BOOK REVIEW 2007 - #4

Kennett, Douglas J. and Bruce Winterhalder (Editors). Behavioral Ecology and the Transition to Agriculture. 2006. xiv + 394 pages; figures; tables; black and white photographs; references; index. University of California Press, Berkeley, California. ISBN 0-520-24647-0. Hard Cover. Price: $60.00. Available from: University of California Press, 2120 Berkeley Way, Berkeley, CA 94704

Human behavioral ecology (HBE) is comprised of a set of inter-related models that aim at fine-grain analyses of human economic decision-making. In Behavioral Ecology and the Transition to Agriculture, the contributing authors set forth the basic premises of HBE, describe the principal models and illustrate their applications with case studies drawn from ethnographic and archaeological investigations. The volume begins and ends with theoretical discussions that position HBE in evolutionary theory. In addition, the authors address the data requirements and the appropriate scales of analyses for the successful applications of HBE models.

Behavioral ecology developed out of studies of animal population dynamics, habitat selection, and niche construction. In anthropology and archaeology, HBE has touchstones in the energy-capture models of Leslie White (White, 1949) and the cultural ecology of Julian Steward (Steward, 1955). In contrast to generalizing broad scale theories like those of White and Steward, HBE aims at elucidating subsistence options and choices at the levels of individuals and small groups over intra-generational time-scales. A central tenet is that subsistence choices have implications for the evolutionary fitness of individuals and their close kin. This application of evolutionary theory gives HBE models a robustness that more generalizing models often lack.

The editors of this volume, Douglas Kennett and Bruce Winterhalder, are among the pioneer scholars who have defined and refined HBE over the past three decades. Their introductory chapter sets out the overall aims and methods of HBE and directs the reader's attention to issues surrounding the origins of agriculture, the focal interest of the volume. As noted above, HBE encompasses a suite of models that can be applied to questions of human subsistence and behavior. The choice among them depends on the quality of the available data (especially in archaeological cases) and the nature of the research question at hand. The different models comprising HBE are in no way mutually exclusive, and they can be applied independently to the same data set as a way to check for consistency of results or to illuminate apparent departures from expectations. To reiterate, HBE and its constituent models make no claim to the status of generalizing (nomothetic; hypothetico-deductive) theory. Their utility is rather in generating hypotheses that can be tested using ethno-historical and archaeological data.

Foraging theory and its variants (e.g., optimal foraging and central place foraging) make optimizing assumptions about subsistence behavior. That is, they assume that people seek to maximize the net energy return from their subsistence labors, preferentially harvesting high-ranking foods (with respect to energy return) when they are available and closely monitoring search and processing time. However, the Mikea of southwestern Madagascar, as discussed ethnographically in the chapter by Bram Tucker, seem at first blush to violate the maximizing assumption. The Mikea are forest-dwelling foragers who also casually (i.e., without systematic weeding or other care) cultivate maize (*Zea mays*) and manioc (*Manihot esculenta*). They are kin to the Masikoro, who live in close proximity but are intensive farmers. There is evidence that the Mikea once farmed more intensively than they do now. Conventional models that view simple horticulture as a stepping stone between foraging and more intensive farming can offer nothing to explain this apparent retrogression. Tucker combines foraging theory with future discounting models drawn from economics. In essence, future discounting describes how people calculate the value of delayed rewards, such as crops that provide no energy return until they ripen and are harvested. Thus, the Mikea have a choice between the immediate rewards of foraging and the delayed rewards of farming, or any combination of the two.

In Tucker's analysis, the Mikea plant maize and manioc because of the potential energy return at harvest time. However, particularly in the case of maize, there are constant risks—too little rain, too much rain, garden pests, livestock, etc.—and these risks tend to increase as the crop matures. More or less constant labor input in the form of weeding, guarding the fields and so forth can to some extent mitigate the risks, but that takes labor away from the foraging that provides the bulk of food energy on a day-to-day basis. Thus, the Mikea are willing to invest labor in their crops until immediate concerns (hunger) lead them to resume foraging. But active foraging means less labor invested in crop care, with the result that the anticipated return at harvest is discounted even more heavily. Therefore, while the Mikea are aware that they could intensify their farming, the imperative to meet immediate needs results in a cycling back and forth between foraging and horticulture. This insight sheds important light on the question of agricultural origins, since it provides an explanation for why the arrival of cultigens (i.e., domesticated plants) in many parts of the world did not immediately give rise to farming.

The next ten chapters illustrate the applications of HBE to archaeology, with case studies ranging from the origins of farming in the neotropics to the spread of cultigens in Oceania (the islands of the central and south Pacific). Two selected examples will serve to convey the rich variety of approaches subsumed under HBE.

