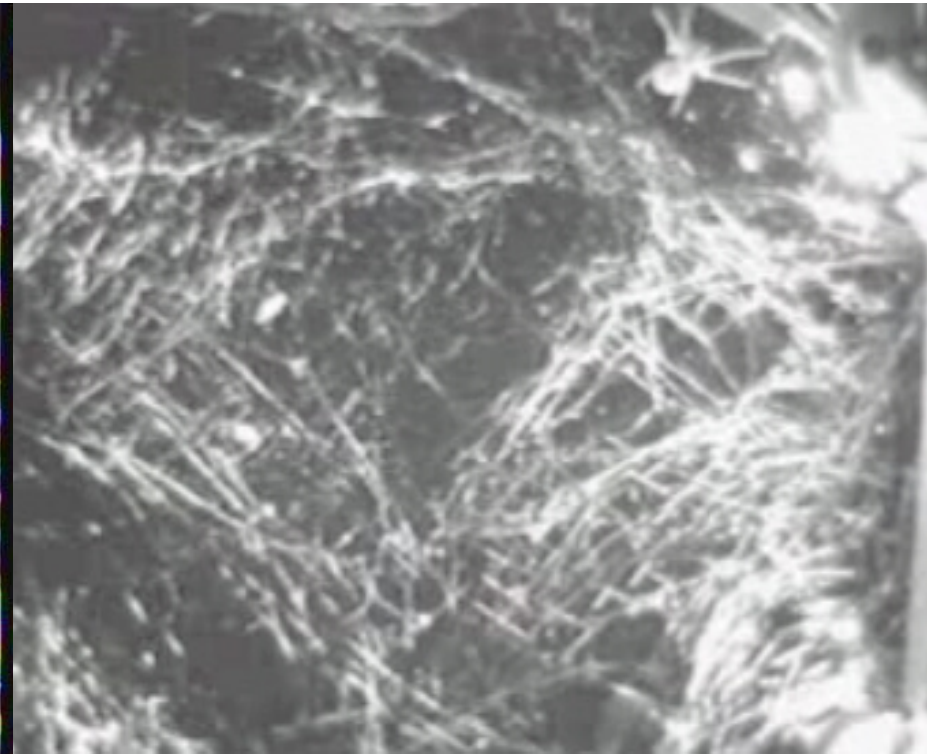
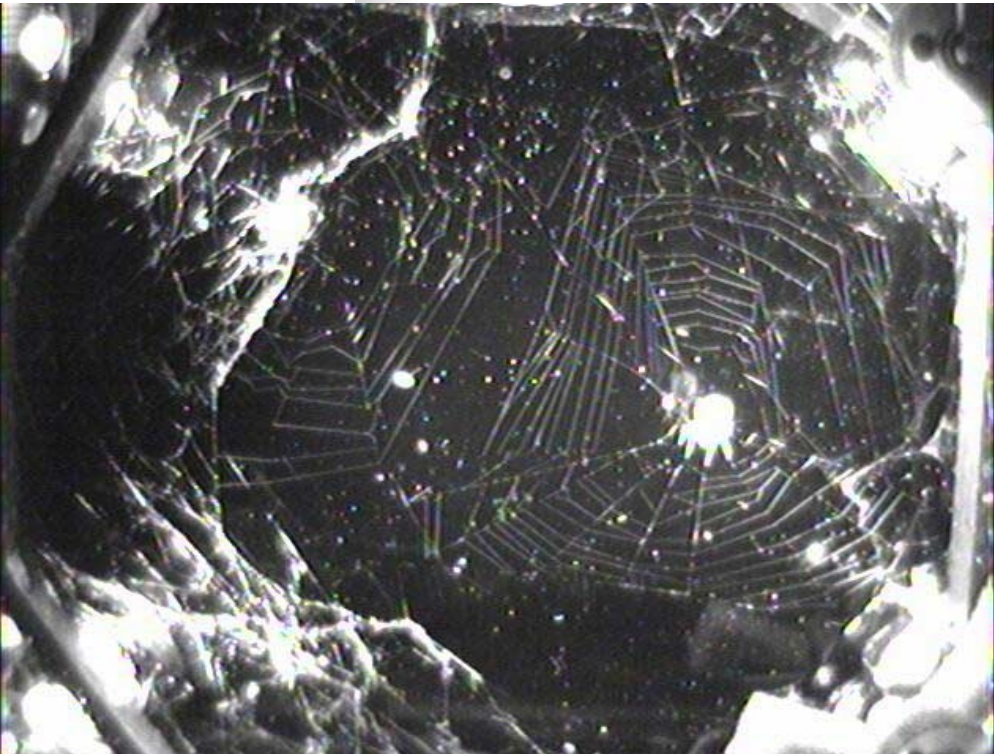
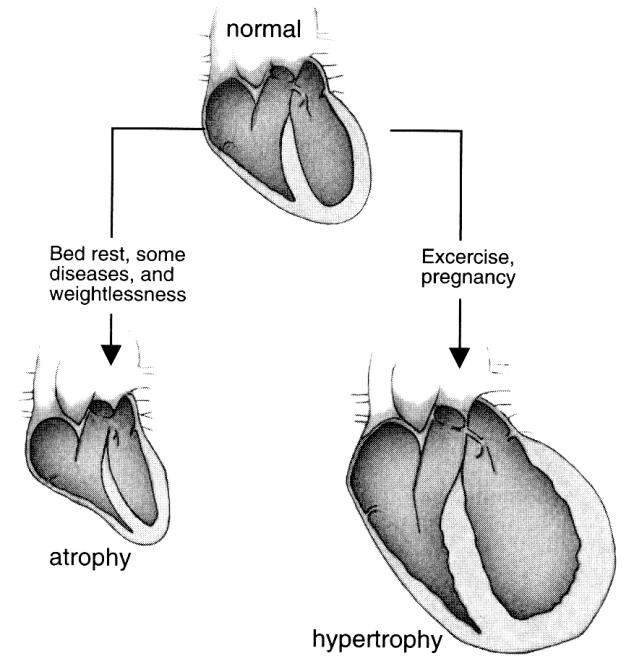
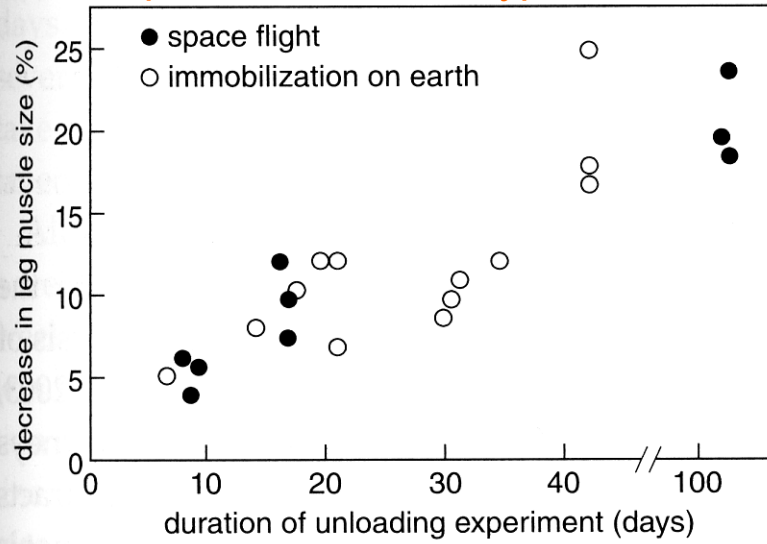


# Evolve fenotypu IV



ADAM MESSER

# Prostředí je vždy důležité při formování fenotypu





**Fenotypová plasticita** – schopnost organismu vytvářet různý fenotyp v závislosti na vnějších podmínkách (jeden genotyp odpovídá mnoha fenotypům)

- fenotypová flexibilita

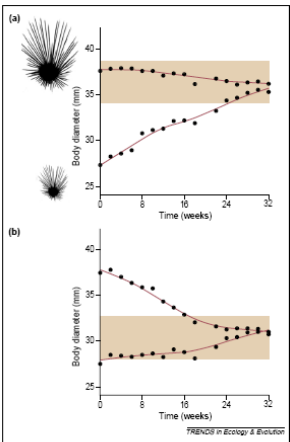
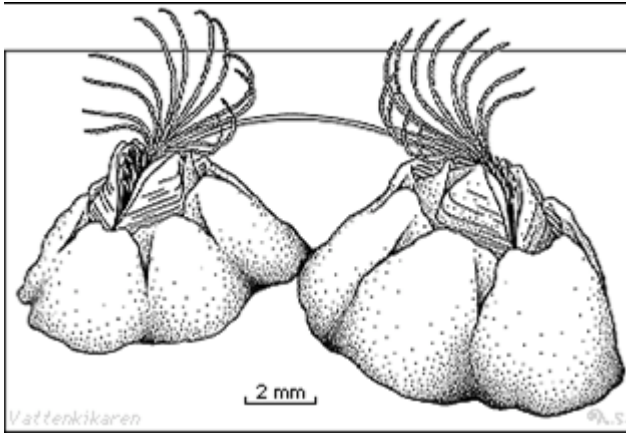
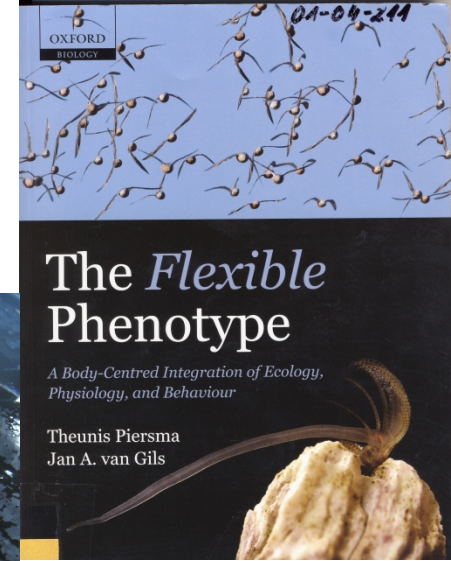
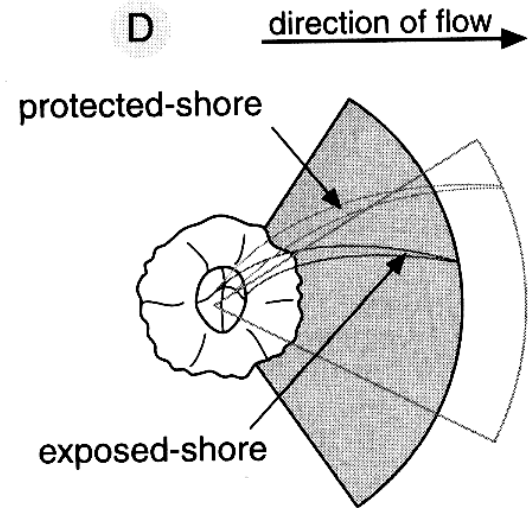
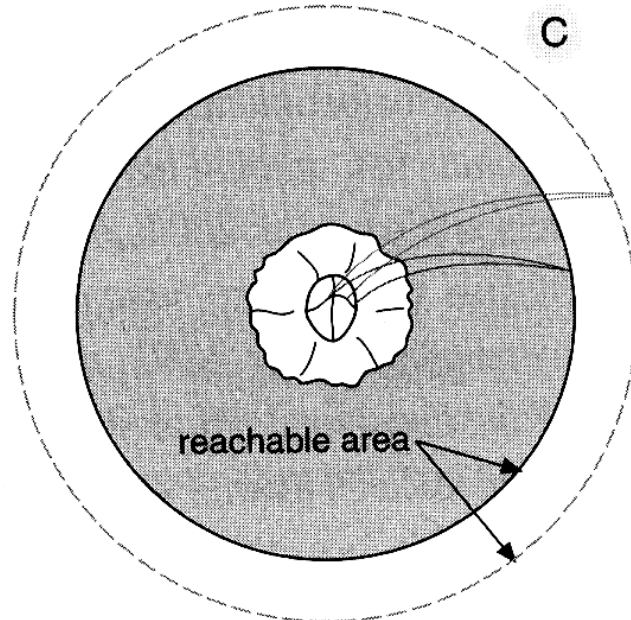
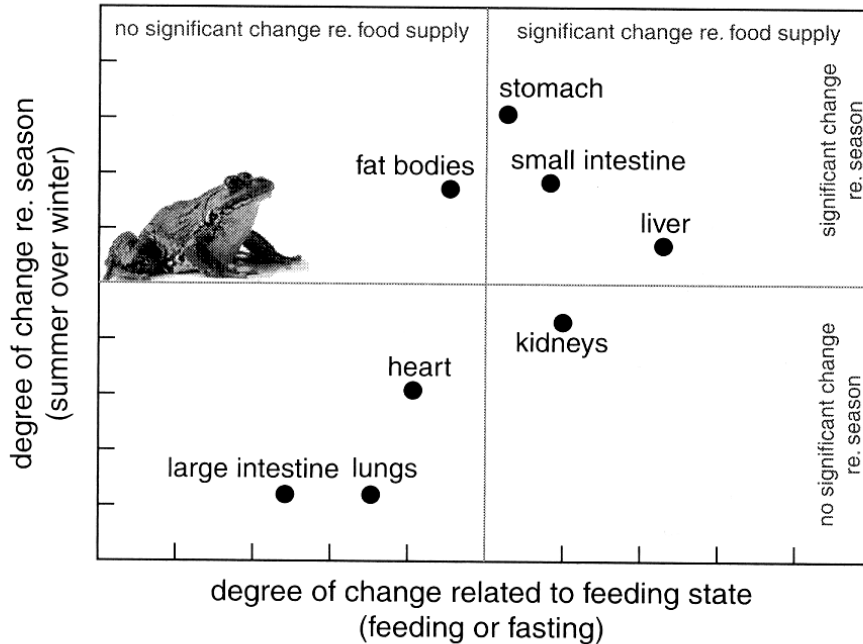


Fig. 1. Body size adjustment as a function of competitor density and/or food availability. Sea urchins *Diodonia aureolum* from the Virgin Islands in the Caribbean adjust body size in proportion to the density of their population, which is correlated with food availability. When the population density is low (i.e. relatively high food availability) (a) the large and small sea urchins converge to the same large body size over the course of eight months (a prediction, indicated by the shaded bar). Under a high urchin density regime (i.e. relatively low food abundance) (b) large and small individuals converge to the much smaller size, as predicted (shaded bar). Based on data from [28] for 144 individuals kept in 32 cage enclosures with stocking densities of three or six animals per cage. Body size predictions are generated from field correlations with food availability.



