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Sutton, Mark Q

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REPORTS

The Productivity of *Pinus monophylla* and Modeling Great Basin Subsistence Strategies

MARK Q. SUTTON

In a landmark study, David H. Thomas (1971, 1973) formulated a model of prehistoric central Great Basin subsistence and settlement patterns based on Julian Steward's (e.g., 1937, 1938) ethnographic data. Thomas (1971, 1973) concluded that from about 5500 B.P. to the time of historic contact, the archaeological record of the Reese River Valley (in central Nevada) reflected the same basic land-use system that characterized the ethnographic period. Exploitation of single-leaf pinyon (*Pinus monophylla*) was an integral part of the model and the pattern of its use (extrapolated from the ethnographic record) was a key element in the archaeological predictions derived from the model. However, due to a lack of specific data on *P. monophylla*, Thomas used ecological data for the Colorado pinyon (*P. edulis*) for his simulation of pine-nut harvests over a 200-year period. Based on Little (1938), Thomas "assumed that the behavior of *Pinus monophylla* [was] comparable to that of *P. edulis*" (1973: 160).

Models similar to that proposed by Thomas have been used in other subsistence

studies in the Great Basin (e.g., Bettinger 1975; Thomas 1983). At least partly as a result of these models, pinyon has gained the reputation of having been an erratic and unpredictable aboriginal food source. This general perception of pinyon can also be traced to Steward's (1938: 27) comment that "Each tree yields once in 3 or 4 years," although he had earlier stated that "A given locality yielded a crop only once in every two, three, or four years" (1937: 629).

COMPARABILITY

Points of inquiry regarding the comparability of *P. edulis* and *P. monophylla* as an aboriginal food source center on cone-crop frequency, seed (food) yield, and on the use of modern (Forest Service) harvest estimates in aboriginal economic contexts.

Habitat and Description

The range of *P. monophylla* (Fig. 1) is confined primarily to the central and southwestern Great Basin, including western Utah, northeastern, central, and southern Nevada, the eastern slopes of the Sierra Nevada, and interior southern California (Sargent 1922; Mirov 1967). *Pinus monophylla* also occurs in portions of northern Arizona (Fig. 1). The species is adapted to semi-arid desert mountains ranging in elevation from about 1500 to 2300 m. (Britton 1908; Mirov 1967). The range of *P. edulis* (Fig. 1) is confined to Colorado, eastern Utah, Arizona, New Mexico, and parts of Texas and Wyoming (Sargent 1922; Mirov 1967). This species is adapted to the drier mountain ranges at elevations from

Mark Q. Sutton, Dept. of Anthropology, Univ. of California, Riverside, CA 92521.

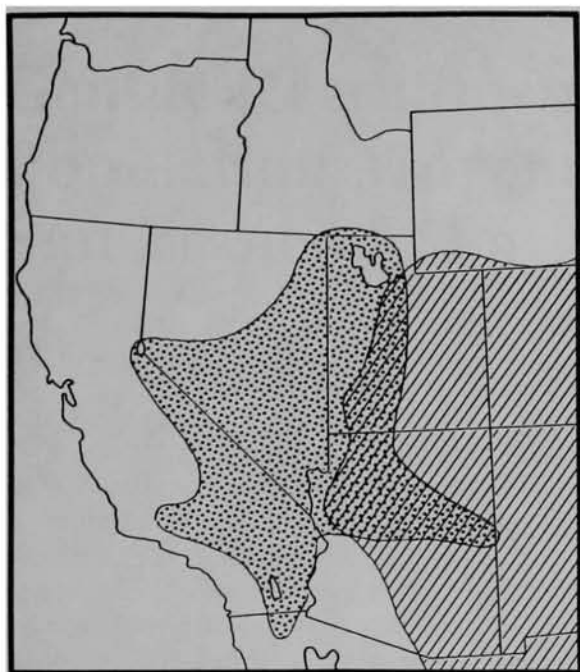


Fig. 1. Distribution of *P. monophylla* (stippled) and *P. edulis* (diagonal lines) in the western United States (after Mirov 1967: Fig. 3-8).

about 1800 to 2400 m. (Britton 1908). A comparison of pertinent characteristics of *P. monophylla* and *P. edulis* is presented in Table 1. Generally speaking, *P. monophylla* trees are bigger and have larger cones and seeds than *P. edulis*. The two species also have a differential geographic distribution. It is important to note that the cones of both species mature in their third growing season (Ligon 1978).

