

On the analysis of risk-sensitive foraging: a comment on Coddington *et al.*

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Comment

On the analysis of risk-sensitive foraging: a comment on Codding *et al.*

Codding *et al.* [1] report that the resources pursued by Aché men involve higher energy but lower variance than the resources pursued by women. This seemingly anomalous result probably stems from a misconception about the appropriate scale for their analysis and a misunderstanding of the multi-faceted Aché datasets.

The authors are interested in the extent to which male and female foraging strategies expose offspring to shortfalls of provisioning. Like Hawkes [2], they use data from Kaplan & Hill's [3] table 7 as an indicator of the riskiness of foraged resources among the Aché. Yet these data are a measure of harvesting asynchrony, or the extent to which families have acquired comparable amounts of a particular resource on the same day. Because these resources are largely substitutable, it matters little if one family has armadillo meat while another has venison as long as each has the needed amount of food. Kaplan & Hill [3] conceded that the *overall* variance is probably a more useful measure than the variance of a particular resource. In a separate publication based on the same data, Kaplan *et al.* [4] reported that families harvest approximately 12 000 ($\pm 13\,243$) calories per day. The resulting coefficient of variation (1.1) provides a better basis for comparison than the coefficients of individual resources, and since men produce 87 per cent of the calories, we may infer that the variance of men's foraging more closely conforms to the Martu and Meriam pattern than the analysis of Codding *et al.* [1] would suggest.

In the same paper, Kaplan *et al.* [4] provided comparable data on just the average amount of hunted game in the harvest: 6583 ($\pm 10\,932$) calories per day. The resulting coefficient of variation (1.6) is greater than the coefficient of variation of all of the individual prey types in the dataset used by Codding *et al.* [1], which is surprising because one would assume (almost by definition) that the aggregate variance would be less than the variance associated with particular prey species. The source of this discrepancy is presumably the mismatch between the mean and the standard deviation used by Codding *et al.* [1]. That is, the reported means and the standard deviations are derived from separate datasets (hence their placement in separate tables by Kaplan & Hill [3]), so expectations of a meaningful analysis based on these data are unrealistic. Furthermore, the reported data offer dubious applicability to research on risk because (i) the calculated mean energy does not include the zeros from unsuccessful pursuits and therefore overestimates the energetic benefit per pursuit, and (ii) the

calculated 'mean daily standard deviation across families' excludes the zeros from trips on which a particular resource was not acquired and therefore misestimates the variance of resources such as peccaries.

Certainly, pursuits of different resources vary in their effect on the mean and variance of overall daily returns. Because the Aché encounter and pursue multiple kinds of resources while foraging, however, attention should be devoted to the suite of resources that minimizes the risk of shortfalls. A formal model has yet to be developed (David Stephens 2011, personal communication), but the risk-minimizing diet breadth can be simulated if researchers have estimates of the mean and variability of both the energetic benefits and the handling times of the resources [5]. The importance of handling time is evident if we imagine two resources with comparable means and variability of energetic benefits. If all pursuits of the first resource require at least several hours whereas pursuits of the second invariably require 1 min or less, then unsuccessful pursuits of the former would increase the risk of a daily shortfall considerably more than failed pursuits of the latter. In short, the riskiness of a decision depends largely on the length of time that a forager must endure the consequences of the decision [5].

Finally, Kaplan *et al.* [4] have candidly acknowledged the demographic peculiarities of the Aché foraging data (specifically that parents frequently left children at the agricultural colony). Given the abundance of unmarried men and an average of less than one child per married couple on these trips, should we really expect foraging strategies that prioritize the provisioning of offspring? More generally, as informative as the initial Aché data have been, perhaps it is time to concede that the published data cannot be applied to all questions that interest human behavioural ecologists.

Bruce Winterhalder and Hillard Kaplan offered thoughtful feedback and clarifications.

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The accompanying reply can be viewed at <http://dx.doi.org/10.1098/rsob.2011.1458>.

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