

UC Merced

Journal of California and Great Basin Anthropology

Title

Pine Nut Use in Three Great Basin Cases: Data, Theory, and a Fragmentary Material Record

Permalink

<https://escholarship.org/uc/item/8bp9f88b>

Journal

Journal of California and Great Basin Anthropology, 7(2)

ISSN

0191-3557

Author

Simms, Steven R

Publication Date

1985-07-01

Peer reviewed

Pine Nut Use in Three Great Basin Cases: Data, Theory, and a Fragmentary Material Record

STEVEN R. SIMMS

AN apparent correlation between the expansion of pinyon pine into the northern Great Basin and prehistoric settlement shifts in the Reese River Valley and Grouse Creek region (Fig. 1) is explored using data on the costs of pine-nut procurement relative to alternative resources. A model of diet breadth is used to develop predictions about the timing of pine-nut use in the two cases. The diet-breadth model does not accurately predict the timing of pine-nut use in a third case, the Owens Valley (Fig. 1), leading to a discussion of other possible adaptive constraints. This study is about more than prehistoric pine-nut use. The issues confronted in these cases can probably not be resolved without interaction between theory and data. Such interaction can work to evaluate a typically incomplete and frequently misleading archaeological data set, as well as the underlying theories. There is a basic premise here that data, direct or otherwise, rarely speak for themselves and that a Baconian stance, requiring us to refrain from theorizing until "all" the data are in, shortchanges the scientific endeavor.

Pine nuts are known to have been an important resource to aboriginal economies in the Great Basin during the late prehistoric and ethnographic periods. The pinyon pine (*Pinus monophylla*) was widespread in the south-



Fig. 1. Map of locations discussed in the text.

western United States in the late Pleistocene (Van Devender and Spaulding 1979) and evidence indicates that pinyon pine approached its modern northern limit of about 37 degrees north latitude in the eastern and central Great Basin by 6,000 B.P. (Lanner 1983; Thompson 1979; Rhode and Thomas 1983; Thompson and Kautz 1983; Thompson and Hattori 1983; Madsen n.d.). Madsen (n.d.) summarized the data on pinyon migration and used the pollen / macrofossil data from natural as well as culturally introduced

Steven R. Simms, Dept. of Sociology and Anthropology, Weber State College, Ogden, UT 84408-1208.

sources to hypothesize the relative abundance of pinyon pine through time. Recognizing that the use of such data to estimate past abundances has its pitfalls, Madsen (n.d.) took the position that pinyon was rare in the eastern and central Great Basin during the mid-Holocene, not becoming abundant until about 4,000 B.P. While the debate over the relative quantities of pinyon will surely continue because of the difficulty of estimating past abundances, it is clear that pinyon was approaching its northern limits by 6,000 B.P.

Archaeological evidence from the Reese River Valley (Thomas 1971, 1973; Thomas and Bettinger 1976), and the Grouse Creek region of northwestern Utah (Dalley 1976; Madsen and Berry 1975) indicates that settlement either began or that settlement shifts occurred in those areas at about the time pine nuts became available. Unfortunately, a clear identification of this pattern and subsequent explanation have been hindered by typical problems of archaeological inference concerning the determination of site function. An appeal to general evolutionary theory via a model of diet breadth from evolutionary ecology presents a means of addressing these issues by identifying predictions about pine-nut use, relative to alternative resources. The diet-breadth model is employed using experimentally derived data on the procurement and processing costs of Great Basin resources (Simms 1984). In brief, procurement of pine nuts is very efficient, relative to procurement costs of most plant-food alternatives that were in use in the Great Basin for thousands of years before the arrival of pinyon pine. Therefore, the initial test prediction is that pine nuts should have been exploited as soon as they were available in sufficient quantity to fill a niche in the diet, possibly as a winter-storage resource. Predictions for the Reese River Valley case are generally met and point to a resolution of the site-function problem. In the case of Grouse Creek, predictions

reveal flaws in the data suggesting that use of negative evidence to argue for the *non-use* of pinyon would be premature. Further, an examination of the Grouse Creek case based on this prediction shows that evidence consistent with the prediction is present. Finally, the Owens Valley — a case with better archaeological data, but where the simplest predictions about the timing of pine-nut use are not met — is discussed as a way of introducing other variables related to the cost of resource procurement. The cases illustrate the use of foraging models, not as recipes for explanation, but as facets of a sequential research process.