Cone Crop Frequency

Citing the work of Little (1941), Thomas (1971) estimated the cone-crop frequency of *P. edulis* at two to five years. These data have been replicated more recently (United States Department of Agriculture 1974) and a cone-crop frequency of two to five years for *P. edulis* appears confirmed. The cone-crop frequency for *P. monophylla* was estimated by Thomas (1971) using the *P. edulis* data since there were no independent data avail-

able for *P. monophylla* at that time. Since then, however, specific data on the cone-crop frequency of *P. monophylla* have been obtained (United States Department of Agriculture 1974)¹ that indicate a cone-crop frequency for *P. monophylla* of one to two years, a substantial difference from the two to five years of *P. edulis*.

Ronald Lanner (1983) recently reported on a five-year study of the cone production of *P. monophylla* within a one-fifth-acre study plot in the Raft River Mountains, Utah. Lanner reported

eight of its [the study plot's] 16 trees bearing in four of five years, and six bearing in three of five years. Per acre cone production on that study plot was as follows during the five year study: 1975, 765 cones; 1976, 0 cones; 1977, 2560 cones; 1978, 2325 cones; 1979, 585 cones [1983: 170].

It is important to note that the 1976 sample produced zero cones, a definite failure, at least within the limited sample area.

Other quantitative data on *P. monophylla* cone crops seem to indicate frequent cone-crop production. Forcella (1978) examined a small sample of trees in eight *P. monophylla* stands (five trees per stand) in southern Idaho and northern Nevada and estimated cone production over a ten-year period. He concluded (1978: 171) that "overall cone crops in pinyon communities are highly irregular," but also stated that the crops measured in his study exceeded the overall ten-year sample average in two or three years with such crops followed by average yields in about half of the study plots. Poor crops (below the ten-year average) were also recorded. Forcella (1978) suggested that variation in cone-crop size might serve as a defense against the pinyon cone moth (*Eucosma bobana*) by not allowing the moths to concentrate in particular stands over successive years. Lanner's (1981) discussion of the life cycle of the pinyon jay (*Gymnorhinus cyanocephalus*),

which subsists primarily on pinyon nuts (seeds), suggests that the crops of *P. monophylla* must occur often and be at least somewhat consistent.

While it is clear that pinyon-cone crops do fail, such failures are probably confined to specific stands (cf. Lanner 1983). Unfortunately, there is no good definition of what a "stand" is or how large "stands" are. Crop failures of radical proportions (e.g., Lanner's [1983] sample-plot failure of 1976) do occur but may be quite limited in geographical extent (Lanner's sample plot was only one-fifth acre). Widespread crop failures might be quite rare (none was reported by Forcella [1978]). Although the above data are not conclusive, they nevertheless support the observation that cone-crop frequencies of *P. monophylla* are higher than those of *P. edulis*.

Cone Crop Predictability

It takes three seasons for a pinyon cone to mature (Britton 1908; Ligon 1978). During the second growing season, more than a full year prior to their maturity, small cones are often plainly visible on the tree – virtually next to the near-mature cones of the current crop (Fig. 2). Immature cones should have been easily observable during pinyon harvests (cf. Wheat 1967: 116). There should, therefore, have been little problem in estimating the crop for the next year, making the following year's crop highly predictable. Monitoring cone development/loss throughout the year, perhaps in the course of other activities (e.g., hunting, grass-seed gathering, traveling) would have added to the reliability of crop predictions.

Seed Yield

Based on sample plots throughout the range of pinyon, the yield of pounds of seeds per bushel of cones has been estimated (United States Department of Agriculture

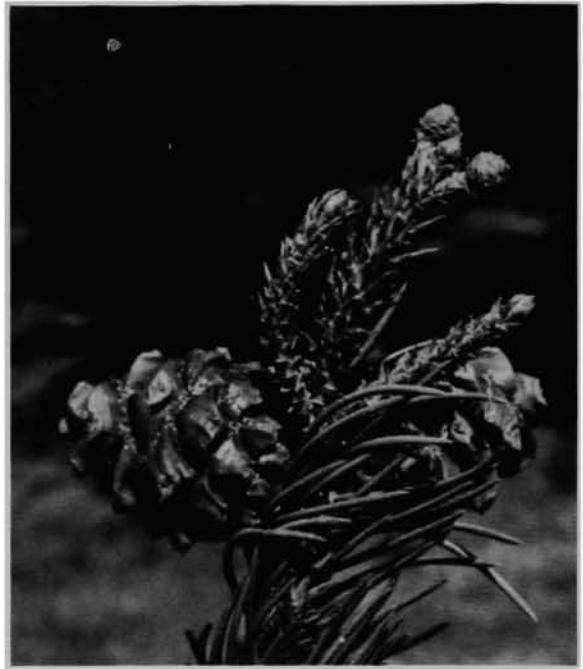


Fig. 2. View of two cone crops on the same branch of *P. monophylla*, June, 1984, Clark Mountain, California.

