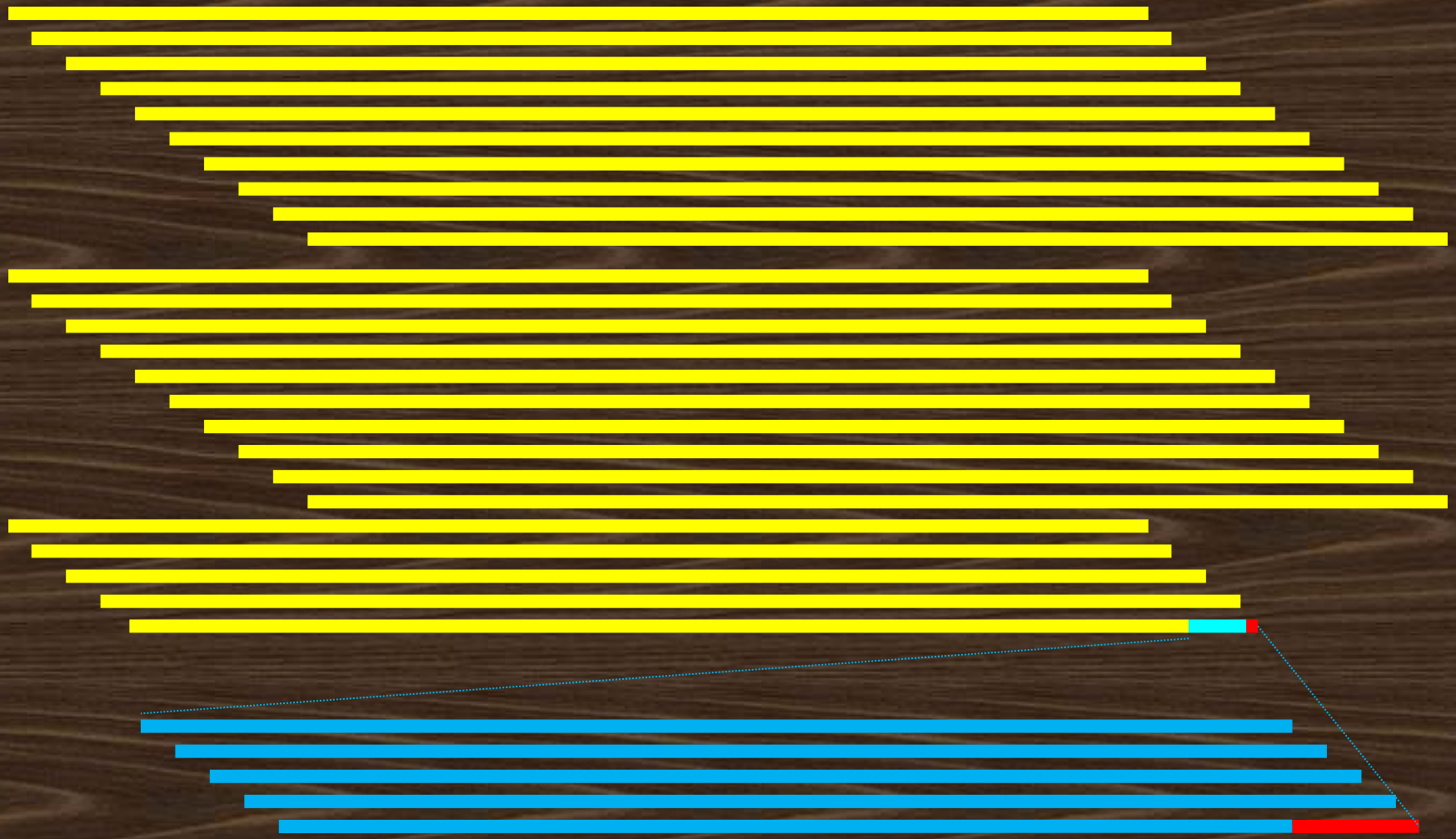
- Pitfalls… the cultural adaptations
  - promote human survival/benefit
  - cost ecosystem (damage, depletion)
  - largely unchecked (without feedback)
    after "post-agro-" phase
    (unlike biological adaptation)

Consequence
- promote human survival/benefit
- emergence of "new" environment
- new environmental stress/challenge
- another cultural adaptation … *(repeat)*