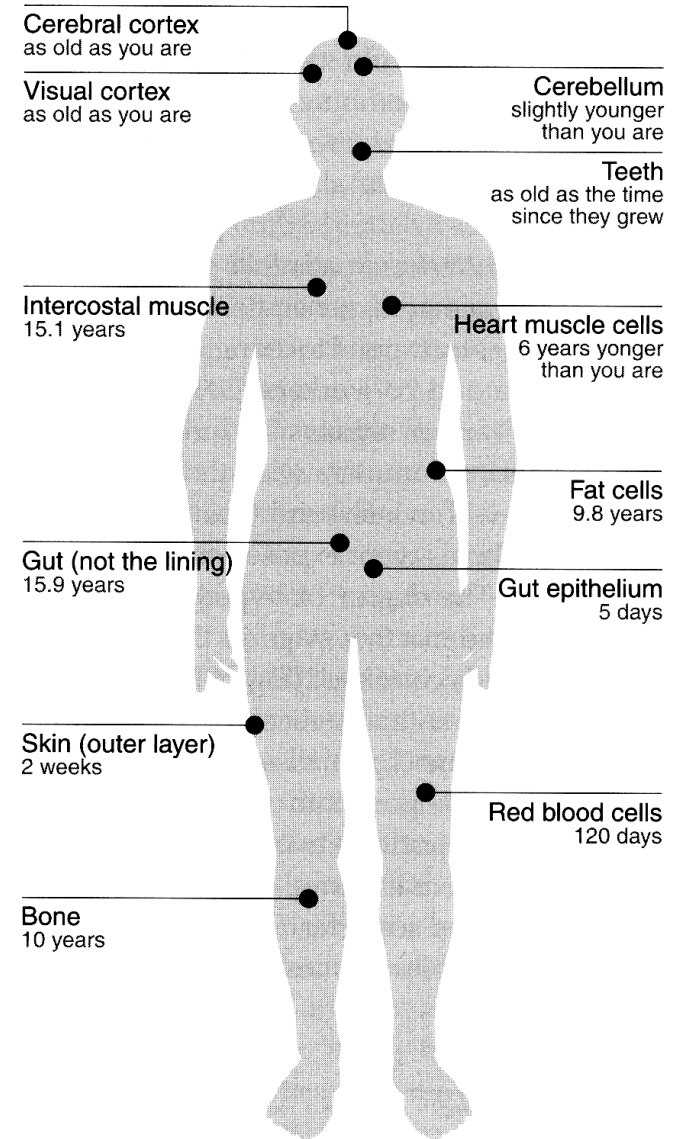
**Fenotypová plasticita** – schopnost organismu vytvářet různý fenotyp v závislosti na vnějších podmínkách (jeden genotyp odpovídá mnoha fenotypům)

- **fenotypová flexibilita**



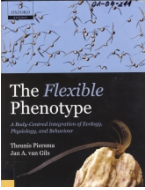
**Figure 59.** Degree of change in the dry mass of various organs of mature Andean toads *Bufo spinulosus* as a function of either feeding and fasting (X-axis) or season (summer compared with winter, Y-axis). The degrees of change reflect the first two principal components in a factor analysis.

Based on Naya *et al.* (2009).



**Figure 58.** Most of your cells are younger than you are (at least the DNA in the cells is), but there is a lot of variation between cell types.

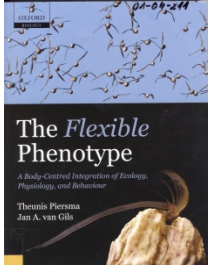
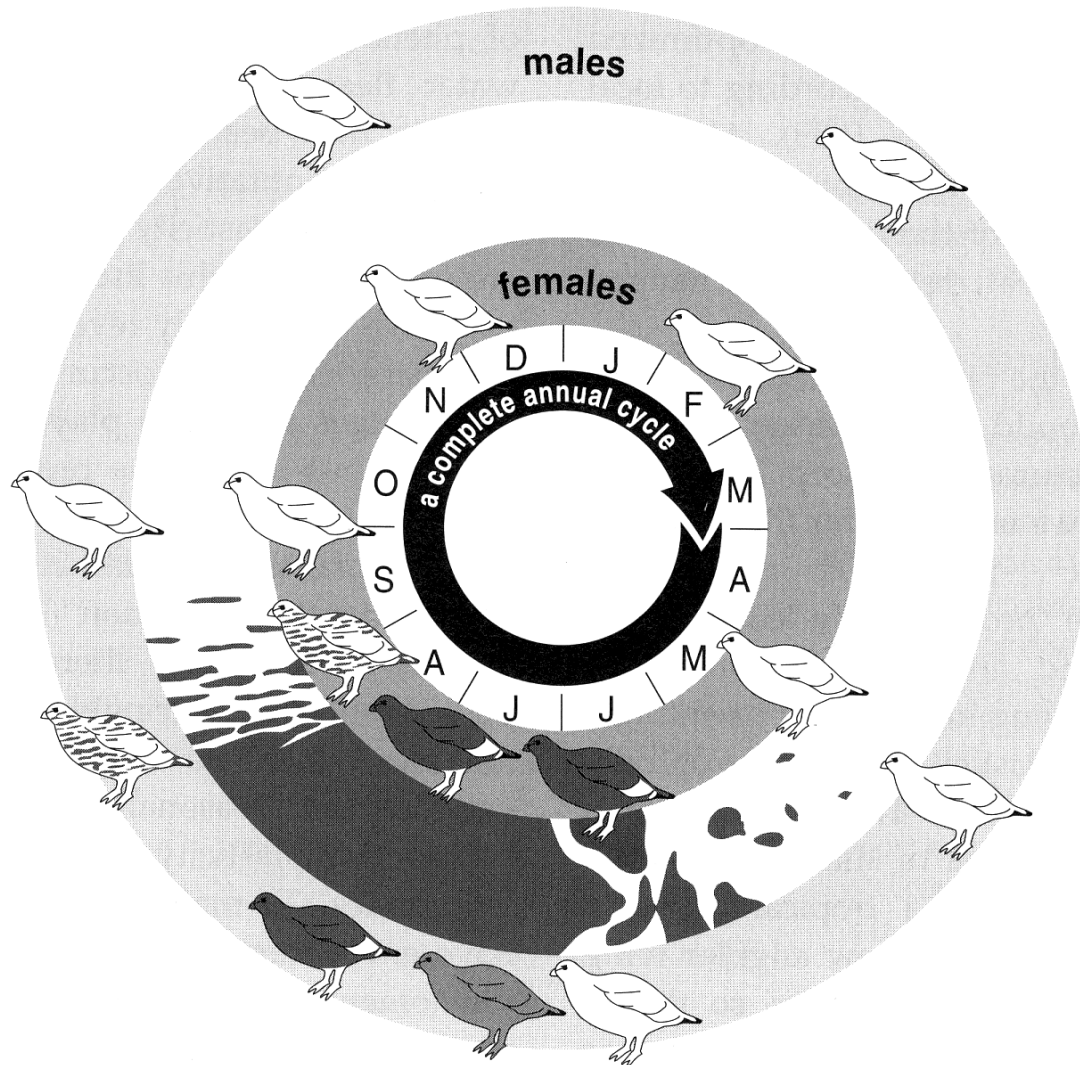
Modified from Vince (2006), partly based on Spalding *et al.* (2005a, 2005b 2008) and Bergmann *et al.* (2009).





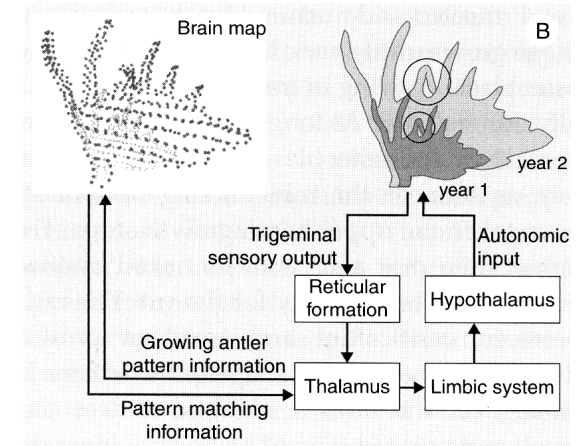
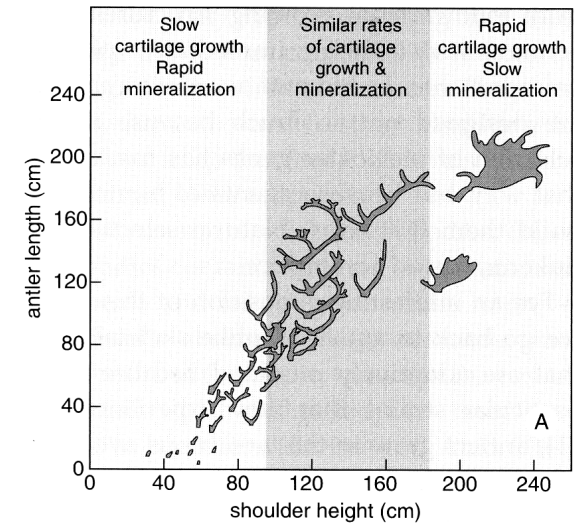
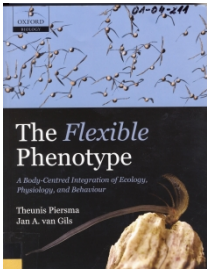
**Fenotypová plasticita** – schopnost organismu vytvářet různý fenotyp v závislosti na vnějších podmínkách (jeden genotyp odpovídá mnoha fenotypům)

- fenotypová flexibilita,
- life-cycle staging



**Fenotypová plasticita** – schopnost organismu vytvářet různý fenotyp v závislosti na vnějších podmínkách (jeden genotyp odpovídá mnoha fenotypům)

- fenotypová flexibilita,
- life-cycle staging



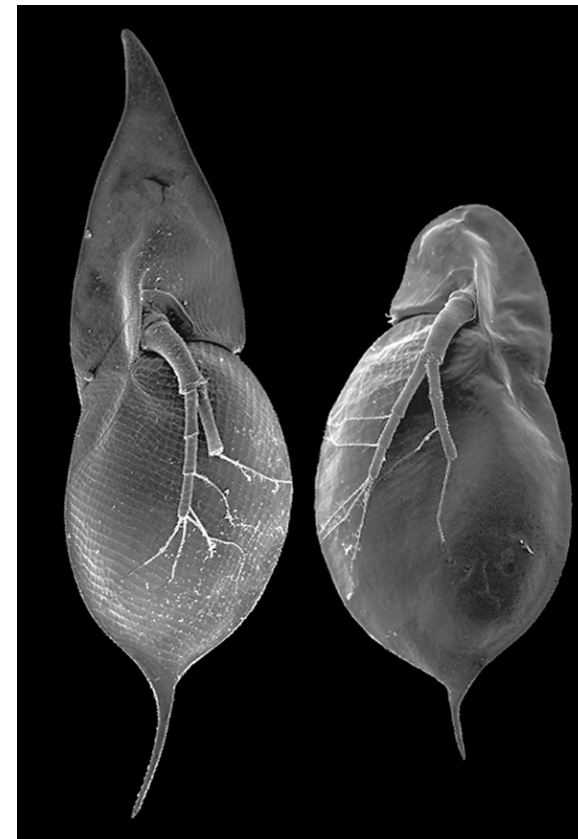
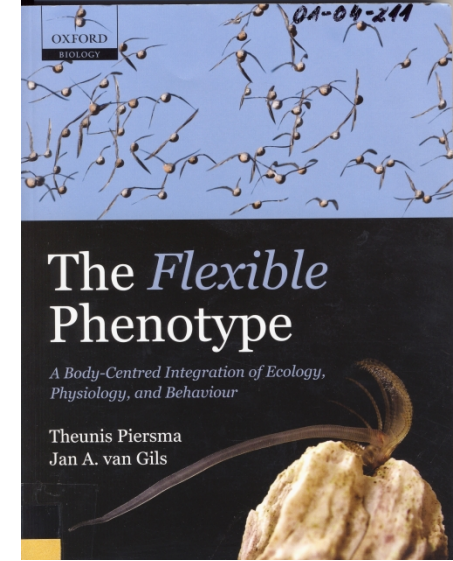
**Figure 62.** (A) Antler length is a function of the shoulder height of the deer stag that carries it. The outcome is determined by a 'race' between how rapidly cartilage grows and how rapidly it mineralizes, a ratio that is body-size dependent. In small deer, mineralization relative to cartilage growth rates is high, which leads to small, single-point antlers. In the largest deer, the ratio is small and this produces the broad plate-like antlers carried by moose *Alces alces* and the extinct Irish elk *Megaloceros giganteus*. (B) A diagram outlining the ways in which antler shape may be memorized in the brain and how this memory feeds back into the shape of the antler during the subsequent growth cycle.