THE ARCHAEOLOGICAL CASES

The Reese River Valley

In the Reese River Valley study in the central Great Basin (Fig. 1), Thomas (1971, 1973) and Thomas and Bettinger (1976) proposed that the economic pattern documented by Steward (1938) for the Great Basin defines certain aspects of the archaeological settlement pattern over the past 6,000 years. The portion of this pattern important here is the hypothesized use of pine nuts for winter storage and the placement of winter camps in the pinyon vegetation zone in proximity to stored food supplies. Thomas found a significant fit between the placement of winter pinyon camps in ethnographic times and the archaeological pattern of settlement in the pinyon zone. He concluded that the economic pattern described by Steward may also describe the archaeological record. The pattern described by Thomas most likely refers to a shift in settlement patterning in the central Great Basin during the mid-Holocene rather than marking the beginning of human use of the region. Recent investigations are adding to the sample size in the area and indicate that people using projectile points of the Western Stemmed Tradition were living

along strand lines of late Pleistocene / early Holocene lakes or other low-lying areas (Elston 1982) prior to the invasion of pinyon pine.

One argument against Thomas' settlement model for the Reese River Valley has been the contention that "the distribution and abundance of pinyon pine in the Great Basin was minimal prior to 3,000 B.P." (Madsen and Berry 1975: 403). It is now clear from recent work in the central Great Basin, especially at Gatecliff Shelter (Thomas 1983), and from Thompson's (1979) study of packrat middens in the Smith Creek caves in central-eastern Nevada, that pinyon has been present for the past 5,000 to 6,000 years. Thomas (1981, 1982) reported finding pinyon cone parts, scales, nuts, and charcoal in "dozens of hearths" at Gatecliff Shelter dating as early as 5,400 B.P. While the overall abundance of pinyon at that time is not known, the appearance of pinyon generally coincides with the archaeological pattern described by Thomas based on the "Steward model."

Another criticism of the pinyon-use hypothesis stems from the paucity of grinding stones at Reese River sites in the pinyon zone. Thomas (1971: 144) reported a total of only 34 grinding stones from the Reese River Valley survey in which over 2,500 finished artifacts were found. Ten of these grinding stones occurred in the pinyon - juniper sampling stratum. If one assumes that grinding stones are required to exploit seeds and pine nuts, then their absence becomes a significant problem in identifying pine-nut use in the Reese River Valley.

The Grouse Creek Region

Given that pinyon was reaching its northern limits by about 6,000 B.P., it should have been in the Grouse Creek area (Fig. 1) of northwestern Utah at about the time there was a shift in settlement in that area. In this shift, upland areas on the western fringe of

the Great Salt Lake basin began to be utilized in addition to the lake periphery, which had been settled for several thousand years (Madsen and Berry 1975). The archaeological record for the Grouse Creek area consists of data from several cave and open-site excavations and from some nonsystematic surveys (Dalley 1976). The pollen records at Swallow Shelter (Dalley 1976) and Remnant Cave (Berry 1976) show that pine pollen first appeared at the beginning of human occupation of those sites (5,400 B.P. at Swallow and 5,000 B.P. at Remnant). Given the present absence of pine other than pinyon in the immediate area, it is assumed that the pine pollen from these sites was primarily pinyon.

Dalley's (1976) report on the archaeology of the Grouse Creek region does not directly address the pinyon-use question and none of the eight excavated sites show direct evidence of pinyon procurement at any time in the past. Despite the amount of work done in the region, there are several reasons none of these sites should be expected to yield evidence of pinyon utilization. Preservation in the open sites was so poor that even bone was poorly preserved. Preservation in the cave sites was variable due to moisture. Swallow Shelter had the best preservation, but Dalley (1976) noted that most of the vegetal matter was from the Fremont and later levels, with poor preservation of all materials in the Archaic levels. None of the excavated sites was within 8 km. of any modern pinyon groves and most were farther, so these sites should not be expected to be pinyon processing or storage sites. All of the cave sites reported by Dalley and Berry were thought to have functioned as short-term hunting camps. However, they did not specify how this functional ascription was determined. Most importantly, Dalley (1976: 159-160) noted that sites representing other portions of the seasonal round may not have been located or recognized because the research design centered on chronological

issues. This biased the initial survey toward springs and the selection criteria for subsurface testing toward cave sites, hence no sites in the pinyon zone were excavated.

