"Darwin's Finches"

The story of "Darwin's" finches

"Darwin's finches," along with Hawaiian honeycreepers and African cichlids, are frequently used as examples of adaptive radiation. In an adaptive radiation, a "founder" species enters a new environment with many unoccupied niches. This species expands (radiates) and evolves adaptations to fit these niches better. The process of becoming adapted to these different niches may lead to, and in these cases has led to, the formation of new species. All the species of finches on the Galápagos Islands appear morphologically very similar, varying mostly in terms of beak size and behavior; they all look very much like a species of finch from the mainland of South America. This suggests that all the finches on the Galápagos are descended from one original colonist species that went through an adaptive radiation. Because of the small, isolated environment of the Galápagos, the finches have become the topic of extensive study into natural selection. The studies that have been conducted on the finches show strong selection for larger beaks during droughts. These data show that climatic changes can have profound effects on the morphology of a species and potentially lead to the formation of new species. When Darwin visited the Galápagos, he observed and collected some of the finch species, believing that they represented a very diverse set of birds that were not closely related. Their significance was not recognized until later, when ornithologist John Gould pointed out that the birds were all closely related finches (Desmond and Moore, 1991). But because Darwin originally collected some of the specimens and because the finches showed so much evidence for evolution and natural selection, they have been dubbed "Darwin's finches." This has led many people to conclude (mistakenly) that Darwin's theory of evolution was specifically inspired by the finches.

A legend in his own mind

Wells apparently feels the need to attack the finches largely because they are an "icon" in need of destruction; the chapter on the finches is perhaps the most poorly conceived section in the book. Wells initially focuses on the "biological urban legend" that the finches inspired Darwin to compose his theory of evolution. Of course this has nothing to do with whether or not the finches are a good example of an adaptive radiation. Therefore, his "requirement" that textbooks specifically mention that the finches "played no role" in Darwin's formulation of natural selection is irrelevant, only serving Wells's efforts to portray evolutionary biologists as people who just "make things up." This is like saying that because Betsy Ross did not really sew the U.S. flag, the flag does not actually exist. Wells even goes so far as to brand the finches a "legend" — what is he trying to imply? Finally, Wells's assertion that Darwin was not inspired by the finches is not exactly correct. Although Darwin did not realize the significance of the finches until after Gould pointed it out to him in 1837, he then noted that the different species of finches were island-specific like the other Galápagos animals and suggested that they too were descendants of a mainland ancestor. Darwin made extensive notes about the finches in his diaries (Desmond and Moore, 1991). The finches, then, did play a role in the formulation of Darwin's theory and they became an important part of his evidence for the role of natural selection in evolution; they were not a "speculative afterthought" as Wells claims.

After branding the finches a "legend," Wells switches gears and discusses the finches themselves, acknowledging the strength of the evidence for an adaptive radiation, given the similarities of the different species. Wells almost seems to accept that the finches are descended from a common ancestor; at least, he does not argue explicitly against it. But he demands that there be *direct* evidence for speciation by natural selection; in his attempt to explain how this demand could be met, the remainder of the chapter degenerates into a series of non sequiturs. This is particularly apparent in Wells's discussion of what would constitute "direct" evidence.

Suggesting that the work of Grant and Grant claimed to be that *direct* evidence, he discusses their experimental work on finch beak variation. The most detailed selection work on the finches was done by the husband and wife team of Peter and Rosemary Grant. For over two decades, the Grants and their students have monitored the sizes of the beaks of some of the finches on one small island (Grant, 1999). They have documented that the size of the finch beaks is correlated to the relative rainfall on the island, and thus to the abundance and hardness of the food. During dry years larger beak size is selected for, while during wet years the beak size is more varied. Wells acknowledges that the beaks vary and that this shows natural selection. He seems to accept that the changes in beak shape are caused by natural selection in reaction to drought-caused changes in the food supply. These data are some of the most compelling for natural selection in the wild — something that even Wells has a hard time denying. However, he then contends that because the beak shape returns to a pre-drought size distribution, that no "net" evolution has occurred. But this is a mysterious contention. Natural selection occurred. If the droughts had continued, larger beak sizes would continue to be selected for, but the droughts did not. Evolutionary theory would predict that if climate oscillates, morphology would oscillate as well. The finches fit the predicted pattern. Speciation would require selection to be more constant than a couple of years here or there. It is not unreasonable to extrapolate that if just a couple of years of drought can have that significant an effect on beak size, then extended droughts could cause such variations to become fixed in a population, and lead to speciation. This is no different than extrapolations of unknown orbits. When a new comet is discovered, its orbit is calculated based on a few short-term observations. We assume that the forces acting on the comet are constant and thus we can predict its position in 10, 20, 100, etc. years. If gravity varied, then these extrapolations would be in doubt. In the case of the finches, climate varied and the extrapolations changed. Does Wells not allow scientists to make reasonable extrapolations based on data and observations? If so, physicists must be up next for Wells's scorn. Perhaps what is most interesting about Wells's discussion of this "icon," however, is that in chapter 7 on the peppered moths, he denies natural selection entirely, when he could have made the same argument — that "no net evolution occurred" because the distribution of dark and light forms of the moths returned to pre-industrial levels just as the finch beaks return to pre-drought levels. For finches he accepts natural selection, but for the peppered moths he does not.