Put together from figures in Turner (2007).



**Fenotypová plasticita** – schopnost organismu vytvářet různý fenotyp v závislosti na vnějších podmínkách (jeden genotyp odpovídá mnoha fenotypům)

- **fenotypová flexibilita**
- **life-cycle staging**
- **vývinová plasticita (developmental plasticity)** – nevratné změny proběhlé během ontogeneze určují konečný fenotyp

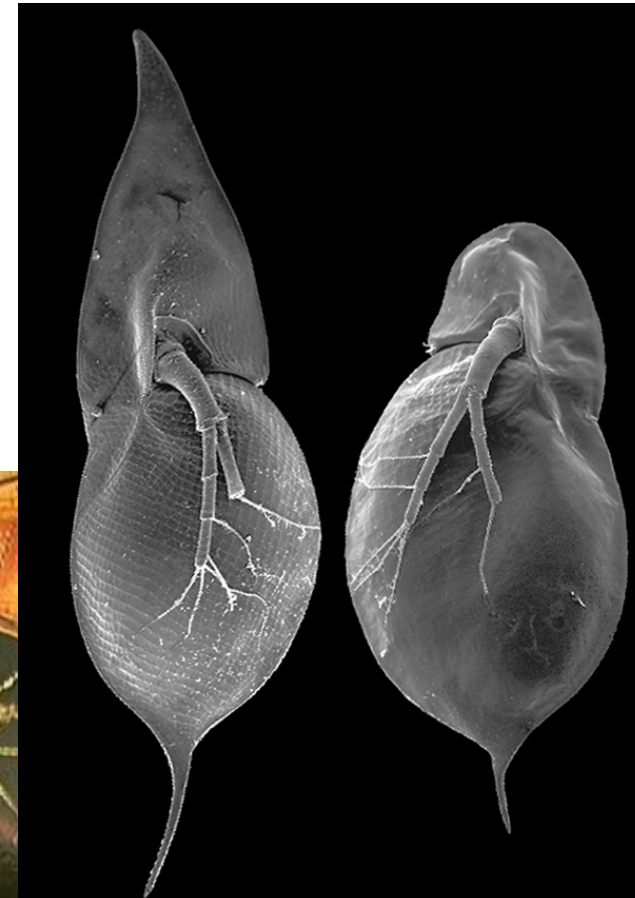
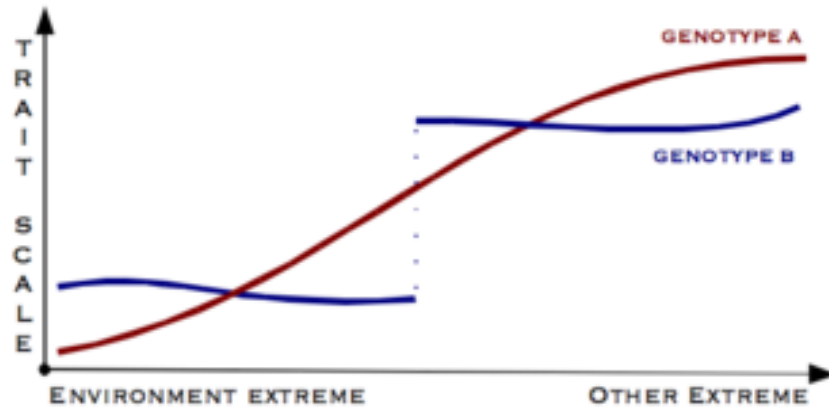


**Norma reakce** – popisuje fenotypy odpovídající jednomu genotypu v závislosti na gradientu vnějších podmínek

- **spojitá**

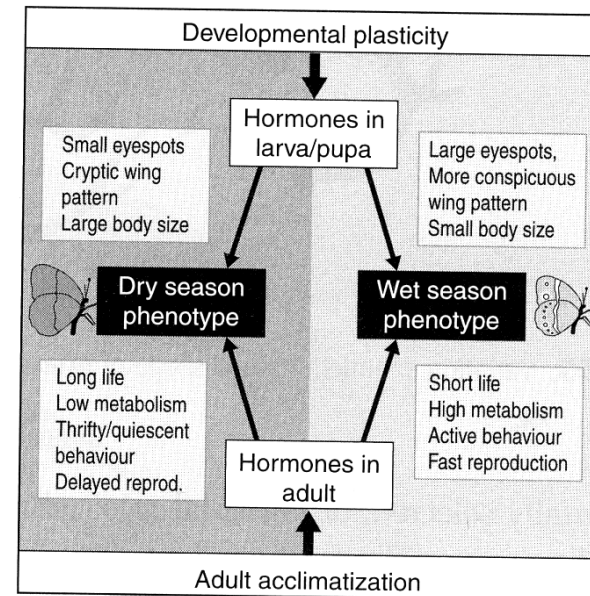
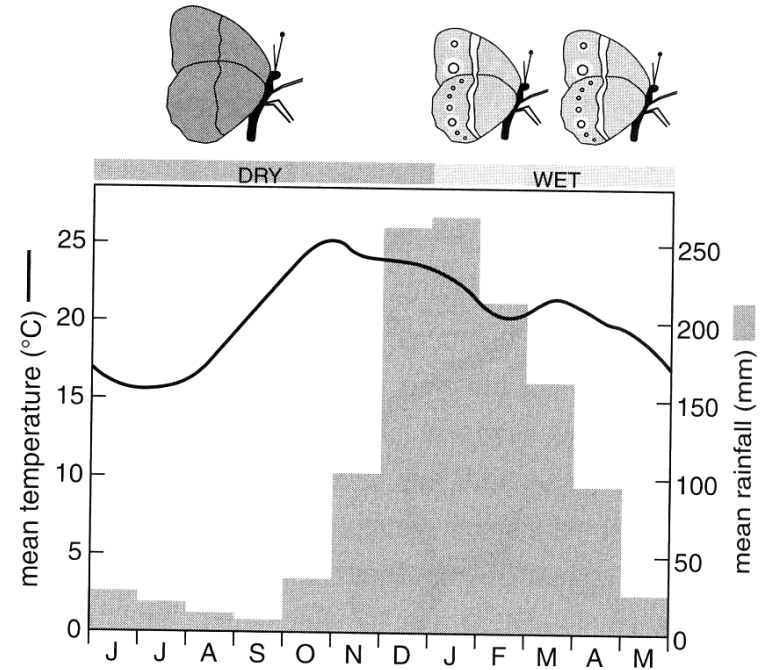
- **polyfénie (polyphenism)**: jeden genotyp odpovídá několika diskretním fenotypům realizovaných v odpovídajících podmínkách prostředí

- **kanalizace (canalization)** – schopnost produkovat stejný fenotyp bez ohledu na proměnlivost podmínek prostředí (environmental canalisation) nebo genotypu (genetic canalisation)





# Za jednotlivé znaky polyfénických morf mohou být zodpovědné různé mechanismy



## Metodologické přístupy ke zkoumání fenotypové plasticity:

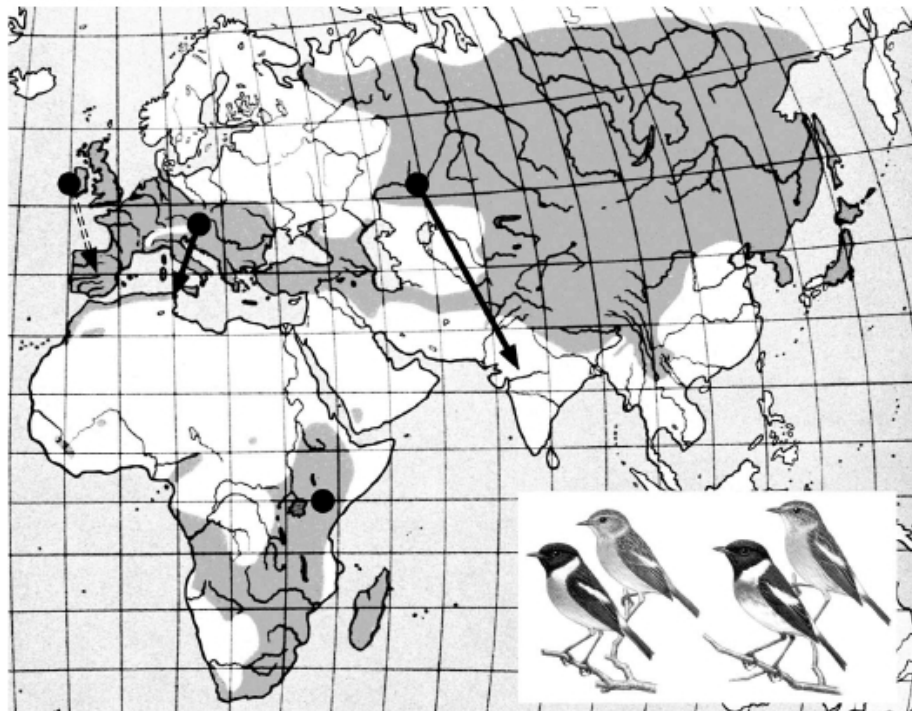
A) „common garden“ experiment

### Slow pace of life in tropical sedentary birds: a common-garden experiment on four stonechat populations from different latitudes

Martin Wikelski<sup>1\*</sup>, Laura Spinney<sup>1</sup>, Wendy Schelsky<sup>2</sup>, Alexander Scheuerlein<sup>3</sup>  
and Eberhard Gwinner<sup>4</sup>

*Proc. R. Soc. Lond. B* (2003)

*Saxicola torquata*



B) transplant experiment

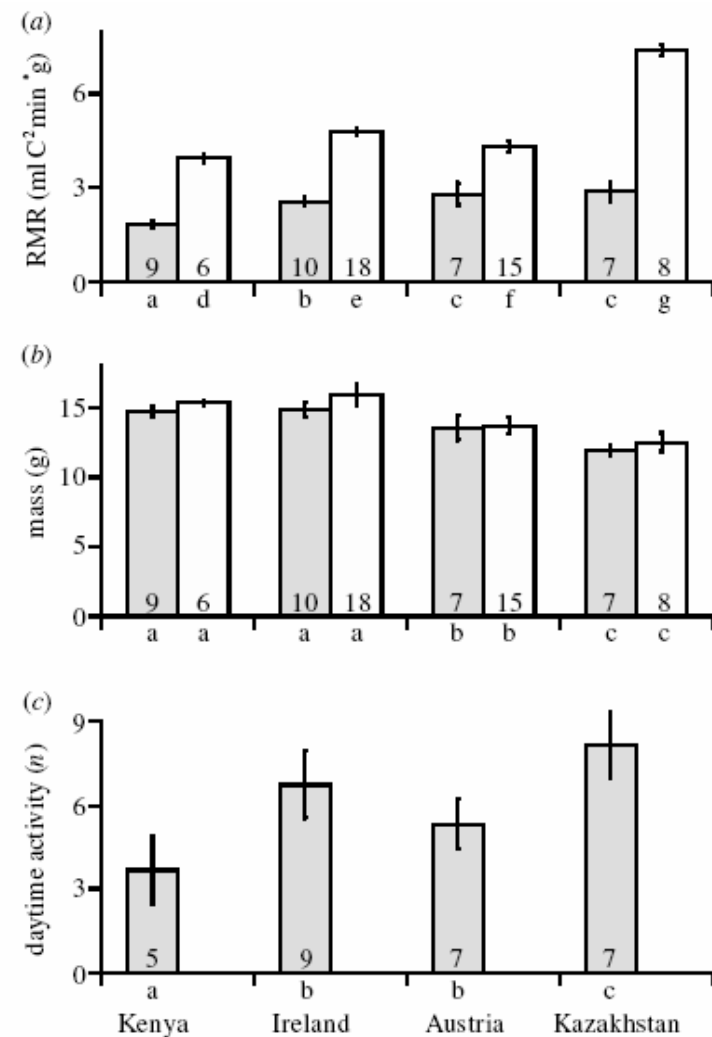


Figure 2. (a) RMR; (b) body mass; (c) activity rates (hopping per 21 h) of stonechats from four populations held in Germany under common-garden laboratory conditions (natural simulated photoperiod for Austrian birds, temperature 20–23 °C). Birds were measured during wintering condition (January 2001, shaded bars) and summer/moult condition (July 2000, open bars). Data show group means  $\pm$  s.e.m. Letters below columns show statistical differences (determined by Scheffe's *post hoc* test; same letters: no significant difference; different letters: significant difference between groups,  $p < 0.05$ ).

