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FIAL
Un éventail de formations, une multitude d'horizons

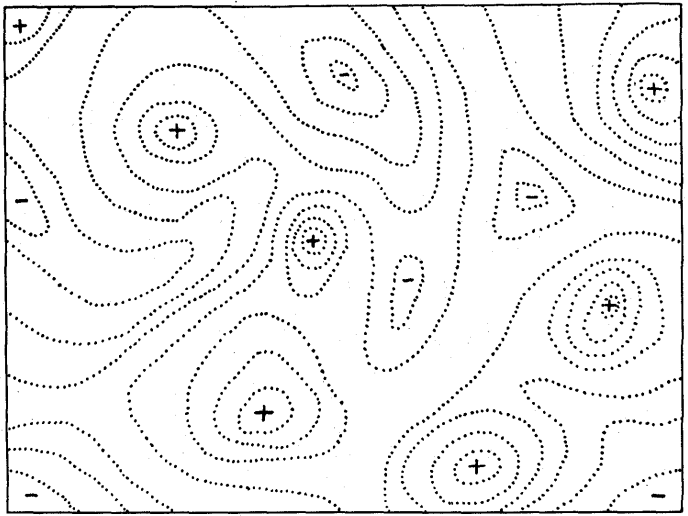
Development, Constraint, and Biodiversity

Short Course @ Ilia State University
April 25, 2025

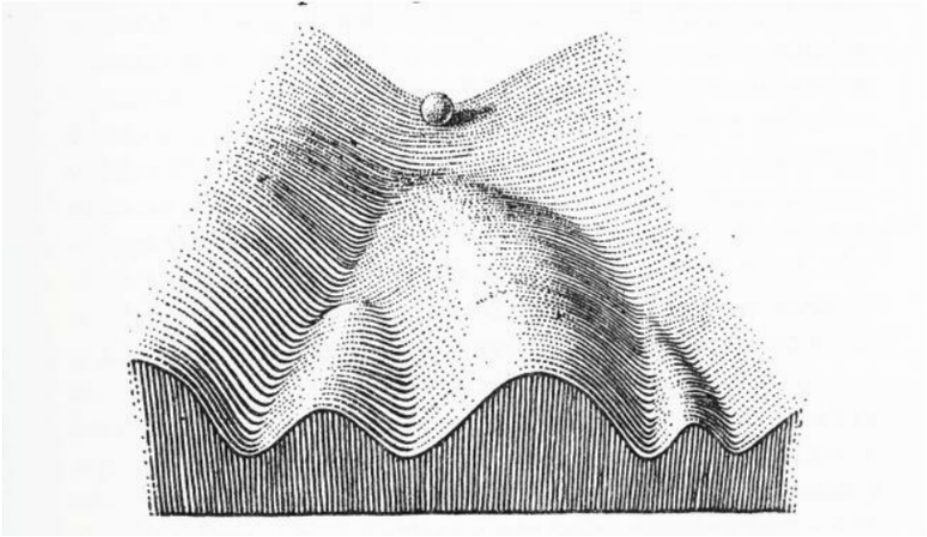
Developmental Constraint

A developmental constraint is a bias on the production of variant phenotypes or a limitation on phenotypic variability caused by the structure, character, composition, or dynamics of the developmental system. (Maynard Smith et al., in Amundson, 558)

The “Landscape” of Wright



The “Landscape” of Waddington



Two Kinds of Constraint

- constraints on **adaptation** or **constraint$_A$** — certain adaptations aren't "accessible" to development
  - On this view, there's no incompatibility between constraints and adaptationism; we're debating relative importance of the two
- constraints on **organic form** or **constraint$_F$** — certain organic forms aren't possible, given the architecture of development
  - Why don't the (large) majority of possible forms appear in nature? Are they non-adaptive, or are the developmentally impossible?

Two Kinds of Constraint

> What would an advocate of constraint$_F$ say about the adaptive status of constrained traits? Adaptation is a topic at the second level of natural selection where the winnowing of the less-well-adapted forms occurs. The discovered facts concerning the embryological development of form imply nothing about the fitness relations between that form and its eventual environment. (Amundson, 570-1)