1974: 622-623) for the two species (Table 1). The data indicate that the seed yield (pounds per bushel) in *P. monophylla* is sometimes larger but perhaps more erratic than that of *P. edulis*.

The seeds of *P. monophylla* are substantially larger than those of *P. edulis* (Table 1). According to an analysis of yield data (United States Department of Agriculture 1974: 622-623), *P. monophylla* averages 1100 unshelled seeds per pound while *P. edulis* averages 1900 unshelled seeds per pound. In addition, the shells of *P. edulis* comprise an average 42% of the seed weight while the shells of *P. monophylla* average 30% of the total weight (Lanner 1981). As a result, *P. monophylla* produces about 12% more edible material per unshelled seed than *P. edulis* – a possibly substantial difference (11.2 vs. 9.3 oz. per pound of unshelled seeds).

Table 1
COMPARATIVE DATA ON
PINUS MONOPHYLLA* AND *PINUS EDULIS

	<i>P. monophylla</i>	<i>P. edulis</i>
Average tree height (m.)	6-15 ¹	3-12 ^{1,2}
Cones mature	late August ³	September ^{1,3}
Cones drop	September-October ³	September-October ³
Average cone length (cm.)	4.0-6.5 ¹	2.0-5.0 ⁴
Cone-crop frequency (in years)	1-2 ¹	2-5 ⁴
Pounds of unshelled seeds per bushel of cones	1.7-4.7 ¹	3.3 ¹
Average shelled-seed length (cm.)	1.5 ²	1.2 ²
Average seed yield: Unshelled seeds per pound	1100 ¹	1900 ¹
Percent of seed weight consumed by shell	30 ¹	42 ¹

¹United States Department of Agriculture (1974)

²Britton (1908)

³Ligon (1978)

⁴Little (1941)

A nutritional analysis of several species of pine, including *P. monophylla* and *P. edulis*, was recently reported by Farris (1980, 1982). Several major differences exist between *P. monophylla* and *P. edulis*, including a higher fat and protein content in the latter and a higher carbohydrate content in the former. The seeds of *P. edulis* have a higher caloric value and would seem to have more of several important minerals (Farris 1982). However, *P. monophylla* contains larger proportions of 12 of 19 amino acids (R. Lanner, personal communication cited in Madsen n.d.).

Good Years and Bad Years

The model proposed by Thomas predicted that the Shoshone could expect a "good" crop of pine nuts every 7.7 years with an "acceptable" (good or fair) crop every 5.4 years (Thomas 1971: 26). Crop failure (un-

defined by Thomas) could, by implication, be expected in most years. The criteria of good and fair used by Thomas (1971, 1972) were based on mid-1940s Forest Service estimates of crop (unshelled seed) yield (on *P. edulis*) from a field station near Tucson, Arizona. These data were intended to measure harvests in modern economic terms, not in aboriginal economic terms, and are somewhat confusing. A "good" harvest to the Forest Service in Arizona was 100,000 lbs. of unshelled seeds per township (4.34 lbs. per acre), the equivalent (after Thomas 1971: 30) of 30,000 lbs. (1.3 lbs. per acre) for Great Basin pinyon densities. A "fair" crop would have been 50,000 lbs. for Arizona, or 15,000 lbs. (0.65 lbs. per acre) for the Basin. Pinyon-crop failure for the Basin would, apparently, be less than 0.65 lbs. of unshelled seeds per acre.

Based on the model constructed by Thomas (1971: 30) for population density and pinyon needs (21 persons per township [36 square miles] requiring a total of 6300 lbs. of unshelled seeds [0.27 lbs. per acre] per year), there could be a serious failure (based on the Forest Service standards of less than 0.65 lbs. of unshelled seeds per acre) — yet there would still have been plenty of pinyon seeds available to support the aboriginal population. While there were certainly local crop failures and "bad" years, it is difficult to see how *P. monophylla* could have been an unreliable food source.

IMPORTANCE OF PINYON IN ABORIGINAL ECONOMIES

It is generally assumed that pinyon was as important in prehistoric contexts as it was during the ethnographic period. Predictive models based on the ethnographic record (i.e., a direct historical approach) make that assumption. This is a key point since pinyon has been viewed as a very important resource in the ethnographic period (cf. Steward 1938),

while its prehistoric significance has yet to be empirically demonstrated with data from the archaeological record (cf. Madsen 1981; Bettinger 1981; Thomas 1981).