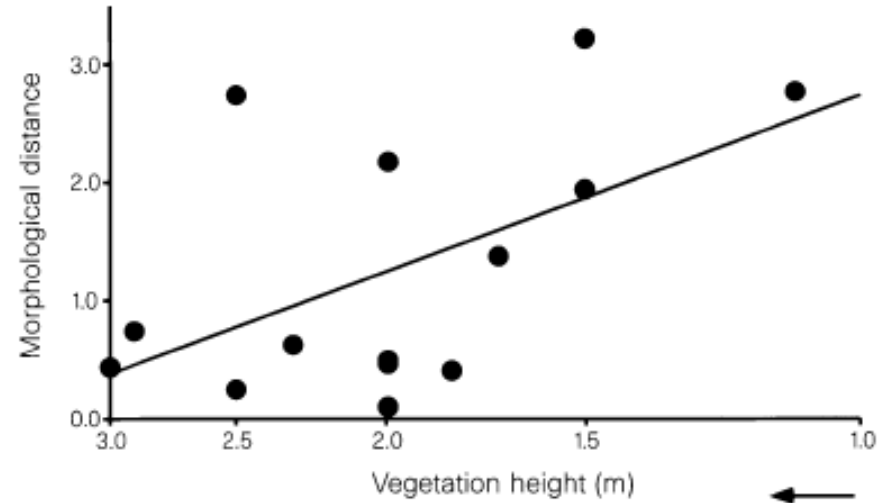
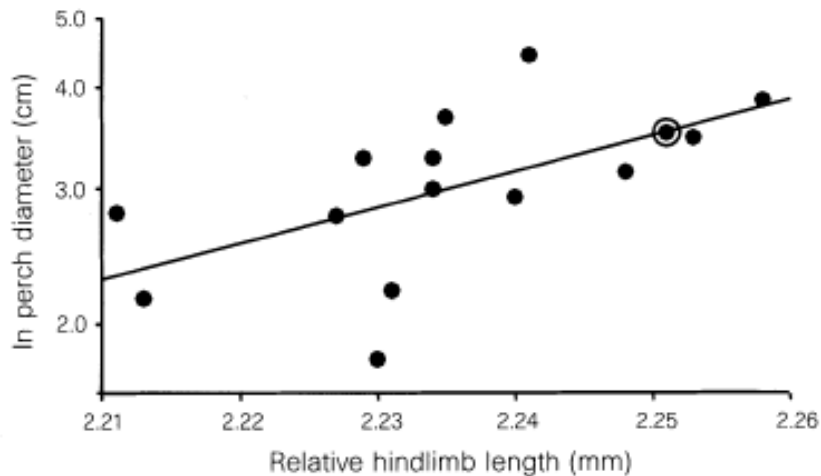


Lokální adaptace nebo fenotypová plasticita?

# Adaptive differentiation following experimental island colonization in *Anolis* lizards

Jonathan B. Losos<sup>+</sup>, Kenneth I. Warheit<sup>†</sup>  
& Thomas W. Schoener<sup>‡</sup>

NATURE | VOL 387 | 1 MAY 1997



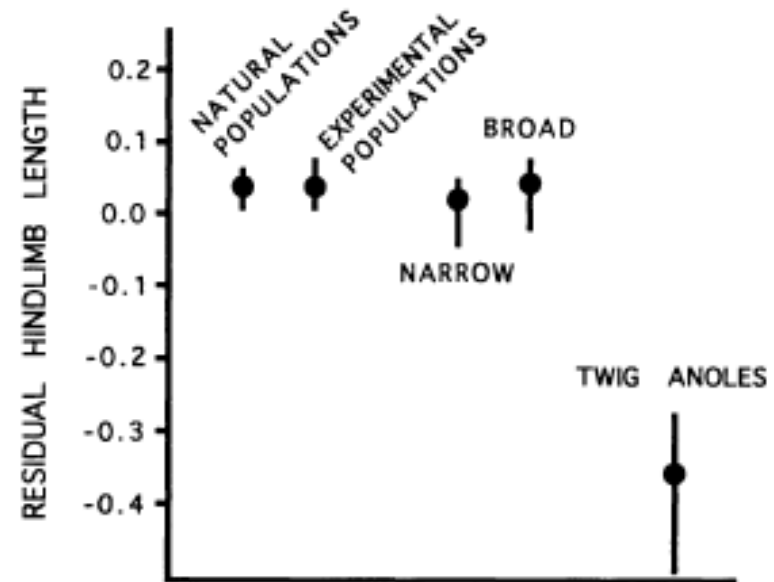
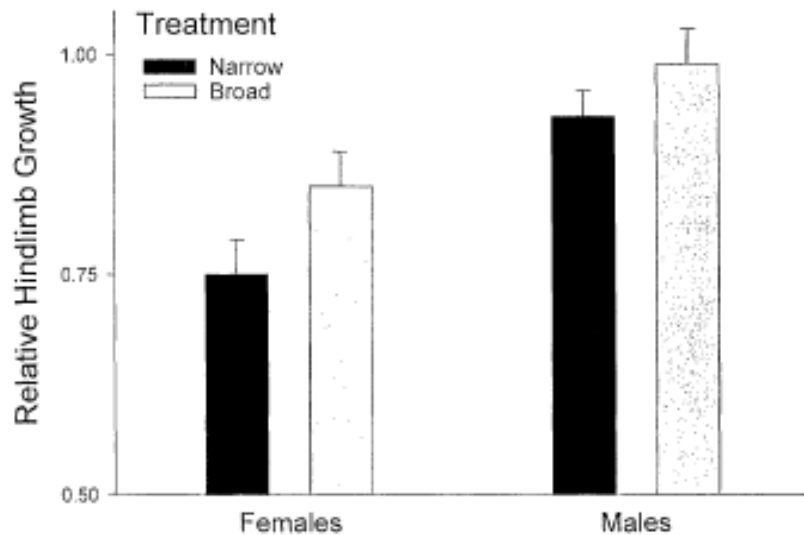
**Figure 3** Relationship between mean perch diameter (ln-transformed) used and size-adjusted hindlimb length in populations of the lizard *Anolis sagrei* on islands near Staniel Cay, Bahamas. Circled point indicates Staniel. The rate of evolution of size adjusted hindlimb length varied from 89- 1,195 darwins.

# Změny navozené fenotypovou plasticitou jsou často ve stejném směru jako změny na vyšších úrovních

## EVOLUTIONARY IMPLICATIONS OF PHENOTYPIC PLASTICITY IN THE HINDLIMB OF THE LIZARD *ANOLIS SAGREI*

JONATHAN B. LOSOS,<sup>1,2</sup> DOUGLAS A. CREER,<sup>1</sup> DANIELLE GLOSSIP,<sup>1,3</sup> RON GOELLNER,<sup>4</sup> AARON HAMPTON,<sup>4,5</sup>  
GLENN ROBERTS,<sup>4</sup> NORMAN HASKELL,<sup>4</sup> PETER TAYLOR,<sup>4</sup> AND JEFF ETTLING<sup>4</sup>

*Evolution*, 54(1), 2000, pp. 301–305





**Genetická asimilace** - fenotyp dříve vyvolaný specifickým podnětem z prostředí (např. stresem) je později produkován vždy bez ohledu na přítomnost podnětu; je závislý na vyvolání preexistující genetické variability

1953: cross-veinless, indukce teplotním šokem



1956: ultrabithorax, indukce éterem



Conrad Hal Waddington



*C. H. Waddington*

Nature Reviews | Genetics

Interpretace pokusu – Hsp90, epimutace

# Hsp90 as a capacitor for morphological evolution

Suzanne L. Rutherford<sup>††</sup> & Susan Lindquist<sup>†\*</sup>

NATURE | VOL 396 | 26 NOVEMBER 1998



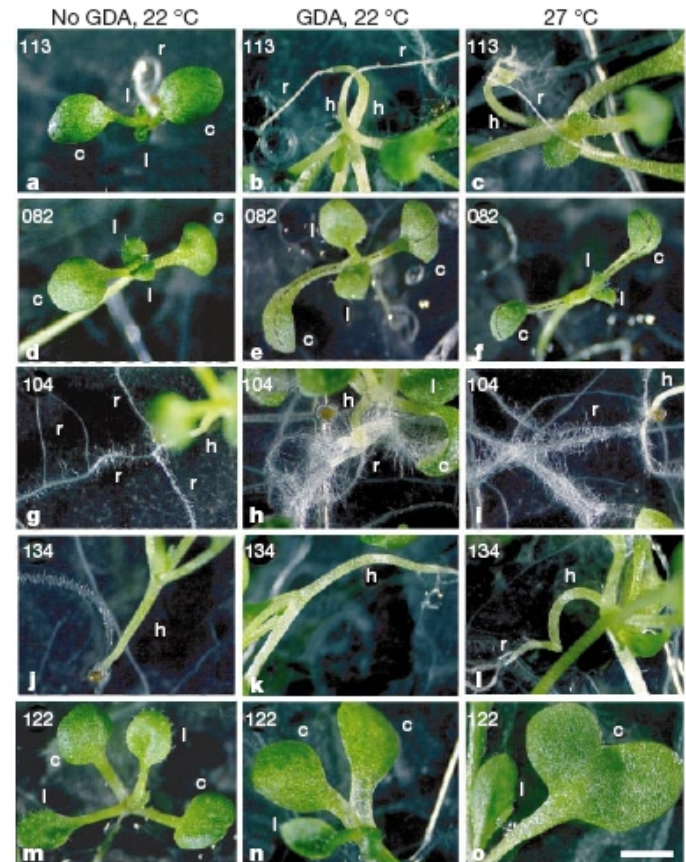
**Figure 1** Developmental abnormalities associated with Hsp90 deficits. See Table 1 for coding of traits. Deformities appearing in *Hsp83* mutant stocks: a, *13F3/TM6B*, deformed fore-leg (code L1) and transformed 2nd leg (L2) with an ectopic sex-comb (arrow); b, *P582/TM6B*, deformed eye (E1) with an extra antennae (arrow); c, *e1D/TM6B*, smooth eyes (E3) with black facets (E5); d, *P582/TM6B*, eye margin transformed into scutellum (E2). Abnormal F<sub>1</sub> hybrids produced from crosses between *Hsp83* mutant stocks and marked laboratory strains: e, *e6DX582<sup>8</sup>*, left eye has black facets (E5); f, *e6AXdpp<sup>4</sup>*, disorganized abdominal tergites (A1); g, *e1DXTM3, ftz-lacz*, small wings (W1); h, *e3AXin(2RH)PLw<sup>10</sup>*,

extraneous tissue growing out of tracheal pit (A2, arrow); i, *19F2XCdc37<sup>4D</sup>*, eyes absent (E6); j, *13F3XCdc37<sup>1E</sup>*, wing margin material growing into wing; m, *19F2X582<sup>8</sup>*, deformed eye. Heteroallelic *Hsp83* combination *e1D/9/1*; k, severely deformed legs (L1), l, severe black-facet phenotype (E5). Abnormal F<sub>1</sub> hybrids produced with wild-type laboratory stocks and *Hsp83* mutants: n, *e1D or 9/1XIR-6*, thickened wing veins (W3); o, *P82XSamarKind*, transformed wing (W5) and extra scutellar bristle (B2, arrow). Abnormalities in wild-type lines raised on geldanamycin: p, *IND-6*, notched wings (W2); q, *Ore-R*, deformed eye (E1).

# Hsp90 as a capacitor of phenotypic variation

Christine Queitsch<sup>†</sup>, Todd A. Sangster<sup>†</sup> & Susan Lindquist<sup>†\*</sup>

NATURE | VOL 417 | 6 JUNE 2002



**Figure 2** The same RI line-specific phenotypes are uncovered when buffering capacity is challenged by GDA (middle) and by growth at 27 °C (right). a, d, g, j, m; RI line seedlings grown without GDA. b, c, Line 113 seedlings, extreme hypocotyl curls and roots partially extended into air. e, f, Line 082 seedlings, S-shaped rosettes with vertically oriented leaf blades. h, i, Line 104 seedlings, abundant root hair growth. k, l, Line 134 seedlings, bent hypocotyls with rosette touching the medium surface. n, o, Line 122 seedlings, juxtaposed cotyledons (similar to those in *Shadara*) fused to varying degrees. In extreme cases, seedlings appeared to have only one very large, malformed cotyledon and one apparently healthy true leaf. Because GDA activity is lost after prolonged light exposure (see Methods), this phenotype (and other leaf phenotypes) did not appear in later-developing leaves. Plant organs are indicated, as defined in Fig. 1. Scale bar: 2 mm for a–f, j–m; 1 mm for g–f, n, o.