Adaptationism vs. Constraints

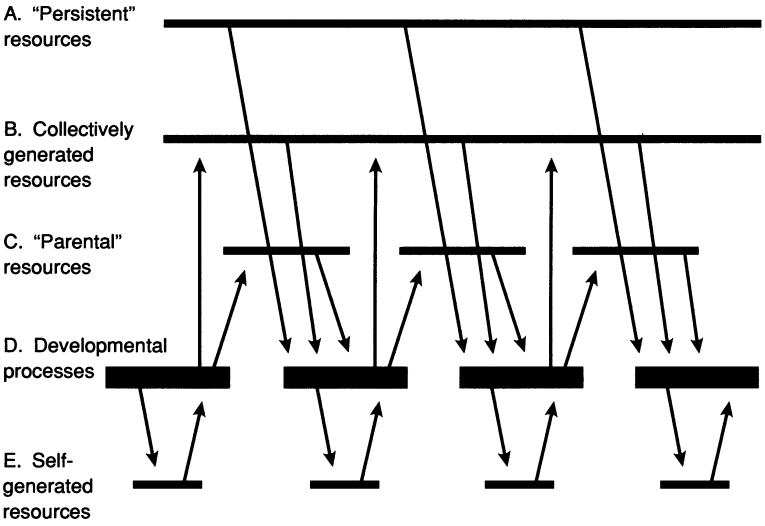
Neutralism: Many organic traits are adaptively neutral, so a constrained trait might well be adaptively neutral.

Soft adaptationism: All organic traits have adaptive values on which…natural selection operates (or would operate if there were a variant). For this reason a constraint on form is (probably) a constraint on adaptation.

Hard adaptationism: All organic traits have adaptive values, and those adaptive values, via the principle of natural selection, provide the proper historical explanation of the existence of those traits. Any developmental constraints can be (and have been) overcome by the forces of natural selection. (Amundson 572)

Developmental Systems Theory (DST)

> The genes are just one resource that is available to the developmental process. There is a fundamental symmetry between the role of genes and that of the maternal cytoplasm, or of childhood exposure to language. The full range of developmental resources represents a complex system that is replicated in development. (Griffiths and Gray 277)


A. “Persistent” resources
B. Collectively generated resources
C. “Parental” resources
D. Developmental processes
E. Self-generated resources

Systems, Processes, and Objects

> We suggest that the primary focus of a constructionist account of development should be on developmental processes, rather than developmental systems. The developmental process is a series of events which initiates new cycles of itself. (Griffiths and Gray 291)

Evolution of Development

But how do these developmental systems **evolve?**

- Selection being part of the “external” environment that “impacts” the organism doesn’t make much sense any longer
- “Fitness” becomes about ability to replicate into the future, not “fit” with the environment
- And there is little difference between cultural and biological evolution! Cultural resources are just more resources to use

New Avenues

These phenomena can be explored (Laubichler 2007):

1. comparatively — phylogenetic comparisons of developmental processes
2. experimentally — manipulation of the regulatory mechanisms that control development
3. genetically — exploring the “genetic toolkit” that underlies developmental architectures
4. computationally — characterizations of, e.g., modularity, robustness, and plasticity in developmental space

Biodiversity

The practice of biologists seems to imply that we're measuring some kind of natural property of biological systems.

Is it the same property in every system in which it's measured, or not? Even if it is, it's almost certain that it can't be **measured** in the same way in every biological system.

That's given rise to a kind of standard methodology for studying biodiversity.

Biodiversity

1. Carve up the world into “locations”
2. Pick a “surrogate” for biodiversity in each environment (some way that biodiversity expresses itself)
3. Pick an estimator of that surrogate that we can actually measure
4. Rank the places based on the measures of the estimator
5. Assess the future of the things we care about in each place
6. Develop and execute a management strategy for each place

Surrogates

- characters or traits
- species
- ecological communities
- environmental parameters
- morphological space

Preserving Groups

> Organisms (populations, species) are the result of a conspiracy between history, environment, and chance. Since those conspirators mark biological systems in different ways – affect their causal profile in different ways – it turns out that there is no single system for identifying all the similarities and differences between biological systems that matter. (Maclaurin and Sterelny, 11)

Estimators

- species richness
- environmental parameters
- soil types
- dominant vegetation
- species composition
- community composition
- higher-taxon composition
- subsets of species composition (keystone species)

Rank-orderings

- complementarity
- rarity

Biodiversity: A Coherent Concept?

> Put bluntly, the position that this paper will argue for is that biodiversity is to be (implicitly) defined as what is being conserved by the practice of conservation biology. (Sarkar, 132)

Biol Philos
DOI 10.1007/s10539-014-9426-2

Save the planet: eliminate biodiversity

Carlos Santana

HPLS (2019) 41:15
https://doi.org/10.1007/s40656-019-0252-3

ORIGINAL PAPER

Taxonomy and conservation science: interdependent and value-laden

Stijn Conix[1]

Biodiversity and Values

> Conservation biology differs from most other biological sciences in one important way: it is often a crisis discipline. Its relation to biology, particularly ecology, is analogous to that of surgery to physiology and war to political science. In crisis disciplines, one must act before knowing all the facts; crisis disciplines are thus a mixture of science and art, and their pursuit requires intuition as well as information. (Soulé 1985)

Biodiversity and Values

Common response: Ethical value judgments are acceptable in conservation, but should be **kept out of taxonomy.** So we can inventory species “neutrally,” and then we involve our values when we move toward conserving them.

But… does this actually work?