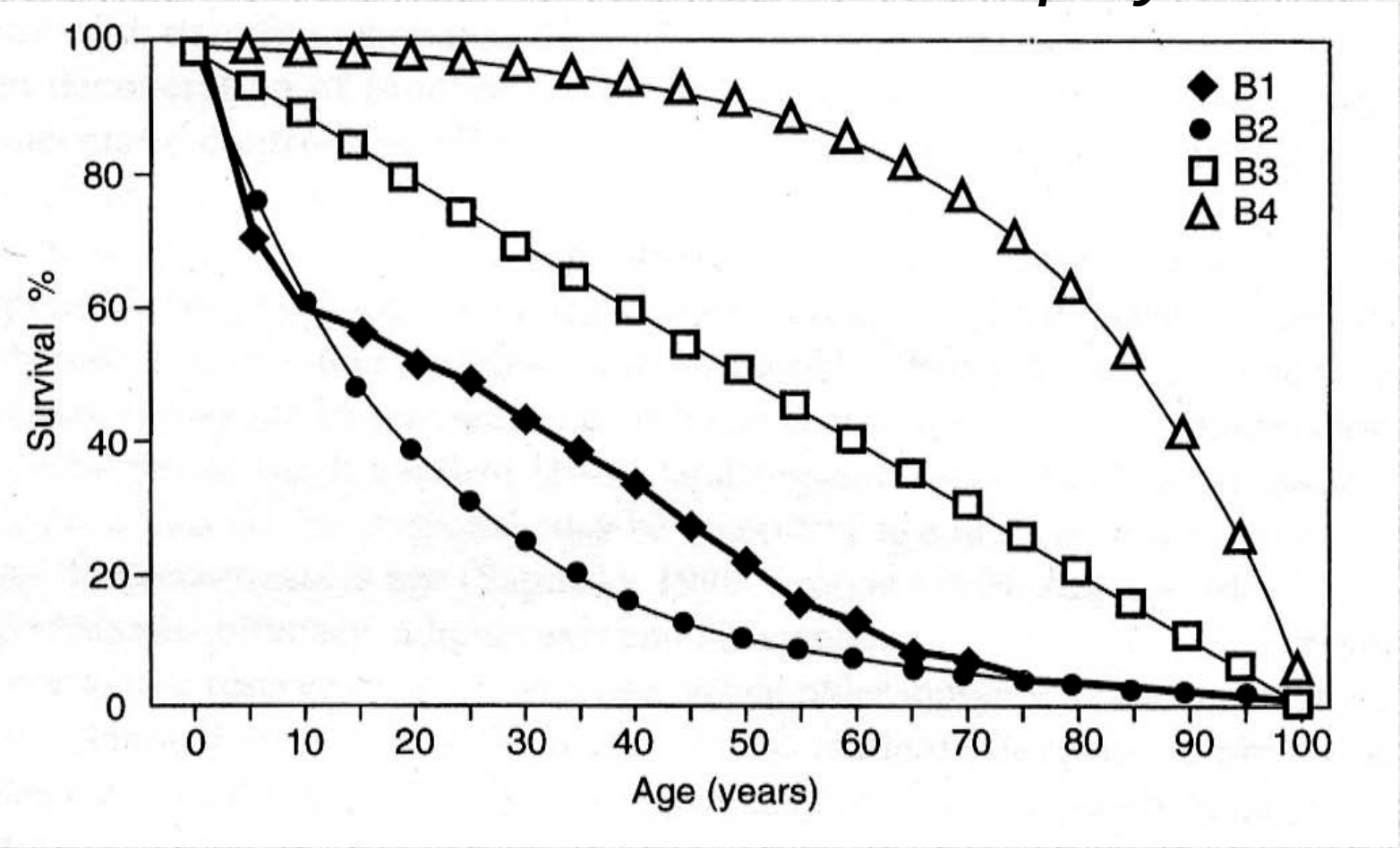
>> Ecological transitions (Bennett, 1996)


10^{10}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}

Our past history



What kind of health matters? Inequity in health



B1: Traditional populations (e.g.,Yanomami, !Kung, Turukana)
B4: Modern-day populations (e.g., Japan, USA, UK, Sweden)

(*sources: Stinson et al. (2000) Human Biology: and Evolutionary and Biocultural Perspectives, Fig 13.1)*

How much and for whom we should spend?

R&D investment and their health impacts
[USD/DALY]

CVD 63
DM 102
Malaria 6
TB 11

＊Disability-Adjusted Life Years（障害調整生命年）
(Cohen, 2006)

Size matters ! Human poplation(s) and their habitat