Wells (1983) recently proposed that the importance of pinyon in aboriginal Great Basin economy (specifically that of central Nevada Shoshone) has been overstated. She argued that Euroamerican disruption of the native economy was centered on valley floors, with cattle grazing effectively eliminating traditional grass-seed exploitation. Wage labor and economic dependence resulted in the nucleation of Shoshone settlements around white-owned ranches which, in turn, further decreased the pursuit of traditional native economic activities.

Further, Wells (1983) suggested that pinyon procurement was retained in Shoshone economy due to its highly social nature, and to lesser Euroamerican impact on upland pinyon stands than on valley-bottom, grass-seed resources, although silver mining and its attendant timber demands resulted in pinyon being virtually eliminated in some areas. Throughout the Basin, however, the disruption of pinyon habitat was minor in comparison to the ecological disruption of valley floors. By the time ethnographers began to record native economies many indigenous subsistence activities had been forgotten, but pinyon exploitation was remembered vividly since it was, and still is, being practiced in many areas (Wells 1983: 172-174).

Nucleation of Shoshone settlements may have moved considerable numbers of people some distance away from traditionally used pinyon stands. This, along with a substantially altered economy, may have influenced Shoshone perception of what a "good" crop was. It may have taken an exceptional crop to get them to travel to such traditional stands. Since it would appear that *P. monophylla* is more productive than has been recognized by anthropologists, Steward's (1938: 72) esti-

mate of a three- to four-year interval between "good" crops may simply be a reflection of historic aboriginal perception of what "good" crops were.

Another possibility is that a "good crop" would have meant that large numbers of people could gather at a particular spot, where there was sufficient pinyon available to support the large population aggregate. This would not have necessarily meant a general cone-crop failure in other areas, but that there would not be a crop capable of supporting a large population aggregate. The Shoshone may have chosen to go to the place where the "good crop" was, where their friends and relatives were.

It may well be that pinyon was a very stable resource which formed a base for the prehistoric aboriginal economy. If this resource has been over-emphasized in the ethnographic literature (upon which the archaeological models were built), it might also be that pinyon has been over-emphasized in the reconstruction of prehistoric subsistence systems and that other resources, such as insects and grasses, may have been relatively more important.

CONCLUSIONS

When the Reese River Valley study was done (Thomas 1971), specific data on *P. monophylla* were not available and Thomas used *P. edulis* data in an attempt to model the pinyon crop. Thomas cannot be faulted for these data not existing and his settlement-subsistence model has proved highly useful to researchers. However, recent data on *P. monophylla* would indicate that the role of pinyon in the prehistoric Great Basin settlement-subsistence models should be reconsidered. It is clear that ecological data from *P. edulis* cannot be substituted for that of *P. monophylla* in the construction of prehistoric settlement-subsistence models. *Pinus monophylla* produces larger cone crops more often,

and would appear to be highly predictable.

It is not my intent to rework the statistical aspects of Thomas' Reese River model with *P. monophylla* data since that task is well beyond the scope of this paper. However, Thomas (1973: Table 1) predicted only 91 successful pinyon harvests over a 1000-year period, a figure that would appear to be far too low for *P. monophylla*. Taking into account the actual productivity of *P. monophylla* and the Forest Service's definition of "success," it may be that Thomas' estimate of pinyon success was low by several hundred percent or more.

Pinus monophylla seed crops are considerably more productive than those of *P. edulis*. This would indicate that the ecosystem of the western and central Great Basin was more productive during the prehistoric period than is currently recognized. The use of *P. monophylla* (rather than *P. edulis*) data in subsistence models should result in the prediction of higher population densities, more restricted settlement patterns, and a more stable social organization during the prehistoric period. This change alone could alter perception of the nature of prehistoric settlement-subsistence patterns in the Great Basin from one of bare survival to one of greater stability.

ACKNOWLEDGEMENTS

My thoughts on this paper benefited from discussions with Gene Anderson, M. C. Hall, Michael K. Lerch, Frank Vasek, and Philip J. Wilke.

NOTE

1. The United States Department of Agriculture data on *P. monophylla* seed-crop frequency were filed in 1969 at the Pacific Southwest Forest and Range Experimental Station, Institute of Forest Genetics, Placerville, California, by S. L. Krugman (United States Department of Agriculture 1974). The data were obtained by formal and informal methods from throughout the range of *P. monophylla* and do not represent a specific stand or environmental zone.

REFERENCES

- Bettinger, Robert L.
 1975 The Surface Archaeology of Owens Valley, Eastern California: Prehistoric Man-Land Relationships in the Great Basin. Ph.D. dissertation, University of California, Riverside.
 1981 Settlement Data and Subsistence Systems. *American Antiquity* 46(3): 640-643.
- Britton, Nathaniel Lord
 1908 North American Trees. New York: Henry Holt and Co.
- Farris, