Evolution: **To seek out new worlds**

Paul H. Harvey

A recent study of stickleback 'ecomorphs' generated by independent speciation events in different freshwater lakes suggests that, despite historical contingency, natural selection can run in surprisingly similar ways on multiple occasions.

Address: Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK.

Current Biology 2000, 10:R271

0960-9822/00/$ – see front matter

The elegant simplicity of life's diversity being explained by evolution through natural selection has repeatedly been challenged over the years. One complicating factor is historical contingency: selection can only work on the variants that occur at a particular time, and the influence of genetic drift will mean that the outcome is not entirely predictable. How important is contingency? We could find out if, in Stephen Gould's delightful metaphor, we were able to play the tape of life on several occasions. This has been achieved in popular science fiction: aficionados of television's Star Trek and associated spin-offs will know that hominoids appear to have evolved on different planets, and can in some combinations mate to produce viable hybrids. I doubt that any evolutionary biologist would take that extreme a view of the unimportance of historical contingency, but on a shorter time scale we can find beautiful examples of convergent evolution.

One good example is provided by the Anolis lizards in the Caribbean, which have invaded many small islands and a few large islands. On the very smallest islands, there tends to be one intermediate-sized species, but as island size increases large and small forms can coexist. Each of the largest islands supports an independently evolved Anolis radiation, with the different species occupying a variety of well-defined ecological niches. To the casual human observer there has been remarkable convergence — for example, the species living on twigs from different islands are well-nigh indistinguishable [1]. Natural selection has led to the evolution of the same so-called ecomorphs evolving on different islands. The twig ecomorphs have a morphology that is adapted to the niche in which they live. Other ecomorphs live in the crowns of trees, on the trunks, on the ground, and so on. While it may be easy to fool a casual human observer, would the same independently evolved ecomorphs be able to fool each other? That is too anthropomorphic a question from which to obtain an answer, but Dolph Schluter's research team at the University of British Columbia have done the next best thing [2].

Rundle and colleagues [2] have been studying stickleback ecomorphs. At the end of the Pleistocene, after the glaciers had retreated from British Columbia, the marine threespine stickleback (*Gasterosteus aculeatus*) invaded a number of freshwater lakes. In those lakes, parallel speciation occurred: a large benthic ecomorph evolved which feeds on invertebrates from the bottom of the lake, together with a smaller limnetic ecomorph which darts around in the open water living off plankton. There is strong assortative mating, such that the benthic and limnetic ecomorphs will only mate with their own type in the wild — they have become true species.

But would opposite sex individuals of the same independently evolved *G. aculeatus* ecomorph from different lakes accept each other as mates? The answer seems to be yes, at least in the laboratory. In a carefully constructed and analysed reciprocal series of experiments, Rundle and colleagues [2] took limnetic and benthic species from three separate lakes. Over 750 mating trials were set up in which individual females were presented with single males of the same or the alternative ecomorph, from the same or a different lake. Females were far more likely to spawn with a male of the same ecomorph as themselves, in which case it mattered not a jot whether the male was from the same or a different lake.

Mate choice is a reasonably well researched area, although the particular cue or cues that the female sticklebacks use to distinguish among male ecomorphs is not yet known (though Rundle and colleagues [2] guess that size may be an important factor). Other related questions will inevitably follow from this model system. Although the phenotypes of the same ecomorphs have converged in the different lakes, to what extent are the same genes involved, what do the hybrid offspring look like, and how fit are they? Being able to investigate experimentally outcomes of the tape of life being replayed provides new answers to old questions, and poses new questions that we never thought were worth asking because there was no conceivable way of answering them. For example, what would a human–vulcan hybrid really look like, and how would it behave?

References

1. Harvey PH, Partridge L: **Different routes to similar ends**. *Nature* 1998, **392:**552-553.
2. Rundle HD, Nagel L, Boughman JW, Schluter D: **Natural selection and parallel speciation in sympatric sticklebacks**. *Science* 2000, **287:**306-308.