Wells goes on to complain about the extrapolations of speciation rates based on the Grants' data, complaining that the finches aren't an example of natural selection-driven speciation because no new species of finches arose during the duration of the Grants' study. However, no one would expect speciation to occur on that scale, and the Grants never claimed to expect it either. And how would you recognize a new species had formed? More importantly, one wonders how Wells would recognize new species based on his garbled discussion of species concepts (Wells, 2000:172-173), where he claims that one should "expect" "true" species to be separated by more than "just" beak shape and song pattern. This is important because in order to document speciation, you need a model by which to recognize species. Wells provides none, and cannot even manage to explain the currently accepted models properly.

Wells makes much of how the species of finches are freely hybridizing and may in fact be merging. He claims that in order to be "true" species, they should be separated by "more than beak shape and song pattern" (Wells, 2000:172). However, such a separation is a perfectly acceptable definition of species based on Recognition Concept (Paterson, 1985), according to which species are separated by behaviors that lead animals to *recognize* potential mates. This species definition is widely accepted amongst animal workers, which Wells should know, having a Ph.D. in biology. If Wells does not, one would expect him to learn it as minimum required research before critiquing others' diagnosis of species. Whether the species are merging or diverging is unimportant because both divergence and merging *are* forms of long-term evolutionary change. If indeed selection favors hybrids, as Wells appears to think, then the separate species will merge. That's still evolution *and* speciation by *natural selection* because the new hybridized form will be a new species favored by natural selection.

Textbook coverage of the finches

Textbooks use the finches to illustrate a wide variety of concepts, from the history of evolutionary theory to adaptive radiation, natural selection, taxonomy, phylogeny, and niche partitioning. Textbooks that discuss the finches in an historical context generally devote a paragraph or two to the finches, sometimes in the discussion of how Darwin constructed his theory. Finches also frequently appear in sections dealing with patterns of evolution as an example of natural selection and/or adaptive radiation. Only the upper-level books discuss the Grants' work specifically. Space allotted to the finches vary from a few words to a few pages (Figure 16). In terms of the historical discussion, most books discuss the finches in connection with Darwin's visit to the Galápagos Islands. Few books explicitly credit the finches as Darwin's inspiration, however. Most do discuss the fact that they were part of his overall evidence that he collected on his voyage. Many books treat the finches as an example of an adaptive radiation. Some books discuss the finches as examples of natural selection and niche splitting instead; these discussions occur in the chapters on evolutionary processes or patterns. In Raven and Johnson, the finches are treated in detail; the discussion includes an accurate summary of the historical story and the work of the Grants. This book mentions the finches as an example of adaptive radiation along with the African cichlids.

Bird-brained grading

Due to the diversity of treatment of the finches in textbooks, it is hard to evaluate the textbook coverage under Wells's grading scheme. The grading scheme employed for the finch icon is perhaps the strangest of all Wells's schemes. Like others,

Book	Darwin's Finches					
	#pages	#words	Darwin's inspiration	as adaptive radiation	Grant's work mentioned	Well's Grade
Schraer, W. D. and H. J. Stolze. 1999. Biology: The Study of Life, seventh edition. Prentice-Hall, Upper Saddle River, NJ. 944p.	1/2	115	Yes	No	No	F
Johnson, G. B. 1998. Biology: Visualizing Life. Holt, Rinehart &Winston, Orlando. 895p.	3/4	237	Yes/no	No	No	D[1]
Biggs, A., C. Kapinka, and L. Lundgren. 1998. Dynamics of life. Glencoe/McGraw Hill, Westerville, OH. 1119p.	1/8	25	No	Yes	No	F
Miller, K. R. and J. Levine. 2000. Biology, fifth edition. Prentice-Hall Upper Saddle River, NJ. 1114p.	2 1/2	580	No	Yes	No	F
Starr, C. and R. Taggart. 1998. Biology: The Unity and Diversity of Life, eighth edition. Wadsworth Publishing Company, Belmont CA. 920p.	1/2 +1/4	184 +107	No	No	No	F[2]
Guttman, B. S. 1999. Biology. WCB/McGraw-Hill, Boston. 1175p.	1/4	147	Yes	No[3]	Yes	X[4]
Mader, S. 1998. Biology, sixth edition. WCB/McGraw-Hill, Boston. 944p.	3/4 +1/4	213 +116	No	No[5]	No	F
Raven, P. H. and G. B. Johnson. 1999. Biology, fifth edition. WCB/McGraw-Hill Boston. 1284p.	2	>500	No	Yes	Yes	D[6]
Cambpell, N. A., J. B. Reese, and M. G. Mitchell. 1999. Biology,fifth edition. Benjamin Cummings, Menlo Park, CA. 1175p.	1/4 +1/2+1	42 +340 +239	No	Yes	Yes	D[7]
Futuyma, D. 1998. Evolutionary Biology. Sinauer Associates, Sunderland, MA. 761p.	1+[8]	436 +1012	No	Yes	Yes	D[9]

