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Opportunistic versus target mode: Prey choice changes in central-western Korean prehistory

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ABSTRACT

Human decision-making processes are usually hierarchical in that higher-level decisions impose constraints on lower-level decisions. As a result, prey choices during individual foraging trips are governed to a large degree by higher-level decisions regarding how to supply resources to satisfy demands, with higher-level decisions typically made prior to foraging trips. Resource selectivity and search bias sometimes take place in this context. By dividing resource procurement modes into opportunistic and target, I discuss how choice of mode on the basis of an overall economic plan affects prey choice during foraging trips and faunal assemblage composition resulting from those trips. An analysis of taxonomic diversity in shellmidden assemblages from the central-western Korean Late Chulmun Period (3500–1300 BC) and Middle and Late Mumun Period (700–100 BC) shows that Late Chulmun people adopted a target mode, while Middle/Late Mumun people adopted an opportunistic mode in their exploitation of marine resources. A decrease in the importance of marine resource in Middle/Late Mumun produced a change in taxonomic diversity by increasing the opportunistic cost of marine resource exploitation.

Prey choice models have been highly influential in the archeology of hunter–gatherers. They have been most successfully applied to predicting hunter–gatherer decision-making regarding resource procurement and understanding the taxonomic diversity represented in the resulting faunal assemblages (e.g., Bird et al., 2009; Hawkes et al., 1982; Hill and Hawkes, 1983; Smith, 1981, 1991). Recent studies have shown, however, that predictions of the model are not always observed in actual ethnographic cases, and that other factors not considered in the model affect the prey choices of hunter–gatherers. These studies demonstrate that prey is not always chosen on the basis of energetic return, usually measured by the ratio of body size to search/handling costs, as prey choice models assume. There are a number of cases in which small, lower ranked prey were chosen over higher ranked prey. To account for this, macronutrient balance (Hill, 1988; Hill et al., 1987), mass collection of small prey (Grayson and Cannon, 1999; Jones, 2006; Lupo and Schmidt, 2002; Ugan, 2005), age and sex-based divisions of labor and composition of the task group (Binford, 1991; Bird and Bliege Bird, 1997; Hawkes et al., 1989, 1995; Hurtado et al., 1985; Noss and Hewlett, 2001; Sosis, 2002; Ugan, 2005; Zeanah, 2004), environmental and seasonal variation (Bettinger, 1991; Hill et al., 1987; Zeanah, 2002, 2004), hunting technology (Lupo and Schmidt, 2005) and prey mobility (Bird et al., 2009) have been identified, among others, as important factors that lead to variation in prey choice. These studies suggest that although net rate of energetic return is obviously one of the most important factors, it is not necessarily the single or most critical factor in determining the prey choices of hunter–gatherers. This does not mean that prey choice models are inappropriate, but that to increase the predictability of the model its assumptions and measurements must be modified.

In my view, the primary reason that the classical prey choice model sometimes fails to predict resource exploitation behavior is that, despite many anthropological applications, it is basically an ecological model based on an analogy with animal behavior (e.g., Chanov, 1976; Stephens and Krebs, 1986) rather than an economic model. The need for a clear distinction between ecology and economy has been pointed out in many studies (e.g., Halperin, 1989; Grier, 2006; Kim and Grier, 2006; Mithen, 1989). The significance of this distinction is that an economy includes the spatial/locational movements of hunter–gatherers to procure resources in their ecological context, but adds to the analysis what Polanyi (1957) and Halperin (1989) call appropriational movements, which are the social relations amongst the various economic units. Another important difference between the two, which is the major concern of this study, is that human economic behaviors are usually planned, and economic decision-making includes the calculation and prediction of demand and supply, opportunistic costs, risk avoidance, and trade-offs between short-term effectiveness and long-term sustainability, all based on prior information (e.g., Kelly, 1995). Ecological behaviors often are short-term responses to environmental factors, as is the case with animal predators. Hu-

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man decision-making during foraging trips for resource procurement must be understood as an economic activity to supply resources in demand (whether the demand is socially-constituted and an appropriational movement or subsistence-related and a locational movement). Simply speaking, carnivores forage but do not have an 'economy', and thus what they do clearly differs from human foraging, which is a planned activity for supplying resources to consumers. In this sense, a prey choice model may successfully explain forager decision-making but its predictability decreases when applied to hunter–gatherers with significantly greater socioeconomic complexity.

