OPTIMAL FORAGING THEORY

SMU Theory Webpage

Origins of Optimal Foraging Theory

In its original form, Optimal Foraging Theory (OFT; aka Foraging Theory) was developed by ecologists and zoologists to explain nonhuman resource use and dietary patterns.

In back to back articles in *The American Naturalist* (1966), authors MacArthur and Pianka, and Emlen, articulated the ideas that would form the basis of Optimal Foraging Theory. While numerous ecological studies before this time had examined food preference in nonhuman diets, according to Emlen, “no one has tried quantitatively to relate caloric values and consumption times of different foods to their respective roles in a predator’s diet”(1966:611). Both of the models derived in the articles attempt to MacArthur do just that, using a variety of environmental constraints. Collectively, the work of MacArthur, Pianka, and Emlen established many of the assumptions and parameters applied today in OFT models and laid the groundwork for future studies.

In the decades since Optimal Foraging Theory first made its way into academic literature, a flood of research has significantly improved our ability to apply OFT models to both human and nonhuman populations in order to test a broad range of hypotheses.

Eric R. Pianka

OFT: Theoretical Foundations Within Anthropology and Archaeology

Optimal Foraging Theory, in its application to anthropology and archaeology, has grown out of evolutionary ecology and behavioral ecology. Evolutionary ecology, as defined by Winterhalder and Smith (1992:5) is “the application of natural selection theory to the study of adaptation and biological design in an ecological setting.” In other words, evolutionary ecologists are interested in how organisms adapt to their environment based upon the interaction between evolutionary factors (e.g. natural selection) and ecological conditions. Behavioral ecology expands upon the basic premise of evolutionary ecology to include the role of behavior in adaptation.

Behavioral Ecology: A Brief Overview

Behavioral ecology arose when Processual theories dominated archaeological thought. As defined by Johnson,
Processualism is "a school of archaeological thought that stresses the idea of process, tends to generalize and adopts a broadly positivist approach"(1998:193). Thus, behavioral ecology easily fits into this body of theories for a number of reasons, including its focus on generative predictive models and/or hypotheses, and the simplistic and generalized nature of its models (for the benefits and critiques of this latter characteristic of behavioral ecology, see specific models below).

Anthropological interpretations founded on behavioral ecology (as well as its sub-theories) rarely involve the concept of culture. Most behavioral ecologists make no attempt to define culture. In the rare instances in which culture is considered, culture is defined as "the extrasomatic means of adaptation," as originally conceived of by Leslie White (1959:8). This definition of culture melds well with the evolutionary/adaptiveist focus of behavioral ecology.

**Optimal Foraging Theory**

OFT is used by behavioral ecologists as a methodology for predicting how human forager populations may utilize potential food resources given different sets of environmental circumstances.

**Assumptions of OFT:**

OFT is framed within a set of general assumptions. In regards to foraging behavior, OFT assumes that "foraging behavior has been 'designed' by natural selection to respond to changing conditions in a way that yields the greatest possible benefit for the individual forager's survival and reproductive success"(Smith 1983:626). A second assumption, which Sheehan (2006:168) suggests may be the most controversial of foraging theory, is "that human decisions are made such that the net rate of energy capture is maximized."

In addition, each optimal foraging model carries with it its own assumptions regarding foraging behavior and environmental/resource conditions. See the individual models below for elaboration.

**OFT Models:**

Optimal foraging models are comprised of four features: a goal, a currency, a set of constraints, and a set of options. Typically, the goal is maximization of foraging efficiency (although it doesn't have to be). The currency is usually a measure of energy, such as calories. The set of constraints are all limiting factors, such as a set amount of time a forager is able to devote to foraging. The set of options are those choices available to the forager, including choices about how a forager will spend his/her time and choices regarding potential food resources (Kelly 1995, Smith 1983). In order to satisfy different criteria and/or hypotheses, numerous models have been developed since the late 1960's which aim to predict foraging behavior. These models include:

- The Diet Breadth Model
- The Patch Choice Model
- Linear Programming

For additional information on each of the models (including a description of the model, how it is utilized with respect to
foraging theory, and benefits and criticisms of the model) click on the links above.

**Frequent Criticism of OFT:**

Probably the most common criticism of optimal foraging theory and its respective models (as applied by anthropologists and archaeologists to human populations) is that it cannot accurately account for the role of culture in determining diet choices. Foraging groups may collect or exclude resources in ways that cannot be explained by optimization. For example, both flora and fauna may be foraged for their non-food benefits as a raw material. Similarly, certain food items may be tabooed and therefore avoided, and men may be more motivated to hunt for social reasons (i.e. gaining prestige) than for gaining the highest return rate with the least energy expended.

In response to this criticism, leading researchers repeatedly stress (Kelly 1995, Smith 1983, Winterhalder 1981, Winterhalder and Smith 1982) that optimal foraging theory is only meant to model foraging behavior; they stress OFT's heuristic value, and deny claims that foraging models aim to duplicate reality. Additionally, Kelly (1995:109) argues that foraging models “flag those resources that are treated for reasons other than energetics.” That is, if an optimal foraging model predicts a particular species will be taken, yet in reality the foraging group excludes this species (or vice versa: the species should be excluded but rather is taken by the forager), this should raise the question of ‘why?’ for the researcher. The answer to this ‘why?’ likely had a cultural explanation. Thus, optimal foraging models have the potential to reveal cultural characteristics or values that may have been otherwise overlooked.

**Leading Figures**

- Jack M. Broughton
- Robert L. Kelly
- Robert H. MacArthur
- James F. O’Connell
- Eric R. Pianka
- Eric A. Smith
- Bruce Winterhalder

**Key Publications**


Broughton, Jack M.

Charnov, Eric L.

Emlen, J. Merritt

Kelly, Robert L.

MacArthur, Robart H. and Eric R. Pianka

Smith, Eric A.

Eric A. Smith and Bruce Winterhalder
Winterhalder, Bruce and Eric A. Smith  

**References:**

Belovsky, G.  

Bird, Douglas W. and James F. O’Connell  

Broughton, Jack M.  

Broughton, Jack M.  

Charnov, Eric L.  

Emien, J. Merritt  

Johnson, Matthew  

Kelly, Robert L.  

MacArthur, Robert H. and Eric R. Pianka  
Sheehan, Michael S.

Smith, Eric A.

White, Leslie

Winterhalder, Bruce

Winterhalder, Bruce and Douglas J. Kennett

Winterhalder, Bruce and Eric A. Smith

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