The University of Utah computerized data files were used to select sites above 6,200 feet elevation in a limited area along the west slope of the Grouse Creek Mountains (Fig. 1) where Dalley reported the presence of a large, dense stand of pinyon. Within this area, there are 16 recorded sites with a pinyon - juniper association, most of which are sparse lithic scatters with few diagnostic projectile points. Generally, the survey seems to have followed the few roads in these mountains, and the surveyed area was surely a small fraction of the total area. Few archaeological sites have since been recorded in the above-mentioned area. Judging from Dalley's survey, there are sites with a pinyon association, and importantly, many of them are in locational situations similar to pinyon sites reported by Thomas and Bettinger (1976) in the Reese River Valley. These are within the present pinyon zone and along the ridges that finger into the valley. Of the recorded sites, none has been excavated and the surface collections have not been analyzed.

In the Grouse Creek region, as in the Reese River Valley, grinding stones are not abundant. Although seven of the eight excavated sites yielded grinding stones, none were recorded at the 16 unexcavated sites in the sample pinyon area mentioned above. In fact, grinding stones seem to be generally absent from the region. Within the area defined along the west slopes of the Grouse Creek Mountains (Fig. 1), there are 135 known archaeological sites, but grinding stones have been identified at only 13 of them.

The Absence of Grinding Stones: An Absence of Grinding?

While it could be argued that the seemingly low numbers of grinding stones in both

archaeological cases indicate that the inhabitants were not exploiting pinyon, or any other seed for that matter, this is not the most viable explanation. In the Reese River Valley case, Thomas and Bettinger (1976: 296) noted that many grinding stones had been removed from the vicinity of the Mateo's Ridge site and used to build a stone wall at a nearby cabin. Artifact hunters also collect finished artifacts. In the Grouse Creek case, Dalley (1976:6) commented on the probability of intense amateur collecting although there are probably other factors which cause the low frequency of grinding stones.

It is important to point out that the paucity of grinding stones is not restricted to the pinyon zone, but applies to the entire area in both cases. However, it is an ethnographic fact that seeds and pine nuts which required grinding were exploited in the Reese River Valley (Steward 1938) and in the Grouse Creek area, where their food practices were even reflected in their name *tubadiika*, or "pine nut eaters" (Steward 1938: 174). Unfortunately, even this known use of pine nuts has not been found in the archaeological record in either area. Dalley (1976: 161) commented on this problem for the Grouse Creek case, and Thomas (1971: 175) raised the possibility that grinding stones were being reused. Simms (1983) also presented evidence that grinding stone frequency is significantly skewed toward the latest sites, as would be expected from a pattern of reuse, and provided ethnographic documentation of the practice. If grinding stone reuse has affected the frequencies of these artifacts, then it becomes more difficult to know on a site-specific level whether pinyon exploitation had occurred. Often, the absence of grinding stones has been used to ascribe a hunting function to particular sites; this may have been a factor in ascribing site function in the Grouse Creek study (Dalley 1976). Thus, while it seems that the reuse of grinding

stones was likely, the question of pine-nut use is still difficult to address relying uncritically on the archaeological "evidence."

These cases are excellent, but not uncommon, examples of the need for general theory, linked to traditional archaeological methods, to help interpret and explain the fragmentary material record. By referring to a general model of foraging behavior, it should be possible to generate some simple predictions about what we might see in an archaeological record that never yields a complete picture of the past.

