

Behavioral Ecology
IB 146
Spring 2004

Discussion **Adaptation**

This handout and the supplementary readings are meant to familiarize you with the concept of adaptation. Adaptation is in some ways a controversial term and it is important to understand how it affects some of the underlying assumptions of behavioral ecology. This handout is meant to guide you through the readings; it is important that you read the material for the discussion.

Supplementary Readings

Attached to this handout:

Pages 354-356 in Evolutionary Biology (Futuyma, 1998).

Papers listed in the Readings section of the course webpage. The abstracts are a required, reading the entire text is optional. The papers are available as PDF's at:
<http://ib.berkeley.edu/courses/ib146/readings.php>

Important Terms

Adaptive: refers to any phenotypic trait that confers a reproductive advantage on the individual that possesses it. Behavioral ecologists generally assume that all behavioral traits are adaptive, and, further, that they are an adaptation.

Adaptation: a trait that is maintained by natural selection because it confers a reproductive advantage on the individuals that possess it. In behavioral ecology this term is used interchangeably with “adaptive”, since behavioral ecologists generally assume that all traits are the result of natural selection. In other disciplines of evolutionary biology, a distinction is drawn between adaptation and exaptation, with the critical difference being the function that the trait fulfilled when it arose.

Exaptation: a trait that arose for one purpose but that currently fulfills a different adaptive purpose. Note that the origin of the trait may not have been due to selection.

Problem of Defining Adaptation

Meanings of Adaptation

Acclimation (not part of evolutionary biology)

Process of becoming adapted

Feature that enhances reproductive success

Historical Definition of Adaptation

Evolution of a trait for a specific function:

“for a character to be regarded as an adaptation, it must be a derived character that evolved in response to a specific selective agent.” (Harvey and Pagel, 1991)

Non-historical Definition of Adaptation

Current effects of the trait on reproductive success:

“An adaptation is a phenotypic variant that results in the highest fitness among a specified set of variants in a given environment.” (Reeve and Sherman, 1993)

Questions and Thought-provoking Statements for Discussion

Is everything we see today adaptive?

Gould and Lewontin (1979) quote the words of Dr. Pangloss (from Voltaire’s Candid) in reference to what they call “adaptationist programme”:

“Things cannot be other than they are [...] Everything is made for the best purpose. Our noses were made to carry spectacles, so we have them. Legs were clearly intended for breeches, and we wear them.”

What possible explanations for behavior might we be missing by assuming that everything is adaptive?

How could you determine that a trait (behavior) is adaptive?

How would you determine if a trait is an adaptation or an exaptation? Could you use the same approach if the test were a behavior?

The tail of the peacock is widely known as a symbol of mate attraction. However, the tail most likely arose for another function, which could hypothetically be flight in an ancestor. In this sense the tail as a decoration is an exaptation, but as a flight aid it is an adaptation. In the same way the tail did not arise originally as a flight aid, it was probably arose for insulation in a still more distant ancestor (say, *Archaeopteryx*). Now the tail is an adaptation for keeping the rear-end warm, but an exaptation for flight. How do these distinctions affect behavioral ecologists?

References

- Futuyma, D. J. (1998) Evolutionary Biology. Third Edition. Sinauer Associates. Sunderland, MA.
- Gould, S.J. and Vrba E.S. (1982) Exaptation - A Missing Term In The Science Of Form. *Paleobiology* . 8 (1): 4-15.
- Gould S.J. and Lewontin R.C. (1979) Spandrels Of San-Marco And The Panglossian Paradigm - A Critique Of The Adaptationist Program. *Proceedings Of The Royal Society Of London Series B* 205 (1161): 581-598
- Harvey, P.H. and Pagel, M.D. (1991) *The Comparative Method in Evolutionary Biology* Oxford University Press. Oxford.
- Reeve, H.K. and P.W. Sherman. 1993. Adaptation and the goals of evolutionary research. *Quarterly Review of Biology* 68: 1-32.