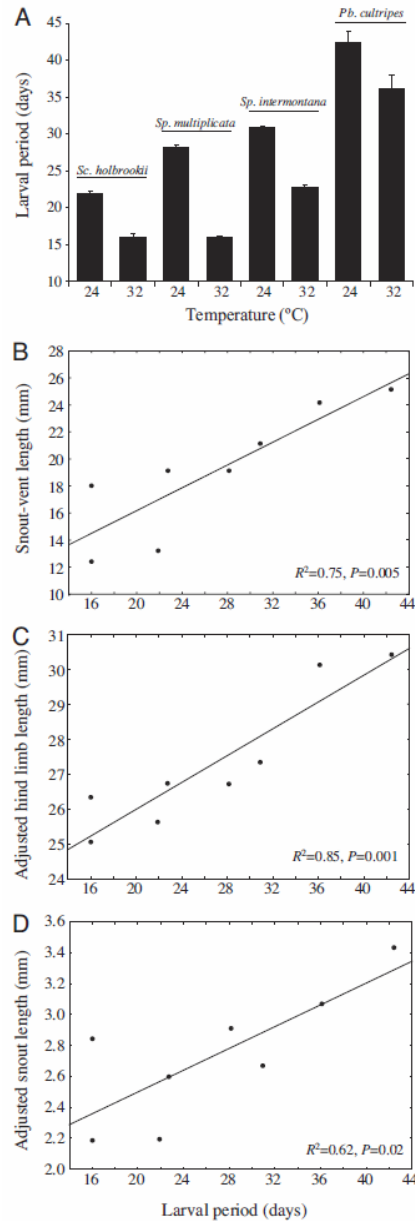
## Organic Selection: Proximate Environmental Effects on the Evolution of Morphology and Behaviour

BRIAN K. HALL

*Table 1.* A summary of the steps in the Baldwin Effect and genetic assimilation to show the major differences between the two processes

Baldwin Effect	Genetic assimilation
1. Interaction with the environment results in phenotypic changes in structure, behaviour, and/or function that are adaptive	Interaction with the environment results in phenotypic changes in structure, behaviour or function that are adaptive
2. Mutations occur that lead to the same adaptive phenotypic changes; existing genetic variability is insufficient	Existing genetic variability is expressed in an assimilated phenotype which appears in the absence of the environmental signal; mutation is not required
3. Selection favors the mutations, which spread through the population; the environmentally induced phenotype is now inherited.	Selection favors the previously unexpressed genetic variability; the number of individuals with the assimilated phenotype increases

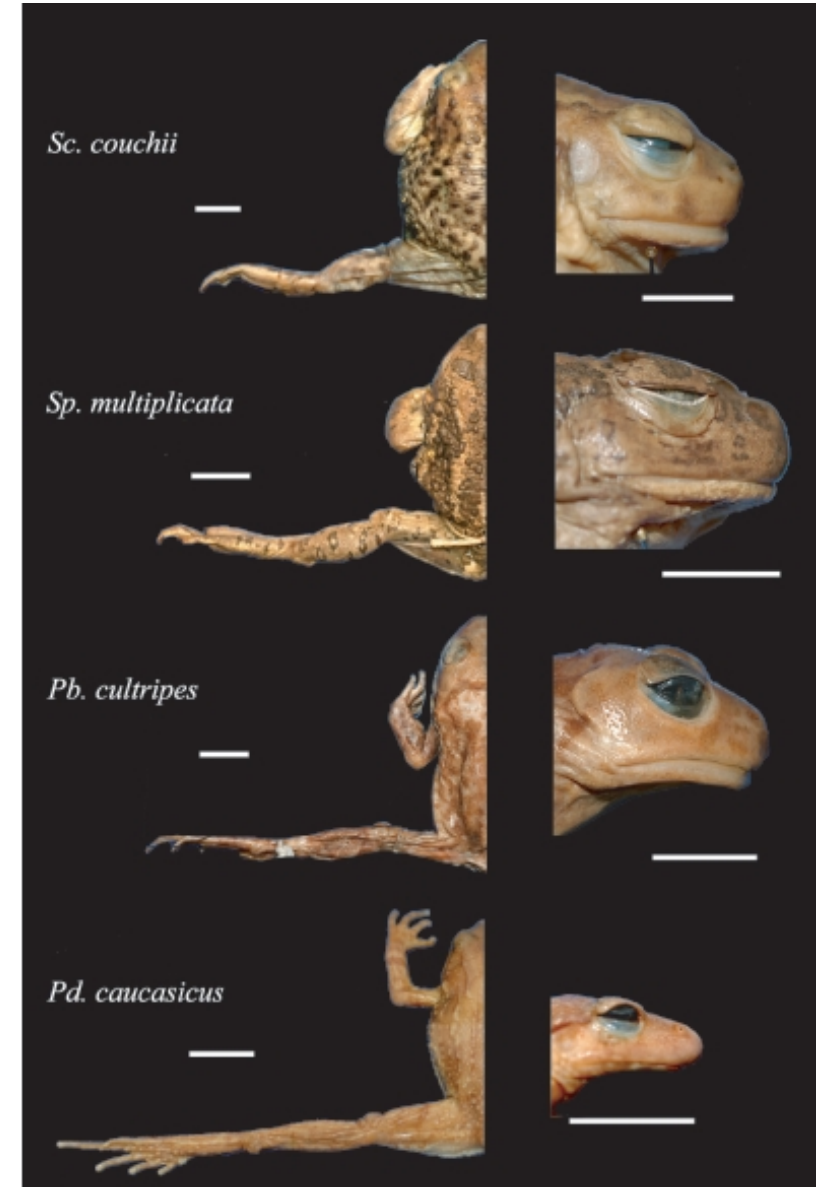
Fenotypové rozdíly mezi druhy mohou být následkem načasování ontogenetických procesů, které jsou ovlivněny prostředím

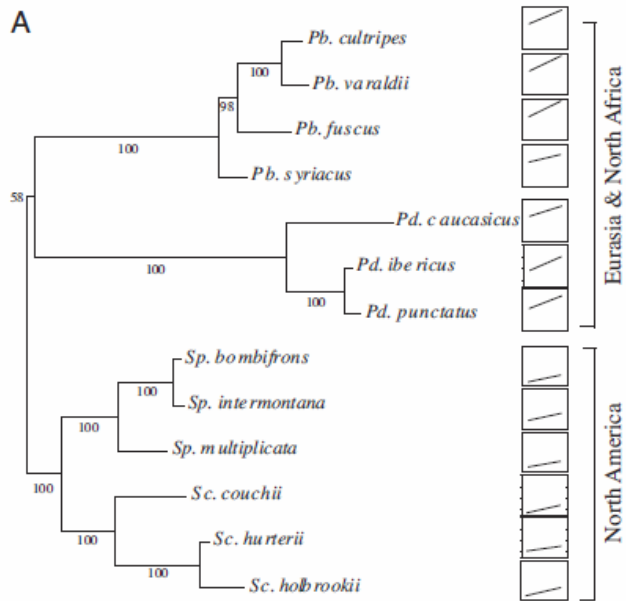


## Developmental plasticity mirrors differences among taxa in spadefoot toads linking plasticity and diversity

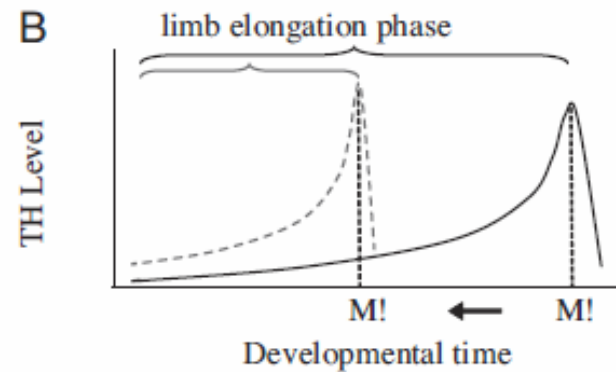
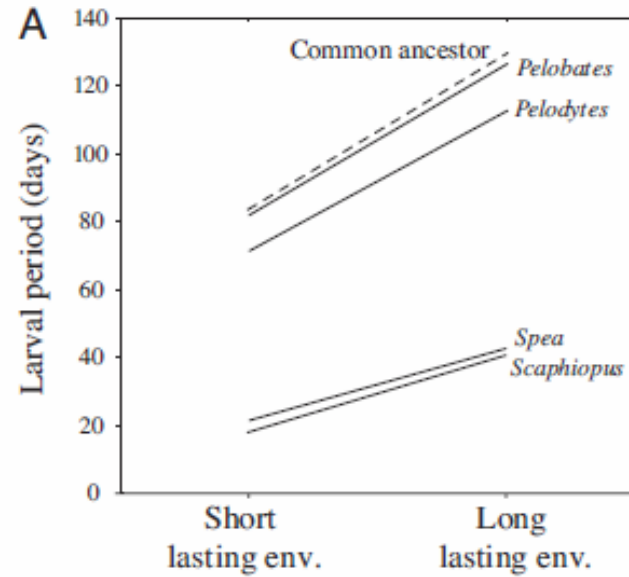
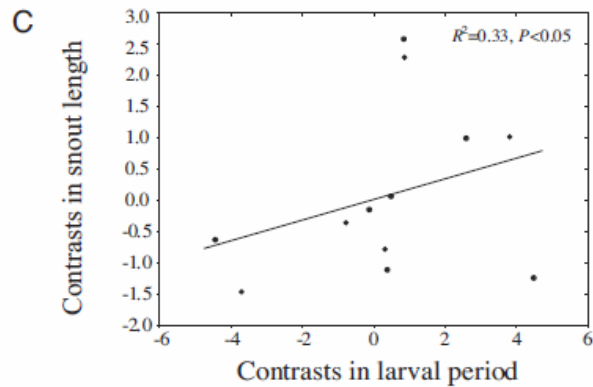
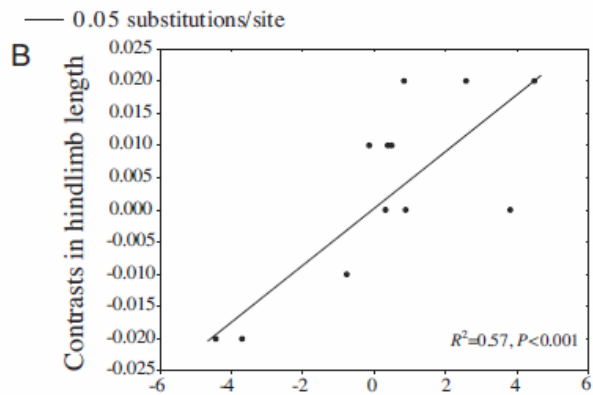
Ivan Gomez-Mestre\*† and Daniel R. Buchholz‡

PNAS | December 12, 2006 | vol. 103 | no. 50 | 19021–19026





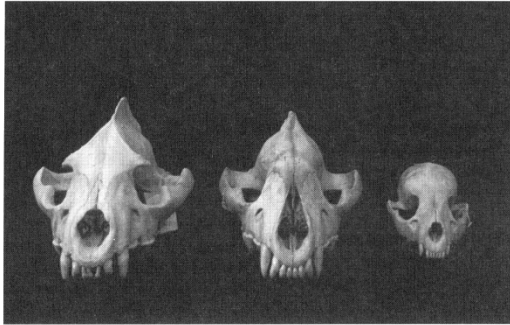
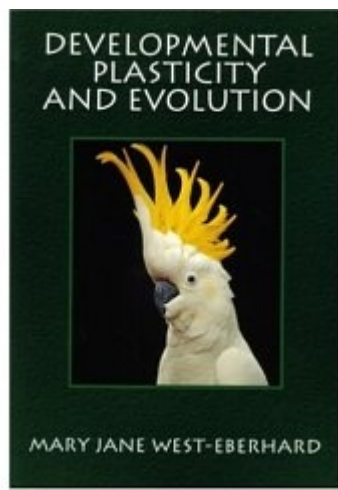
ADAM MESSER



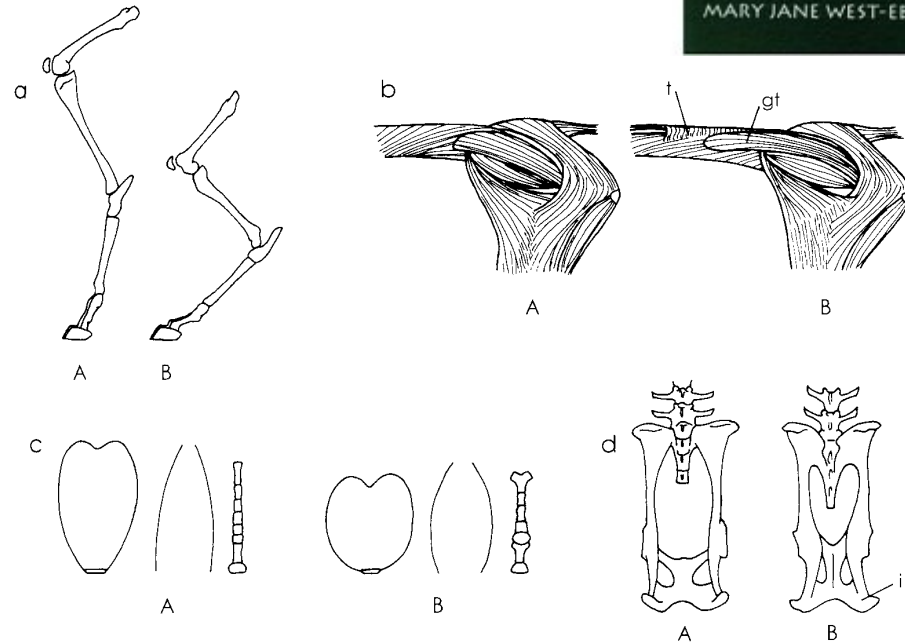


## Organismus je plastický integrovaný systém

Fenotypová akomodace (phenotypic accommodation) – „adaptive mutual adjustment among variable parts during development without genetic change“



**Fig. 3.3.** Diet-dependent developmental change in the skull of wild spotted hyenas. Skulls collected following death of individuals (right to left) 3 months, 24 months, and 11 years old show marked change in attachment sites for feeding muscles (sagittal crest, cheekbones, and forehead). In animals raised in captivity, which feed relatively rarely on bone, these feeding structures are poorly developed; elderly captive hyenas have skulls that resemble those of cubs (Holekamp and Smale, 1998; Holekamp, personal communication). Courtesy of K. E. Holekamp.