A MODEL OF DIET BREADTH AND THE TIMING OF PINE NUT USE

Diet-Breadth Models

A model of diet breadth, the simplest type of optimal foraging model, is used to address the problem of pine-nut use in the Great Basin (see Simms [1984] for background about the use of foraging models in the Great Basin). The optimal-diet model predicts that in a fine-grained environment where resources are encountered at random, a predator will take a resource only if the *handling time* (collecting plus processing time, after the resource has been encountered) is less than those of alternative resources. This model can be used to predict *the order* in which resources will be added to or deleted from a changing diet. Diet-breadth models have limited direct application because few natural environments contain resources distributed at random. However, they can be used to predict the order of resource use within a patch where humans are known to have been during the season when the resources of interest were available. For this reason, the model can be initially applied to the pinyon-use case. Several non-obvious, but important, predictions that are relevant to the archaeological cases used here stem from the model. These predictions are:

1. High-ranking (relatively inexpensive) resources will always be taken when they are encountered. This implies that even a *very rare* item may be taken if it is highly ranked (Royama 1970).

2. The inclusion of lower-ranked resources in the diet will depend *not on their own abundance, but on the abundance of higher-ranked items*.

3. As the abundance of higher-ranked items decreases, lower-ranked items will be included in the diet. Conversely, as the abundance of higher-ranked items increases, lower-ranked items will be excluded from the diet *no matter how abundant they are* (MacArthur and Pianka 1966; Emlen 1966; Schoener 1971; Charnov and Orians 1973).

It is important to reiterate that the diet-breadth model does not predict the dietary importance of a particular resource. Rather, it predicts the order in which resources will be added to the diet. This is because diet-breadth models do not consider the *search time* between resources and patches. Thus, as search time varies, a function of general environmental abundance, greater or lesser amounts of a resource will be included in the diet. However, the abundance of the resource does not inevitably determine whether it is in or out of the diet. It is the handling time that determines whether a resource is profitable to exploit, once it is encountered. An example is the use of mongongo nuts by the !Kung San. Mongongo nuts are a low-ranked resource, but contribute a high proportion of food to the !Kung diet at certain times because of decreases in the abundance of higher-ranked resources (Hawkes and O'Connell 1981).

The Timing of Pine-Nut Use

For pine nuts to be used, pinyon must be high in the diet ranking and must be abundant enough to fill a particular role in the econ-

Table 1
RELATIVE COSTS OF PROCUREMENT OF SELECTED
STORABLE ALTERNATIVES TO PINYON¹

Taxa	Common Name	Handling Time ²	
		Range	Typical
<i>Pinus monophylla</i>	Pinyon Pine	841 - 1,408+	higher
<i>Scirpus</i> sp.	Bulrush	302 - 1,699	900 - 1,000
<i>Elymus</i> sp.	Wild Rye	266 - 1,238	600 - 650
<i>Lepidium fremontii</i>	Peppergrass	537	same
<i>Poa</i> sp.	Bluegrass	418 - 491	same
<i>Oryzopsis hymenoides</i>	Rice Grass	301 - 392	same
<i>Muhlenbergia asperifolia</i> or <i>Sporobolus asperifolius</i>	Dropseed Scratchgrass	162 - 294	same
<i>Typha latifolia</i> (roots)	Cattail	128 - 267	same
<i>Sitanion hystrix</i>	Squirreltail	91	90 - 120

¹Resources are seeds unless otherwise noted.

²Calories per hour.

omy. If pinyon procurement is sufficient in comparison with the alternatives that can fill the same role in the system, then pinyon should be included in the diet as soon as it becomes available. In this scenario, one need not have extensive pinyon forests to envision a subsistence strategy that includes pinyon. Thus, pinyon could still be *relatively* rare, or to use Madsen and Berry's (1975) less relative term, "minimal," and still influence subsistence and settlement decision making. The studies cited earlier show that pinyon was reaching its northern limits earlier than previously thought and the most probable interpretation of current evidence is that pinyon reached its northern limits by about 6,000 B.P. Given the unlikelihood that we will be able to accurately know past abundances of pinyon, this study proceeds with available evidence.

The diet ranking (Table 1) of selected Great Basin plant resources (Simms 1984) shows that pinyon is among the highest ranked of storable plant resources. Relative to the alternatives, pinyon is an extremely attractive resource.

The significant prediction is that in Grouse Creek and the Reese River Valley,

pine nuts should have been used close to the time they first became available. This prediction clearly falls in line with Thomas' locational evidence for pine-nut use in the Reese River Valley, supports his general conclusions, and points to an explanation for the pattern he identified.

