Specimen Shrinkage versus Evolution: I'iwi Morphology

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Smith et al. (1995) report a historic shortening of the upper mandible of an Hawaiian honeycreeper, the I'iwi (*Vestiaria coccinea*). They view this change as an evolutionary response to a dietary shift necessitated by the widespread declines and extinctions of lobeloids (*Lobelioideae*), the I'iwi's historically preferred food source. Although the authors have been relatively careful in their collection and analysis of data, their results may represent an artifact of specimen shrinkage, rather than evolutionary change. Although the direction of bill length change is negative between old (museum) and recent (live) birds, and the authors have given specimen shrinkage some consideration, it is distinctly odd that we see no evidence of shrinkage, even where we most expect it to occur (in the wing chord, for example).

We know that shrinkage occurs and that it causes significant change in specimen morphology (see references in Winker 1993). Therefore, we should expect evidence of shrinkage to appear in any study with decent sample sizes, and we should be highly suspicious when such evidence does not appear. It concerns me that the only significant change appearing in the study by Smith et al. (1995) (in which there should be evidence of shrinkage) is attributed to a rapid evolutionary change. Smith et al. (1995) purport to have a control in the closely related Apapane (*Himatione sanguinea*), but in fact this species has a very different bill morphology, and it has been shown previously that different species shrink in different ways (Winker 1993). (It is also unclear whether the Apapane were all museum specimens.) The shrinkage data available to date should cause us to expect differences in both the magnitude and direction of shrinkage changes between species of different morphology.

Additional aspects of shrinkage were not adequately addressed in the study by Smith et al. (1995). First, the primary measure used on the bill was exposed culmen (Baldwin et al. 1931; Parkes 1988:599). Drying may cause the head skin (and the feathers in it) to retract posteriorly, exposing more of the culmen and artificially "lengthening" this character in museum specimens. Also, the nature and degree of curvature changes were not adequately determined. The authors are to be commended for their use of a new analytical technique to examine changes in bill curvature, but the specimen base they used was inappropriate. To determine whether shrinkage was affecting this parameter, it would have been necessary to compare live birds with museum specimens (or the same birds fresh and later prepared and dried), not recent museum specimens with older museum specimens. Most shrinkage changes occur relatively rapidly upon drying; Fjeldså (1980) could find no changes occurring beyond 39 weeks following specimen preparation.

For the few taxa examined thus far, specimen drying has resulted in bill length changes varying from an increase in length of 1% to a decrease of 4% (Winker 1993). The 1.8% difference reported for the upper mandible by Smith et al. (1995:Table 1) would be a credible shrinkage change—even though a larger increase than any reported thus far—because the form of long bills can change appreciably during specimen drying. Finally, by neglecting to obtain comparable sample sizes for all measured components in the recent sample of birds, the authors did not give equivalent effort to the discovery of morphological change in characters other than upper mandible length, further contributing to doubts about where shrinkage might be affecting the results.

The results that Smith et al. (1995) report may well be true, but they would be more credible if the expected shrinkage changes had been documented. Not finding evidence of shrinkage where we know it should occur casts doubt upon all subsequent conclusions.

The best way to compare the morphology of historic and present populations is to compare them as museum specimens. Unless specimen shrinkage has been carefully documented in the species being examined, live birds should not be used in such studies unless collec-

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tion is impossible. At population densities of up to 3,200 birds per km^2, Smith et al. (1995) would have been fully justified in collecting all of their recent sample to properly address their hypothesis (see Remsen 1995). Any study comparing the morphology of museum specimens and live birds must recognize that, a priori, differences will occur due to shrinkage and, thus, that the most parsimonious explanation for observed differences is shrinkage, not evolution.

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