**Fig. 3.13.** Morphological innovation in a two-legged goat: development of (a) left hind leg, (b) pelvic musculature, (c) thoracic skeleton, and (d) pelvic skeleton of a normal (A) and a bipedal (B) specimen of the same age. Changes in the pelvic musculature (b) include a greatly thickened and elongated gluteal tendon (gt), whose anterior attachments are reinforced by the novel addition of numerous long, flat tendons (t). The form of the thoracic skeleton (c) is represented by a transverse section of the cranial part of the thorax (left), a horizontal section at the middle of the ribs (middle), and a ventral view of the sternum (right). The relatively long ischium (i) of the pelvis (d) and other changes (see text) resemble those of bipedal mammal species. After Slijper (1942a,b).

Organismus je plastický integrovaný systém: trade-offs mezi jednotlivými částmi

## Mechanistic Analysis of Natural Selection and a Refinement of Lack's and Williams's Principles

Barry Sinervo

VOL. 154, SUPPLEMENT THE AMERICAN NATURALIST JULY 1999

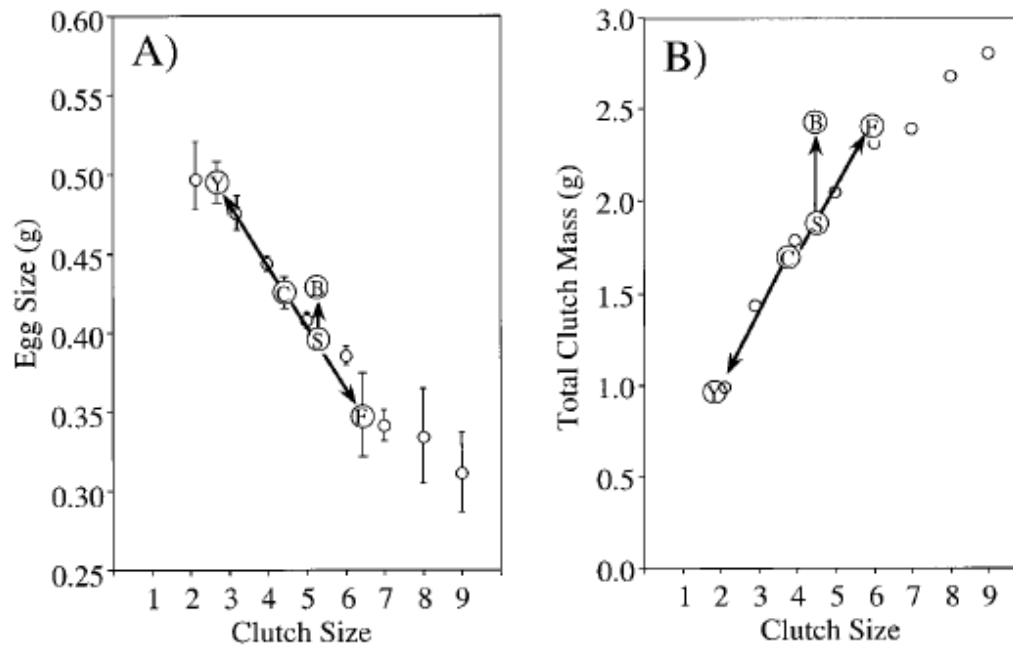


Figure 1: Natural variation (*open circles*; mean  $\pm$  SE) compared to experimentally induced variation (*arrows*) between (A) clutch size and egg size and (B) clutch size and total clutch mass for female side-blotched lizards (*Uta stansburiana*) from the inner Coast Range of California. Three manipulations of the endocrine system probe the mechanistic bases of allocation trade-offs: ablation of ovarian follicles (Y) during early vitellogenesis reduces clutch size and total clutch mass but increases egg size; administration of exogenous FSH (F) during early vitellogenesis increases clutch size and total clutch mass but reduces egg size; and exogenous corticosterone implants (B) increase offspring size and total clutch mass, but clutch size remains unaltered. Manipulated females are compared to both unmanipulated (C) and sham-manipulated females (S).

Organismus je plastický integrovaný systém: trade-offs mezi jednotlivými částmi

# Costs and the Diversification of Exaggerated Animal Structures

Douglas J. Emlen

23 FEBRUARY 2001 VOL 291 SCIENCE

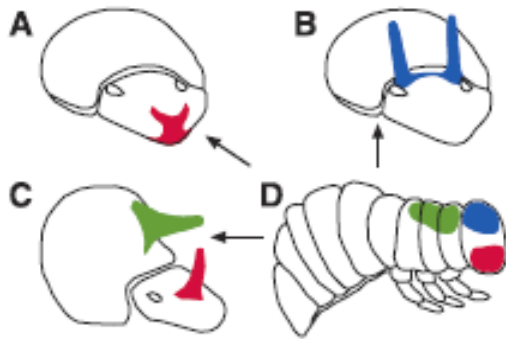


Fig. 1. Physical locations of beetle horns. (A) Males of *O. sharpi* produce a horn that extends from the front of the head. (B) Males of an unidentified *Onthophagus* species sampled from lowland forests of Ecuador produce a pair of horns that extend from the base of the head. (C) Females of *O. sagittarius* produce two horns, one extending from the thorax and the other from the center of the head. (D) Horns in different locations develop adjacent to different structures. Horns at the center or front of the head (red) develop closest to growing antennae, horns at the base of the head (blue) develop nearest to eyes, and horns on the thorax (green) develop nearest to wings.

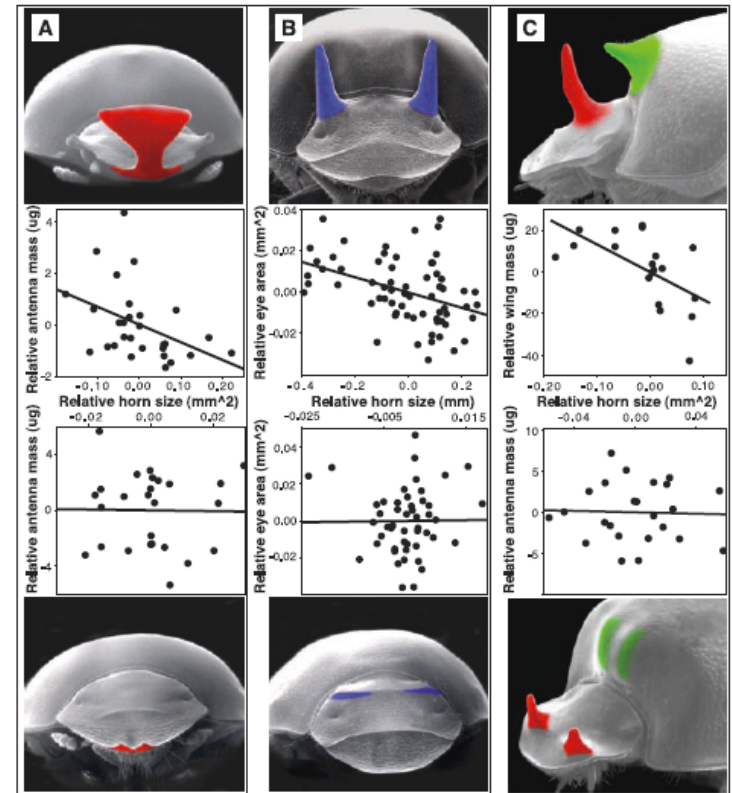


Fig. 2. Functional costs of beetle horns. In each species, the relative size of horns was negatively correlated with the relative size of the nearest neighboring structure (antennae, eyes, or wings), and these developmental tradeoffs were present only in the sex-expressing enlarged horns. (A) *O. sharpi* males (top) produce a horn at the front of the face (red), and males with the longest horns relative to their body size had proportionately smaller antennae (measured as a negative phenotypic correlation between relative horn area and relative antenna mass). Female *O. sharpi* (bottom) do not produce enlarged horns and do not have negative correlations with antenna size. (B) In an unidentified *Onthophagus* species from Ecuador, males (top) produce a pair of horns extending from the base of the head (blue), and the relative length of male horns was negatively correlated with the relative area of eyes. Females of this species (bottom) do not produce enlarged horns and show no evidence for tradeoffs with eyes. In both of these species, "horn" size in females was estimated as the area of the comparable region of head cuticle (shown in red, or blue, as appropriate). (C) In *O. sagittarius*, females produce two horns (top), one extending from the thorax (green), and a second from the center of the head (red), and relative female horn length was negatively correlated with the relative mass of both wings and antennae (horns versus wings shown). Males of *O. sagittarius* produce only minimal horns extending from the front of the face (bottom), and these small horns are not negatively correlated with antennae (the closest neighboring trait). This third species provides the most convincing evidence for developmental tradeoffs associated with horn expression because females rather than males produce the enlarged horns, and females also show location-specific patterns of negative phenotypic correlation with adjoining structures.



Organismus je plastický integrovaný systém: trade-offs mezi jednotlivými částmi

# Competition among body parts in the development and evolution of insect morphology

Proc. Natl. Acad. Sci. USA  
Vol. 95, pp. 3685–3689, March 1998  
Developmental Biology, Evolution

H. F. NIJHOUT\* AND D. J. EMLEN†

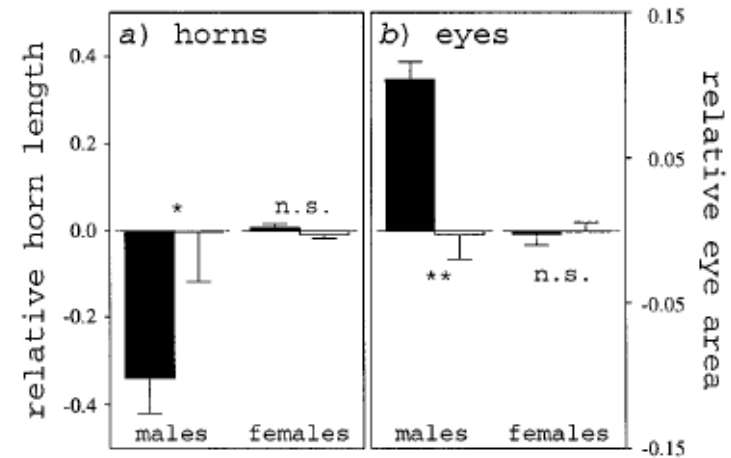
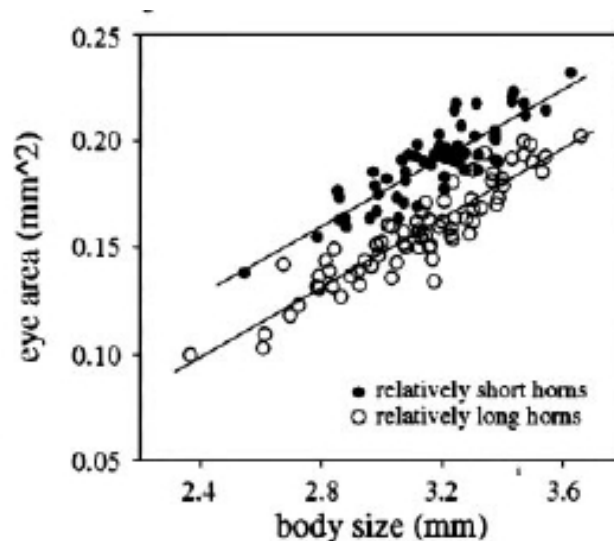


FIG. 2. Resource allocation tradeoffs in developing *O. taurus* revealed by treatment with the JH analog methoprene. Solid bars, animals receiving methoprene in acetone; open bars, acetone-treated controls. (a) Topical application of JH during the second and third days of the final larval instar induced males to reduce allocation to horns. Males just above the critical size for horn production developed significantly shorter horns relative to their body size than control males (Mann-Whitney  $U$  test on relative horn length:  $U_{7,7} = 9$ ,  $Z = -1.981$ ,  $P = 0.0476$ ). Bars indicate the residual horn length (mean  $\pm$  SEM), calculated as the difference between actual horn length and that expected for a male of the same body size. Expected values were generated from the best-fit curve relating horn size to body size in unmanipulated males (25). Females never develop horns and were not affected by the JH treatment (Mann-Whitney  $U$  test:  $U_{13,13} = 61$ ,  $Z = -1.205$ ,  $P = 0.228$ ). (b) JH-induced diminution of male horns was accompanied by a significant increase in the size of male compound eyes (Mann-Whitney  $U$  test:  $U_{7,7} = 1$ ,  $Z = -3.003$ ,  $P = .0027$ ). Bars indicate the mean  $\pm$  SEM of residual eye size, calculated from the mean relationship between eye surface area and body size of unmanipulated males. Female eye size was unaffected by JH treatment (Mann-Whitney  $U$  test:  $U_{13,13} = 75$ ,  $Z = -0.487$ ,  $P = 0.626$ ), indicating that increased eye size in males resulted from reduced allocation to horns rather than as a direct response to JH.