In the Grouse Creek case, the record is more difficult to evaluate. However, there are several lines of evidence pertinent to the problem. The initial use of the Grouse Creek area correlates with the appearance of pinyon (although further research may produce additional correlations). Lower ranked, storable resources shown in Table 1 such as *Oryzopsis hymenoides* (Indian rice grass), *Elymus cinereus* (Great Basin wild rye), and *Scirpus microcarpus* (Bulrush) apparently were exploited at the lower-elevation sites (Dalley 1976: 67). This implies that high-ranked resources such as pine nuts should be in the diet if people were present in the fall when the nuts were available. This criterion is met because summer-through-fall occupation of the area is documented (Dalley 1976). There is locational evidence in the pinyon zone of the Grouse Creek Mountains for the use of pinyon, but an assessment of this use was not

one of Dalley's project goals. Finally, the fact that the ethnographic Shoshoni exploited the area for pine nuts, but left few currently known traces of this, militates against the common archaeological practice of using the paucity of grinding stones or *absence* of direct subsistence data thus far reported as evidence for the *non-use* of pine nuts.

Perhaps the availability of a low-cost, winter-storage resource played a role in the decision making associated with the shift to upland occupation in the Grouse Creek area. Of course, other resources were known to have been taken, particularly game animals (Dalley 1976), which are known to be highly ranked (Simms 1984). These may have had an even more significant effect than pinyon on the shift to upland occupation. Also, it is conceivable that a great abundance of game caused the inhabitants to ignore pinyon, but this is made less likely by the presence of direct evidence for the use of resources of lower rank than pinyon, including rice grass, rye, and bulrush. Since the Grouse Creek evidence suggests summer and fall occupation, if pinyon was out of the diet, then lower-ranked seeds should also be out. The fit of these correlations suggests that the appearance of pinyon pine may have had an impact on the subsistence and consequently, the settlement systems in these areas. At the very least, it should be possible to have a clearer focus on future data recovery objectives in the Grouse Creek area.

The Owens Valley: An Exceptional Case?

The diet-breadth model apparently fails to predict the beginnings of pine-nut use in the Owens Valley in eastern California. The problem of archaeological visibility of pine-nut use may be a factor there as well. However, the effect of pine-nut use on the settlement system is not apparent until 1,300 B.P., even though pinyon had been present for a while and the valley had been occupied for the past

5,500 years (Bettinger 1976, 1977). If pinyon was highly ranked among storable plant resources, why wasn't it utilized for storage as soon as it was available? This situation may require the identification of different constraints on the use of pine nuts and show that diet-breadth models cannot be used to explain all cases. The discussion here explores the Owens Valley case in an initial way and illustrates the role of foraging models in the research process.

Although the range of exploitable species in the Owens Valley was similar to that of other valleys in the Great Basin, the area supported some of the highest population densities found in the ethnographic Great Basin (Steward 1938; Bettinger 1976). The ethnographic pattern in the Owens Valley was centered around several fairly large base camps during the spring, summer, and fall. Resources were collected and transported to these base camps. When the pine-nut harvest was good, people spent much of the winter in the pinyon zone. If they did not spend the winter there, they spent it on the valley floor at the base camp. This created a nearly sedentary pattern in which resources were transported to the central base. This pattern, while not unique in the Great Basin, contrasts with the *relatively* mobile patterns operant in the Reese River Valley and Grouse Creek region where large, semi-sedentary or sedentary Archaic habitation sites have not been found.

Prior to 3,500 B.P. in the Owens Valley, subsistence was focused toward the riverine ecological community. After 3,500 B.P. a broadening of the diet occurred and resources from the adjacent desert scrub community became more important. After 1,300 B.P. pinyon utilization is apparent in the record in the form of sites thought to have resulted from pinyon processing, indicating that use of the resource had had an effect on the settlement pattern by that time. During each of

these periods, the inhabitants were probably traversing all of the ecological communities in the valley, and hunting in the pinyon community is documented for the earliest period. Why would the inhabitants have ignored pinyon, at least as a winter-storage resource?

