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Trends in
Ecology &
Evolution
The jellyfish joyride
Unicolonial ants
Gene tree discordance
Human sex roles
Cell

Conclusion

Although recent meta-analyses have considered among-population genetic differentiation for molecular and quantitative traits [17], no such study is available on the correlation between measures of molecular versus phenotypic variability within populations, especially following environmental changes. As recently emphasised [18], prior evolutionary history of a species will influence phenotypic evolution during biological invasion. Furthermore, life-history and mating system probably also influence the relationship between the two types of diversity [13]. Genetic monitoring of both molecular and quantitative genetics diversity will provide invaluable information about evolutionary processes during range expansion, but also about the genetic architecture of quantitative traits, as suggested by the recent study of *H. canariense* [12].

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Letters

Evolution education in natural history museums

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During 2009, scientists around the world will celebrate the 200th anniversary of the birth of Charles Darwin, the father of the theory of evolution, and the 150th anniversary of the publication of his main thesis, *On the Origin of Species by Means of Natural Selection*. Today, the theory of evolution is considered to be one of the greatest milestones in the history of science. Despite its undisputed merit in science, there seems to be constant turmoil around the theory in the public, which might be related to the incomplete understanding of the basic principles of evolution [1,2].

Recently, MacFadden [3] rightly pointed out that natural history museums, which have ca. 100 million visitors annually worldwide, have enormous potential to educate the public about the principles of evolution. In his essay, MacFadden advocates the allocation of resources into novel contents, such as genomics or molecular biology,

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in order to increase the public understanding of evolution. We argue that museums should concentrate more on demonstrating the basic principles and outcomes of natural selection, rather than presenting fashionable novel contents such as genomics (which, it seems, even scientists often have a hard time understanding [4]).

It is our intuition that visitors to museums will be taken a long way toward a better understanding of evolution by means of natural selection if museums can get across three often misunderstood principles: variation, selection and constant change. The reason these simple concepts are difficult to grasp is that our everyday observations of nature do not support them, and indeed often deceive us: we perceive all members of a given species to be nearly uniform, or to vary much less than we humans do; we never observe any selection in action; and we seldom observe any natural change in our familiar environment.

Museums are glimpses of the past and present, but frequently exhibits are fairly static, which is a problem if we want to get across a process as dynamic as evolution by means of natural selection. Habitat dioramas are the most popular mode of presentation in natural history museums, even though they have been around for 120 years [5,6]. Indeed, dioramas were (and still are) often crafted into such perfection, with the impeccable cooperation of taxidermists, background painters and foreground artists, that they have become 3D national icons just like the 2D paintings or 3D sculptures of national galleries. This situation constrains museums from removing or changing the dioramas.

If we want to educate the visitors of natural history museums about evolution by means of natural selection, we should aim at delivering the message that across species there is enormous within-species variation, that some of this variation is likely to cause differences among individuals in their lifetime reproductive success and that these differences will result in a constant change – evolution. In museums, we have a great opportunity to do this; as well as the exhibits open to the public, museums usually have extensive collections containing numerous individuals of each species. A simple illustration of the replacement of one generation by the next generation might work in making the operation of natural selection more tangible. With such an illustration, we can easily see why and how a population can undergo constant change, and thus grasp the basic principles of evolution by means of natural selection.

Natural history museums are our collective memory of the past. Their collections can, and have been, used to study evolution (e.g. [7]). Perhaps even more importantly, however, they could also be used to illustrate to the general public the evolutionary changes that have taken place. We challenge the exhibit designers of natural history museums to emphasize variation within species, and to demonstrate change due to natural selection, rather than stasis in nature.

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Book Review

Coping with the heat

Thermal Adaptation – A Theoretical and Empirical Synthesis by Michael J. Angilletta Jr. Oxford University Press, 2009. £65.00/£34.95 hbk/pbk (320 pages) ISBN 978 0 19 857087 5/978 0 19 857088 2

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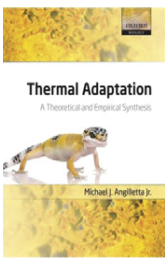

Many books deal with the adaptation of organisms to their environment, and there are others that focus on thermal biology, but *Thermal Adaptation* brings these two subjects together by tackling adaptive strategies for coping with temperature variation. Pulling this subject together into a coherent account is far from easy, especially as the literature is widely scattered, often with theoretical and empirical studies being unconnected, and with diverse strategies being used by organisms for coping with thermal variation.

Mike Angilletta imposes order amid this potential messiness first by focusing on a particular type of question. He argues that, despite a 'vast and venerable literature' documenting the responses of organisms to temperature, we do not understand why certain species exhibit certain phenotypes. To this end, he draws on models from evolutionary biology to gain insights into thermal adaptation, focusing on mathematical models to ensure that assumptions are made explicit and predictions more precise. Angilletta then tests the predictions against the empirical evidence, which comprises quantification of natural selec-

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