1. Johnson makes no mention of beak shape variation and may hint that the finches were inspirational to Darwin. An "F" would be a more appropriate grade.
2. Starr and Taggart accurately represent the finches role in Darwin's research, a "D" may be a more appropriate grade.
3. Guttman discusses the finches as an example of natural selection in action, along with other examples, in that section it mentions the finches as "influential to Darwin's thinking".Guttman uses Hawaiian honeycreepers as an example of adaptive radiation.
4. Finches are not called an example of adaptive radiation but are considered influential to Darwin. The "X" grade makes litte sense overall, should be an "F."
5. Mader discusses the finches in the context of niche partitioning along with other examples. Mader Uses Hawaiian honeycreepers as an example of adaptive radiation.
6. Raven and Johnson accurately discusses the Darwin-Gould finch connection, and mentions that the beak shape oscillates. A "C" would be a more appropriate grade.
7.Campbell et al. receive a "D" from Wells, however, the text clearly states that beak shape oscillates, and in no way implies that Darwin used the finches as his inspiration. A "C" would be a more appropriate grade.
8. Futuyma discusses the finches in 9 separate sections of the text. One page(436 words) is devoted to the Grants work specifically.
9. Futuyma discusses the the finches are dealt with in great detail and mentions that beak size oscillates. In no way does Futuyma imply that the finches played a role in Darwin's inspiration. Therefore, a "C" may be a more appropriate grade.

Figure 16. *Wells's grades of textbook treatments of Darwin's finches. Plus numbers refer to additional treatments of finches.*

this grading scheme appears constructed specifically for failure. First, Wells objects to textbooks using the finches as an example of adaptive radiation, and he incorrectly equates an "adaptive radiation" with the "origin of species by natural selection" in his grading criteria. Adaptive radiation is a description of a pattern and makes no statement as to the process — which the "origin of speciation by natural selection" does. This is important because one can document an adaptive radiation without knowing the process by which it occurred. He also wants textbooks explicitly to state that the beak shape oscillates. Further, in order for a book to get an A, a B, or even a C, the book must explicitly point out that the finches had nothing to do with Darwin's formulation of the theory of evolution. While books should not suggest that the finches were more important in the formulation than they were, it is interesting that in order to get a good grade, Wells insists that the books *assert the negative*. In his grading scheme, this means that any treatment of the finches that does *not* explicitly say that the finches did *not* inspire Darwin automatically gets a D, even if it mentions the beak size oscillation or evidence of merging. Thus the only criterion for the books' grade is the statement of an unnecessary piece of information — that Darwin was not inspired by finches. This has no pedagogical value and isn't even wholly true; even if it were wholly true, it has no bearing on the theory of evolution one way or the other. This brings up the question of Wells's real intent. His true goals are made apparent by the grades themselves. Wells grades many of the books needlessly low. When reevaluated on Wells's own criteria, many of the books given a D or F should hav been given a C (Figure 16). Is Wells simply looking for any excuse to damage textbooks' reputations?

Why we can still use the Galápagos finches as a teaching example

The finches clearly show adaptive radiation and were important to Darwin's research. Their inclusion in texbooks is perfectly legitimate and should not change. The best way textbooks could improve their presentations of adaptive radiation is to include other examples such as Hawaiian honeycreepers or African cichlids as well. There are numerous examples of adaptive radiation; the more of those that we teach to students, the better they will understand evolution. Comically, Wells never really objects to the finches as an example of natural selection, even concluding that "In this limited sense, the finches provide evidence for Darwin's theory" (Wells, 2000:173). If that is the case, what's the big deal?

References

Desmond, A., and J. Moore. 1991. *Darwin: the life of a tormented evolutionist*. Warner Books, New York, 808p.

Grant, P. R. 1999. *The ecology and evolution of Darwin's finches.* Princeton University Press, Princeton, 492p.

Paterson, H. E. H. 1985. The recognition concept of species. *Transvaal Museum Monograph* 4:21–29.

Wells, J. 2000. *Icons of evolution: science or myth?: why much of what we teach about evolution is wrong.* Regnery, Washington DC, 338p.