The key to the pinyon-use problem may lie in the presence of a semi-sedentary or sedentary strategy based in the valley bottom and the importance of transport costs in such a system. The use of pinyon as a winter staple would have required transporting the nuts to the base camp or moving the group to a distant patch away from the main base. Apparently the former never occurred on a regular basis, even in ethnographic times, suggesting that transportation of pine nuts was a costly endeavor. When the diet broadened at about 3,500 B.P., the plant resources added were farther from the base camp than those previously exploited, but were not as distant as pinyon. By the time pinyon was in the diet as a winter-storage resource, it apparently was exploited by people moving to the resource for the winter. Pinyon did not play an earlier role because the diet was broadened by adding higher-cost resources (relative to pinyon, but not including pine-nut-transport costs) closer to the central base in lieu of moving the entire camp to the pinyon groves. Prior to 1,300 B.P., pine nuts should have been used when people were in the pinyon community, as predicted for the Grouse Creek and Reese River cases. Such use is probably more difficult to detect in the archaeological record compared to a pattern where large quantities were processed for storage and use by a relatively higher density of population, a pattern that apparently did not exist in the Owens Valley until after 1,300 B.P.

DISCUSSION

This paper certainly does not settle the questions of pinyon use. It places the issue in

a different light and suggests one way of approaching the problem and consequent interpretation. In addition to addressing a rather local, albeit important, culture historical and explanatory problem involving pine-nut use in the Great Basin, these cases illustrate a basic point about the relationship between archaeological method and theory.

Archaeologists realize that the material record of past human behavior can be so scant as to be frustrating. Cultural resource management has shown that while more data are always welcome, our knowledge does not inevitably increase in proportion to increases in raw data. Following the arguments set forth by O'Connell, Jones, and Simms (1982), the underlying theme here has been that general theory should play a continuous and complementary role in the process of understanding the incomplete material record and explaining the behavior represented by that record. The cases discussed here support this position. In the study of pine-nut use, the issue about grinding-stone reuse had existed for over a decade, but until some expectations were developed, the middle-range issues were not perceived to be serious problems. The appeal to general theory not only points to a resolution of the site-function problem, but moves us closer to an explanation of the patterns. Finally, if this analysis leads to a better focused search for new data, the results will affect not only our understanding of the culture historical problems, but will feed back into the larger theoretical issues in anthropology.

ACKNOWLEDGEMENTS

This research was supported by a University of Utah Graduate Research Fellowship, the Bancroft Fund, and a National Science Foundation Dissertation Improvement Grant (BNS 81 - 20411). Thanks also to Jim O'Connell, Kristin Hawkes, Kevin Jones, Rebecca Rauch, Kate Toomey, Al Lichty, Eric Smith, Van Reidhead, and David Madsen.