Another problem deriving from the ecological orientation of prey choice model is that, as Smith (1991) correctly points out, it rarely takes into account that human decision-making processes are both hierarchical and sequential. Schmidt (1998) suggests that when foragers are planning on a foraging trip, they face two choices: (1) how and what to search for and (2) what to take when an encounter occurs. In many cases these two decisions have different goals and are not made simultaneously. The former decision is generally made first, usually before undertaking a foraging trip, and the latter is made when foragers encounter prey. The former decision is about how to supply resources that are in demand and thus are governed by the nature and kind of demand that exists and an overall economic plan. The latter is about how to maximize efficiency on any individual foraging trip, which is the major concern of the prey choice model. It must be noted that the former decision usually poses constraints on the latter. Because the former concerns how and what to search for, it inherently includes decisions regarding the type of hunt that will take place (*sensu* Smith, 1991) and the intended prey characteristics (Schmidt, 1998). The decisions made represent a trade-off between stability-maximization and efficiency-maximization of an economy. Whether to lean toward stability or efficiency will depend largely on the long-term economic strategy being employed. This decision cannot be made without calculation of current demand, anticipation of future demand, prior information, and a land-use strategy, whether or not decision-makers are hyper-rational. Whenever a decision is made, it creates opportunity costs. Only after the higher-level decision is made can the latter decision be made by task groups. Since foraging trips of hunter–gatherers are activities for supplying resources in demand, prey choices made during the trip will be governed by prior decisions about what to supply unless a task group encounters appropriately substitutable resources.

In many cases resource selectivity (Smith, 1991) or search bias (Fisher, 2002; Lupo and Schmidt, 2005; Schmidt, 1998) takes place in this context. While it is certainly true that search bias may result opportunistically from differences in resource density (Schmidt, 1998), whether to pursue specific prey (types) may be determined prior to trips. The distinction between pursuit and search modes made by Chatters (1987) and Smith's consideration of hunt types (Smith, 1991) are examples of this. Although these researchers do not clearly relate their divisions of foraging modes to hierarchical and sequential aspects of human decision-making, they both argue that prey choice and associated activities during a foraging trip vary with what foraging mode is adopted.

Hunter–gatherer decision-making processes regarding prey choice will sequentially take the following steps. First, they will decide what and how much to acquire on the basis of current needs and an overall economic plan. Energy return from and efficiency of individual foraging trips may not be an issue, at least for making this decision. If demand is for smaller prey that better meets current needs (e.g., macronutrient balance, storability or social needs), even if it does not maximize the net rate of energy return, that resource will tend to be chosen as a target or at least provide a search bias. Second, they will choose where to forage and how to take that resource on the basis of prior information about the prey characteristics, distribution and seasonality. If prior information indicates that the distribution of the resource is patchy and its productivity at each patch is uneven, there will be a trade-off between distance (or accessibility) and the productivity of each patch. Third, once these decisions are made, then task groups will move to patches and search for the resource. Although the task group will surely try to maximize the efficiency of individual foraging trips, what foragers do and what decisions they make during the trips, such as prey choice, must be restricted to the earlier decisions.

To the contrary, in some cases, hunter–gatherers may need a certain amount of total calories, regardless of the type of prey they obtain those calories from. In other words, if earlier, higher-level decisions did not specify a target prey, then prey choice during foraging trips would tend to lean toward efficiency of a trip and thus follow predictions suggested by the prey choice model. Whatever decisions are made prior to foraging trips, decisions made during the trip are unlikely to be out of the stipulated limits of earlier, higher-level decisions. Thus, depending on earlier decisions, what a task group does at patches varies, and so will the diversity and composition of faunal assemblages produced at each patch. These points further suggest that change in the diversity or composition of a faunal assemblage may not necessarily result from resource availability, environmental changes or population pressure as many archeological applications of prey choice model explain, but in some cases from changes in the economic strategy and associated higher-level decisions regarding prey choice.

The relationships among: (1) hierarchical and sequential human decision-making processes, (2) when and how search bias or focal prey takes place and (3) variability in faunal assemblage have rarely been rigorously modeled and applied to explaining archeological cases. In this paper I discuss variability and change in faunal assemblages resulting from a hierarchy of microeconomic decisions regarding prey choice. Although as stated above social aspects of decision-making are also critical to understanding prey choice, I do not address these directly here. Rather, I focus on prey choice associated with microeconomic decision-making and locational movements (Halperin, 1989; Polanyi, 1957). I first propose two different resource procurement modes (opportunistic and target modes) for cases where logistical mobility (*sensu* Binford, 1980) is practiced. I discuss their cost–benefit relationships relative to an overall economic strategy. Then, I apply this model to explaining change in the faunal assemblage composition of shellmiddens for logistically-organized marine resource exploitation in central-western Korean prehistory.

Modeling hunter–gatherer resource procurement modes

To better specify the relationship between prey choice and the hierarchy of decision-making, I here heuristically divide hunter–gatherer resource procurement modes of into an 'opportunistic mode' and a 'target mode'. A similar approach has previously been taken by Chatters (1987), who divides modes of logistical organization into a 'pursuit mode' and a 'search mode'. In pursuit mode the forager hunts a specific prey item or group of similar items, ignoring other potential edible species during the quest. In search mode, the forager hunts or collects any acceptable prey in an opportunistic fashion. Chatters suggests that the archeological measure of each mode, with breadth of the available subsistence spectrum being equal, is the taxonomic evenness of predation places. An uneven taxonomic assemblage is created when the pursuit mode was employed and an even taxonomic assemblage where the search mode was practiced.

From a different perspective, Schmidt (1998) has modeled the choice of how and what to search for and when search bias takes place. Dividing search modes into 'selective mode' and 'opportu-