As several authors point out, the origins of farming no longer appear to be 'revolutionary' either in timing or in social impact. Rather, cultigens seem to have played marginal roles in subsistence for hundreds or thousands of years before they became the mainstays of human economies. Such a lag time is evident on the Cumberland Plateau in eastern Kentucky, where foragers began exploiting seed crops between 4000 and 3000 radiocarbon years ago. By at least 1200 BC, seeds of chenopod (*Chenopodium berlandieri*), sumpweed (*Iva annua*), gourds (*Cucurbita* spp. & *Lagenaria* spp.), maygrass (*Phalaris caroliniana*), and knotweeds (*Polygonum* spp.) were being stored in dry rock shelters in the slopes above the floodplain of the Red River. Contributor Kristen Gremillion construes these storage sites as central places to investigate possible garden locations. Central place foraging theory recognizes several key variables as conditioning human decision-making. Four among them are: the distance of 'patches' of resources from the central place; the density of resources within such 'patches'; harvesting and in-field processing time; and the maximum loads that people can transport on a regular basis. Gremillion observes that while foraging theory would predict that gardens be located close to the central place (in this case, storage facilities), other considerations, such as the density and dependability of wild resources in potential garden sites, might shift the calculation in favor of gardens some distance away. Gremillion concludes that people on the Cumberland Plateau probably employed a flexible land-use strategy. That is, they based their decisions about how to use floodplain and hillside gardens—whether to plant cultigens or leave them to wild foods—on the plants' relative productivity at specific moments in time, as well as on the total energy costs of travel, harvesting, and transport. Hence, the choice to abandon a mixed foraging-cultivating strategy in favor of farming may have been spurred by increasing population or by changing environmental conditions that reduced the natural productivity of wild plants compared to domesticated crops. It is just this sort of hypothesis-generating utility that distinguishes HBE and its methods and models from generalizing theories that are insensitive to specific places and times.

Human behavioral ecology is robust in part because it explicitly links subsistence behavior to Darwinian evolutionary fitness. In most cases, the net rate of energy return from food serves as a proxy for fitness on the thesis that those who maximize their net energy gain relative to their neighbors are likely to have a greater range of mating choices. Energy capture, however, is only one way among many of enhancing reproductive success, hence fitness. Contributor Mark Aldenderfer invokes costly signaling theory and the sexual division of labor in combination with diet breadth models to investigate the domestication of guanaco (*Lama guanicoe*) at the sites of Asana and El Panteon in the Andean highlands. 'Costly signaling' refers to displays or behaviors that communicate trustworthy information about the qualities—health, competitiveness, intelligence, etc.—of the signaler. One way that the trustworthiness of such signals is evaluated by signal recipients is that the signals are costly to the signaler in terms of energy expended or opportunities deferred. Noteworthy recipients of costly signals are potential mates, competitors, and allies. Put simply, whereas the payoff for foraging optimally is energy, the payoff for costly signaling is status.

Importantly, Aldenderfer notes that men and women "have different subsistence strategies that may or may not converge." Women's fitness increases with increased parental investment, notably including provisioning their offspring. Men's fitness is increased by expanding opportunities for mating, as well as by cowing competitors and enlisting allies. Aldenderfer weaves together a diet breadth model (when high energy-ranked food resources are abundant, people will forego collecting low-ranked ones; when highly ranked resources are scarce, people will add a broader spectrum of low-ranked foods to their diets) with costly signaling and the sexual division of labor to construct a model of guanaco domestication that considers changing social factors (residential site choice; the sexual division of labor) as well as ecological factors (the locations of water, forage, crops, etc.).

In Aldenderfer's view, herding may have begun in the Andean highlands under conditions of growing human population and declining game populations. As some people moved elsewhere in search of more abundant resources, the remaining hunters would have had to decide whether to take game upon encounter or to conserve it by lowering the rate at which future gains were discounted. However, decisions to begin herding animals (i.e., conserve resources) would have been based not only on the discounted rate of energy return, but also on the increased status that accrued to men who were able successfully to begin controlling groups of animals.

This new form of costly signaling had significant consequences for the subsistence strategies and status of women. Archaeological and paleobotanical data suggest that women traditionally collected wild chenopods (*Chenopodium* spp.) as they foraged in a radius around their home sites. This continued even as the men began to move their herds to locations where water was available during the dry season. Eventually, a confluence of factors including lower yields from wild stands of chenopods and dense stands growing up where guanaco were pastured led women to shift their own foraging strategy to one that drew them closer to the herded animals, where they also contributed labor to the maintenance of the herd. This shift was accompanied by a change in women's status, since women were no longer the primary sources of household food. (While hunted game animals are generally considered a public resource, domesticated animals tend to become private goods.) Thus, Aldenderfer provides a fascinating example of the ways in which HBE can illuminate changing social relationships in the context of changing subsistence strategies.

The final two chapters of the book consider the epistemological status of HBE, broadly construed, and the cases in which its application is or is not warranted. The authors, Bruce Smith and Robert Bettinger, respectively, remind their readers that HBE comprises a set of hypothesis-generating models and is not an overarching or generalizing theory. This is an important caution because of the temptation to over-generalize or to interpret a successful test of an HBE-generated hypothesis as confirming some underlying theory. A second reason to be cautious when applying HBE, especially in archaeological cases, is the requirement for appropriate data. As the case studies in this volume illustrate, the best results are obtained when archaeological data (faunal and plant remains and artifacts related to the food quest, etc.) are combined with contemporary ecological and ethnobotanical data. Since HBE models focus on individual decision-making at intra-generational time scales, the data should provide resolution at that level, a condition that is seldom met in practice. Still, when researchers exercise due caution and choose models suitable for the available data, HBE has the potential to reveal much more about the processes underlying domestication than any other approach currently in use.

Behavioral Ecology and the Transition to Agriculture is sure to be of interest to anthropologists, archaeologists, human ecologists, and all those with an interest in the origins of agriculture. The volume is an appropriate text for upper division undergraduate and graduate courses in those and related disciplines. Furthermore, this book is an essential reference for college and university libraries.

Reviewer: Richard G. Milo, Professor and Dean, Honors College, Chicago State University, Chicago IL 60628

Literature Cited

White, L. 1949. The Science of Culture: A Study of Man and Civilization. Farrar, Straus, and Giroux, New York, New York. 442 pp.

Steward, J. 1955. Theory of Culture Change: The Methodology of Multilinear Evolution. University of Illinois Press, Urbana, Illinois. 244 pp.