Organismus je plastický integrovaný systém: trade-offs mezi jednotlivými částmi

# Evolutionary trade-off between weapons and testes

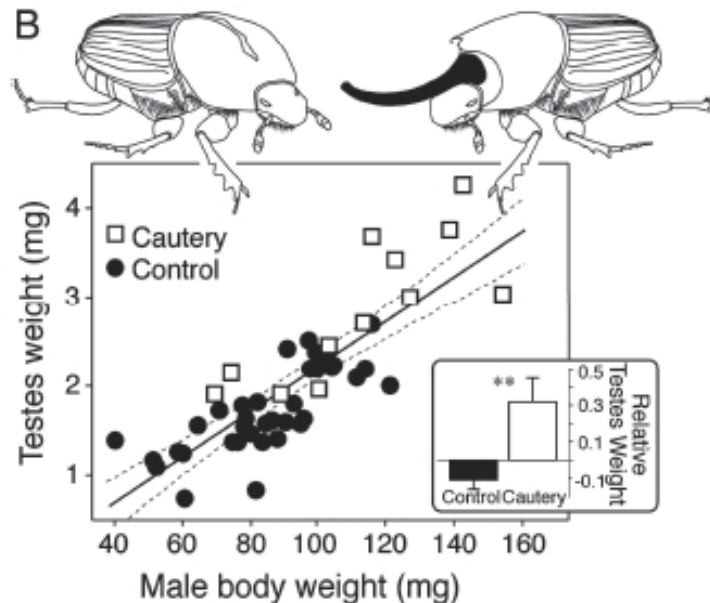
Leigh W. Simmons\*† and Douglas J. Emlen‡

16346–16351 | PNAS | October 31, 2006 | vol. 103 | no. 44

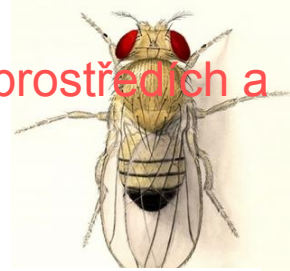
A



B

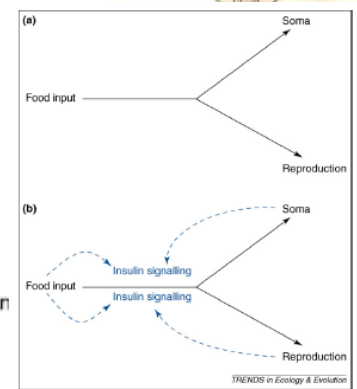
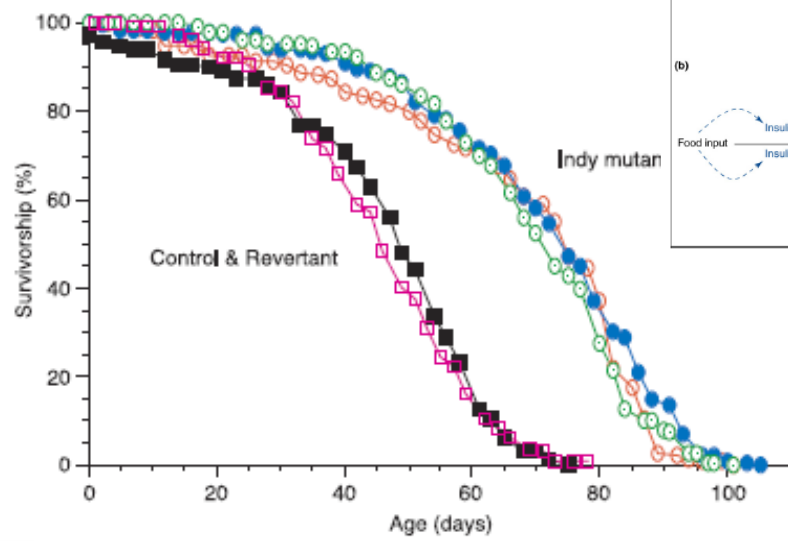
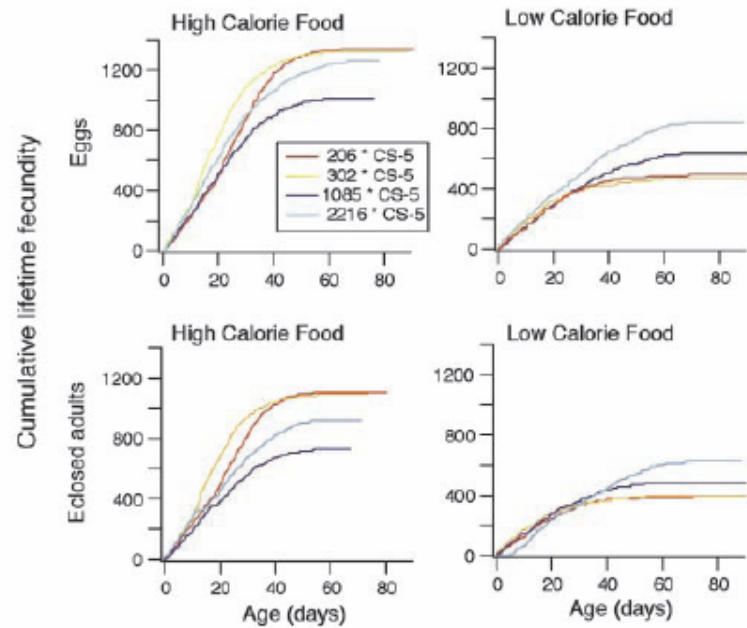


Pro pochopení trade-offs budeme potřebovat znalost fenotypů v několika prostředích a znalost proximálních mechanismů



# Conditional tradeoffs between aging and organismal performance of *Indy* long-lived mutant flies

James H. Marden<sup>\*\*†‡</sup>, Blanka Rogina<sup>+§</sup>, Kristi L. Montooth<sup>\*¶</sup>, and Stephen L. Helfand<sup>‡§</sup>



**Fig. 5.** Mean cumulative lifetime fecundity of female *Indy* long-lived mutants is not reduced. Lines heterozygous for the *Indy* mutation showed great early egg production ( $\leq 25$  days) and greater total lifetime egg production when reared on high-quality food (*Upper Left*) but showed reduced early ( $\leq 25$  days) and total lifetime egg production when reared on low-calorie food (*Upper Right*; ref. 22). (*Lower*) Total production of adult offspring; pattern are essentially the same as for egg production. Error bars have been omitted from all of these plots for the sake of clarity.

## Extended Life-Span Conferred by Cotransporter Gene Mutations in *Drosophila*

Blanka Rogina, Robert A. Reenan, Steven P. Nilsen, Stephen L. Helfand\*

SCIENCE VOL 290 15 DECEMBER 2000

## Evolutionary Endocrinology: The Developing Synthesis between Endocrinology and Evolutionary Genetics

Anthony J. Zera,<sup>1</sup> Lawrence G. Harshman,<sup>1</sup> and Tony D. Williams<sup>2</sup>

Annu. Rev. Ecol. Evol. Syst. 2007. 38:793–817



## Conflicting processes in the evolution of body size and development time

H. Frederik Nijhout<sup>1,\*</sup>, Derek A. Roff<sup>2</sup> and Goggy Davidowitz<sup>3</sup>

Parameters of body size and developmental time:

- the growth rate
- the initial weight
- the ICG

$$\text{Final size} = w_5 * \exp\left(\left(k * \text{ICG} + \ln 5.33 - \frac{0.8}{W_0}\right) * (1 - 0.073 * \text{ICG})\right), \quad (2.1)$$

where  $W_0$  is the initial weight of the instar and  $k$  is the growth exponent, which is calculated from the growth rate (GR) during the third day of the instar as follows:

$$k = 0.15 * \exp(-0.65 * W_0) * \text{GR} + 0.27. \quad (2.2)$$

The duration of the instar (development time) is given by

$$\text{Duration of instar} = \frac{\ln(5.33 - 0.8/W_0)}{k} + \text{ICG}. \quad (2.3)$$

We note that these equations do not include the photoperiodic gating (i.e. as written, they stop after the second checkpoint). We calculate the gating numerically by knowing when the larva starts growing to the nearest hour and calculate whether equation (2.3) predicts a time inside a gate; if it does not then we add the appropriate time interval to the ICG term in equations (2.1) and (2.2).

The model thus requires only three easily measurable inputs, which we call the *underlying factors*. These are (i) the growth rate, (ii) the initial weight and (iii) the ICG. The critical weight (CW) is related to the initial weight of the instar by the linear function  $CW = 5.33 * W_0 - 0.8$  (Nijhout *et al.* 2006). In the figures used in this paper, we show body size and development time as functions of the CW. The model accurately predicts individual final weights and development times for the entire physiologically relevant range of the three underlying factors, which are growth rate = 1–4  $\text{gd}^{-1}$ , ICG = 16–96 h and CW = 3–9 g. The mathematical model is implemented in MatLab (The Math Works, Natick, MA, USA), and the visualizations of the multivariate data as well as the calculations of the gradients were done in AMIRA (Mercury Computer Systems, Chelmsford, MA, USA).

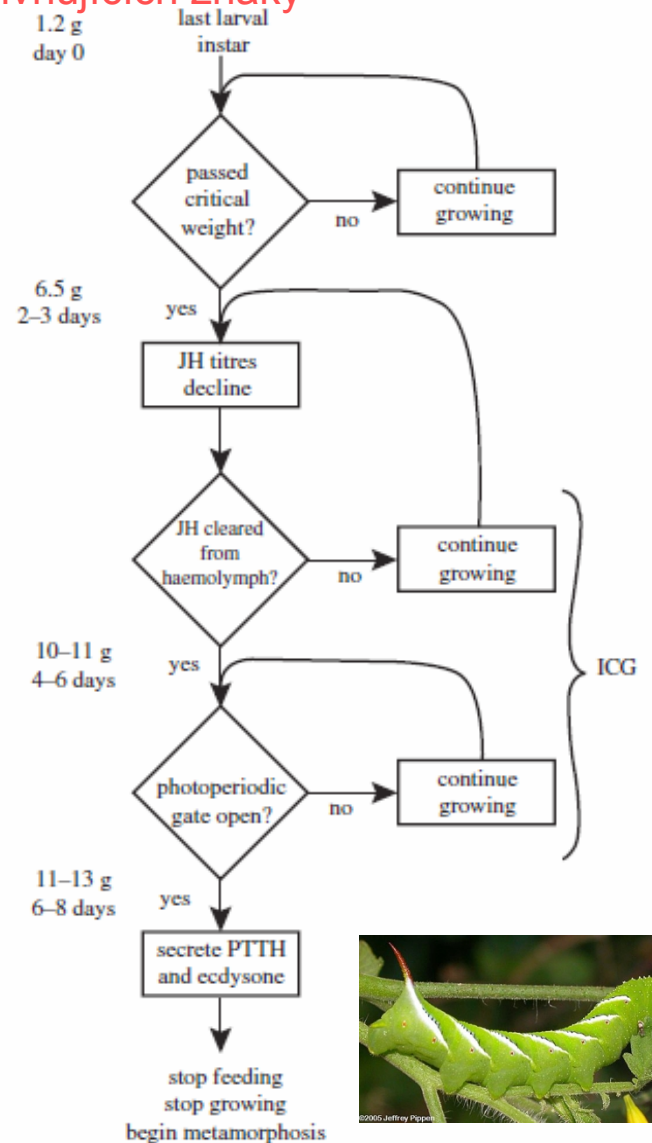
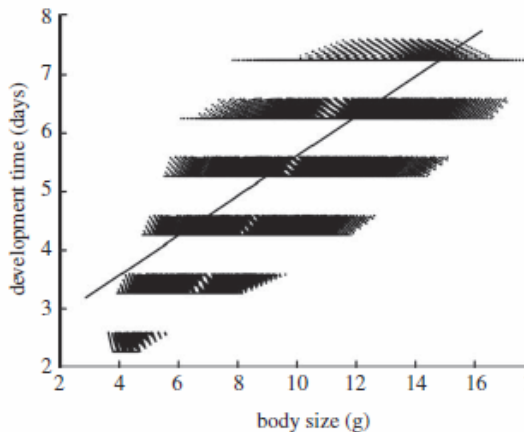
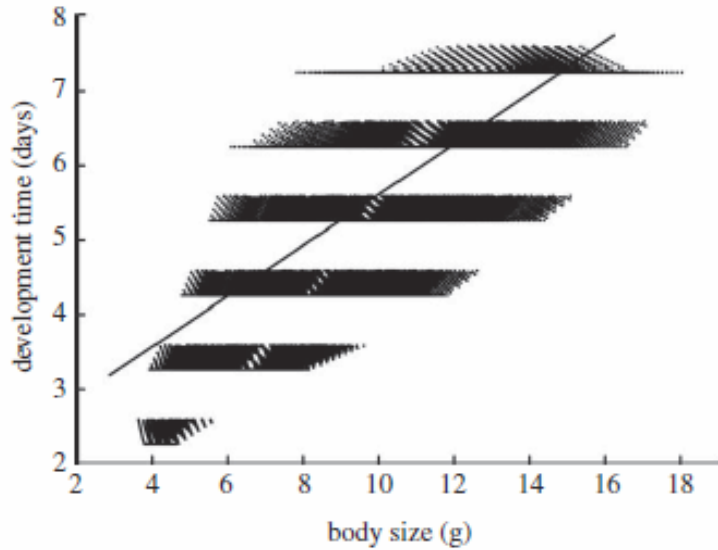


Figure 1. Logic diagram of the mathematical model for body size and development time in the final (fifth) larval instar of *M. sexta*. Diamonds represent checkpoints. Approximate masses and times for the wild type at each stage are indicated. ICG, interval to cessation of growth; JH, juvenile hormone; PTTH, prothoracicotropic hormone.