REFERENCES

- Berry, M. S.
1976 Remnant Cave. In: Swallow Shelter and Associated Sites, G. F. Dalley, ed., pp. 115-127. University of Utah Anthropological Papers No. 96.
- Bettinger, R. L.
1976 The Development of Pinyon Exploitation in Central Eastern California. *The Journal of California Anthropology* 3: 81-95.
1977 Aboriginal Human Ecology in Owens Valley, Eastern California: Prehistoric Change in the Great Basin. *American Antiquity* 43: 81-95.
- Charnov, E. L., and G. L. Orians
1973 Optimal Foraging: Some Theoretical Explorations. Manuscript on file, Department of Biology, University of Utah.
- Dalley, G. F.
1976 Swallow Shelter and Associated Sites. University of Utah Anthropological Papers No. 96.
- Elston, Robert G.
1982 Good Times, Hard Times: Prehistoric Culture Change in the Western Great Basin. In: *Man and Environment in the Great Basin*, David B. Madsen and James F. O'Connell, eds., pp. 186-206. Society for American Archaeology Papers No. 2.
- Emlen, J. M.
1966 The Role of Time and Energy in Food Preference. *American Naturalist* 100: 611-617.
- Hawkes K., and J. F. O'Connell
1981 Affluent Hunters? Some Comments in Light of the Alyawara Case. *American Anthropologist* 83: 622-626.
- Lanner, R. M.
1983 The Expansion of Singleleaf Pinyon in the Great Basin. In: *The Archaeology of Monitor Valley 2: Gatecliff Shelter*, by D. H. Thomas, pp. 167-171. Anthropological Papers of the American Museum of Natural History 59.
- MacArthur, R., and E. Pianka
1966 On Optimal Use of a Patchy Environment. *American Naturalist* 100: 603-609.
- Madsen, D. B.
n.d. Great Basin Nuts: A Short Treatise on the Distribution, Productivity, and Prehistoric Use of Pinyon. In: *Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings*, C. J. Stout and D. D. Fowler, eds. University of Utah Anthropological Papers No. 110 (In Press).
- Madsen, D. B., and M. S. Berry
1975 A Reassessment of Northeastern Great Basin Prehistory. *American Antiquity* 40: 391-405.
- O'Connell, J. F., K. T. Jones, and S. R. Simms
1982 Some Thoughts on Prehistoric Archaeology in the Great Basin. In: *Man and Environment in the Great Basin*, D. B. Madsen and J. F. O'Connell, eds., pp. 227-240. Society for American Archaeology Papers No. 2.
- Rhode, David, and David H. Thomas
1983 Flotation Analysis of Selected Hearths. In: *The Archaeology of Monitor Valley 2: Gatecliff Shelter*, by D. H. Thomas, pp. 151-156. Anthropological Papers of the American Museum of Natural History 59.
- Royama, T.
1970 Factors Governing the Hunting Behavior and Selection of Food by the Great Tit (*Parus major* L.). *Journal of Animal Ecology* 39: 619-668.
- Schoener, T. W.
1971 Theory of Feeding Strategies. *Annual Review of Ecology and Systematics* 2: 369-404.
- Simms, Steven R.
1983 The Effects of Grinding Stone Reuse on the Archaeological Record In the Eastern Great Basin. *Journal of California and Great Basin Anthropology* 5: 98-102.
1984 Aboriginal Great Basin Foraging Strategies: An Evolutionary Analysis. Ph.D. dissertation, University of Utah.
- Steward, J. H.
1938 Basin-Plateau Aboriginal Sociopolitical Groups. Bureau of American Ethnology Bulletin 120.
- Thomas, D. H.
1971 Prehistoric Subsistence-Settlement Patterns of the Reese River Valley, Central Nevada.

- Ph.D. dissertation, University of California, Davis.
- 1973 An Empirical Test for Steward's Model of Great Basin Settlement Patterns. *American Antiquity* 38: 155-176.
- 1981 God's Truth in Great Basin Archaeology? *American Antiquity* 46: 644-648.
- 1982 An Overview of Central Great Basin Prehistory. In: *Man and Environment in the Great Basin*, D. B. Madsen and J. F. O'Connell, eds., pp. 156-171. Society for American Archaeology Papers No. 2.
- 1983 The Archaeology of Monitor Valley 2: Gatecliff Shelter. *Anthropological Papers of the American Museum of Natural History* 59.
- Thomas D. H., and R. L. Bettinger
 1976 Prehistoric Pinyon Ecotone Settlements of the Upper Reese River Valley, Central Nevada. *Anthropological Papers of the American Museum of Natural History* 53.
- Thompson, R. S.
 1979 Late Pleistocene Packrat Middens From Smith Creek Canyon, White Pine County Nevada. In: *The Archaeology of Smith Creek Canyon, Eastern Nevada*, D. R. Tuohy and D. L. Rendall, eds., pp. 360-380. Nevada State Museum Anthropological Papers No. 17.
- Thompson, R. S., and E. M. Hattori
 1983 Packrat (*Neotoma*) Middens from Gatecliff Shelter and Holocene Migrations of Woodland Plants. In: *The Archaeology of Monitor Valley 2: Gatecliff Shelter*, by D. H. Thomas, pp. 157-166. *Anthropological Papers of the American Museum of Natural History* 59.
- Thompson, R. S., and R. R. Kautz
 1983 Pollen Analysis. In: *The Archaeology of Monitor Valley 2: Gatecliff Shelter*, by D. H. Thomas, pp. 136-150. *Anthropological Papers of the American Museum of Natural History* 59.
- VanDevender, T. R., and W. G. Spaulding
 1979 Development of Vegetation and Climate in the Southwestern United States. *Science* 204: 701-710.