Celkový vztah mezi dobou vývinu a velikostí predikovaný modelem:



Fenotypové krajiny pro velikost a dobu vývoje se značně liší:

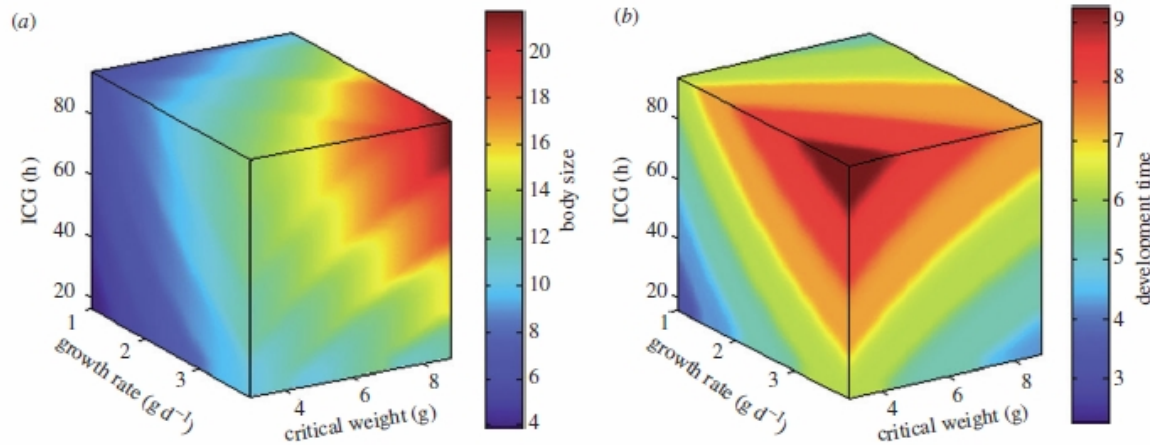


Figure 5. Phenotypic landscapes of body size (a) and development time (b) as functions of the growth rate, critical weight and ICG. Orientation of axes is the same for the two landscapes. Body size (g) and development time (days) are indicated by colour scales.

Existují oblasti, kde vztah není pozitivní:

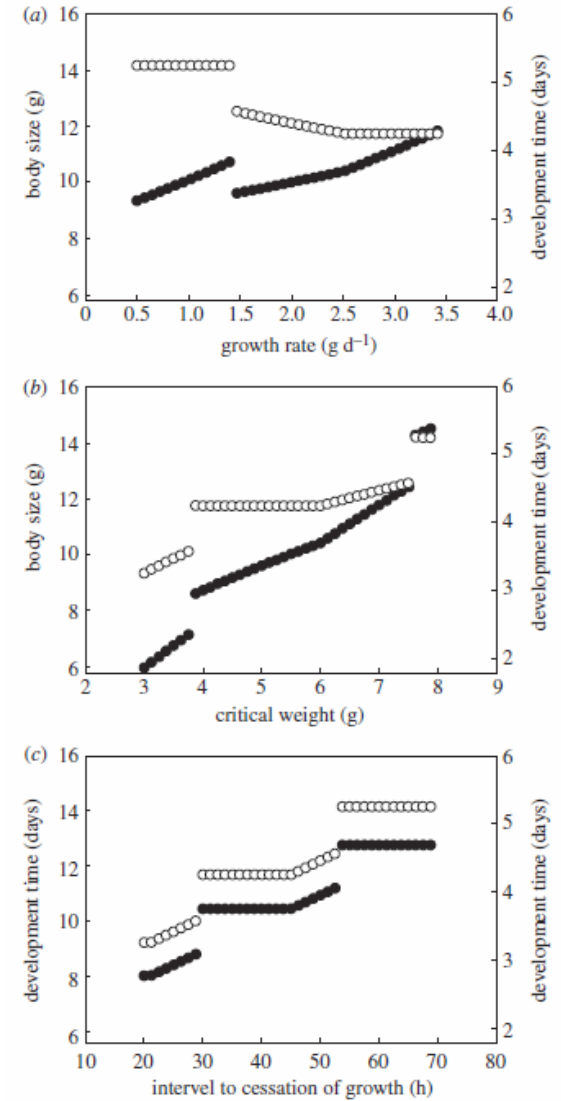


Figure 4. Body size and development time as functions of either the growth rate (a), critical weight (b), or ICG (c), when the other factors are held constant. The constant values were growth rate,  $2.5 \text{ g d}^{-1}$ ; critical weight, 6 g; and ICG, 48 h. Filled circles, body size; open circles, development time.

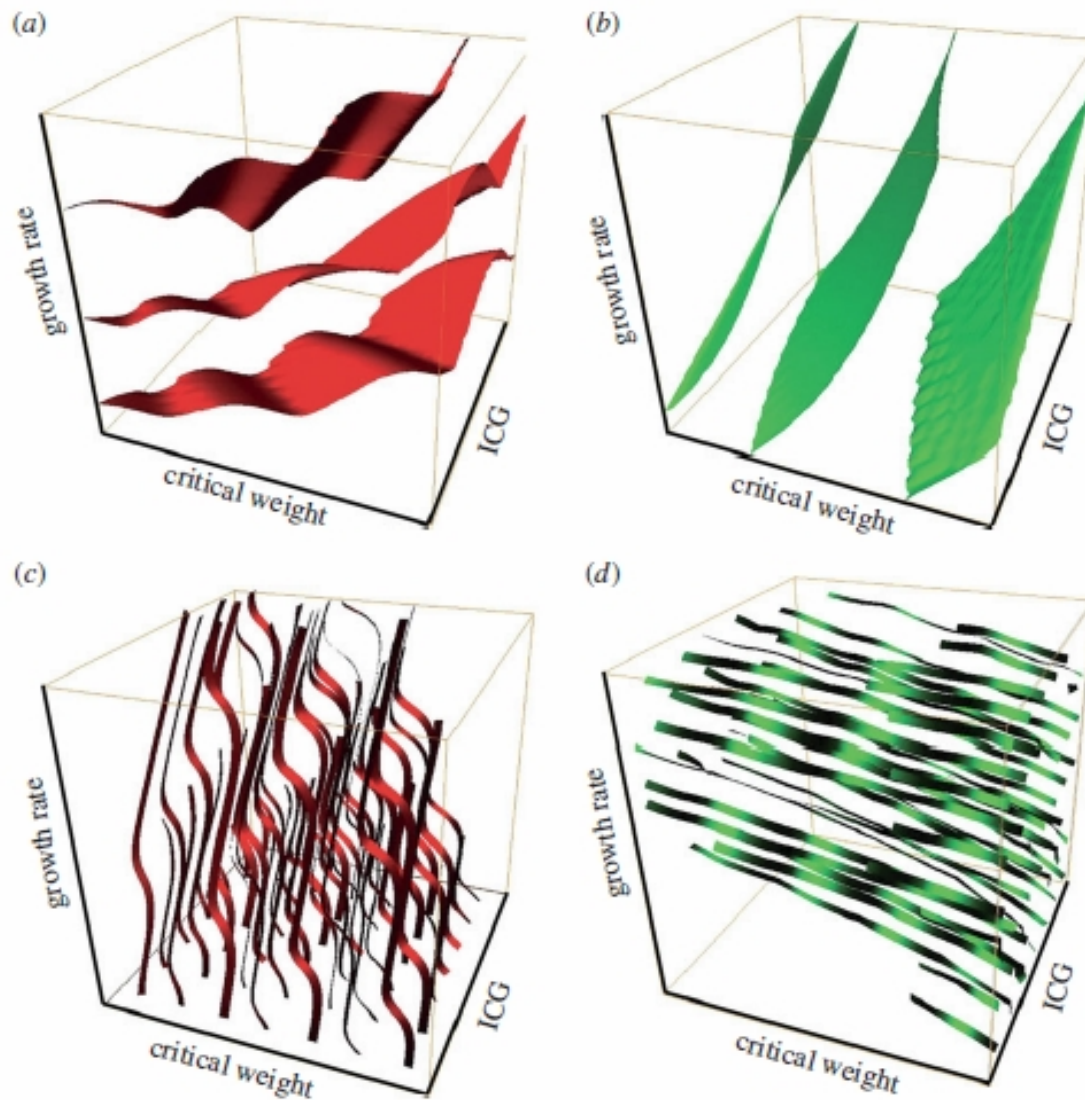


Figure 7. Selected isosurfaces for (a) body size (red) and (b) development time (green). Orientation of the phenotypic landscape is the same in all panels. Isosurfaces are combinations of parameter values that produce the same phenotype. The gradients of the phenotypic landscapes for (c) body size and (d) development time. The gradients are shown as ribbons that follow the steepest internal slopes of the phenotypic landscapes. The gradients are orthogonal to the isosurfaces.



Parametry modelu jsou závislé na podmínkách prostředí, ale i na genotypu

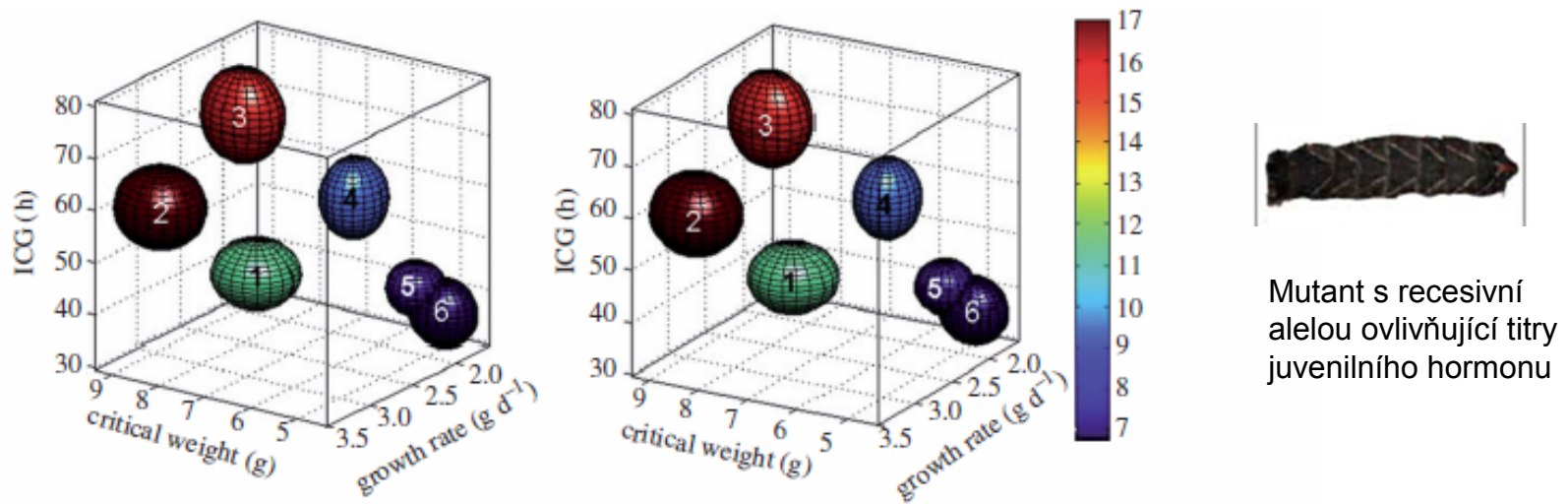


Figure 8. Stereo-pair showing distributions of six strains of *M. sexta* within the phenotypic landscape of body size. Strain 1 is the ancestor of strains 2–5, which were derived by selection for increased or decreased body size and development time. Strain 6 is the black larval mutant. The dimensions of the axes of the spheroids correspond to standard deviations around the mean for each of the underlying factors. Colour of the spheroids indicates body size.

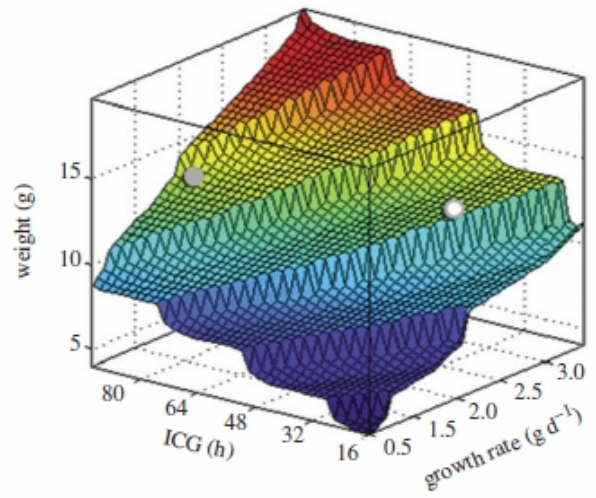


Figure 6. Phenotypic landscape for body size when critical weight is held constant at 7 g. The two circles indicate phenotypes at two different temperatures: 30°C (on the right) and 20°C (left).



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## Shrnutí

- pojmy fenotypová plasticita (fenotypová flexibilita; vývojová plasticita: polyfenie, norma reakce); kanalizace (environmentální, genetická), Hsp90 jako systém redukce chyb vedoucí ke kanalizaci; genetická asimilace
- genetická asimilace je něco jiného než Baldwinův efekt, který předpokládá změnu fenotypu před změnou genetickou (čekání na mutaci)
- fenotypová plasticita někdy může vysvětlit rozdíly mezi populacemi, které bývají přičítány adaptivním genetickým změnám, k rozlišení těchto možností se používají „common garden“ nebo „transplant“ experimenty
- organismus je integrovaný systém, často existují trade-offs mezi jednotlivými jeho znaky, ty mohou být patrné jen v určitém prostředí a jejich síla záleží na proximálních mechanismech
- stejného fenotypu může být dosaženo genetickou změnou i změnou podmínek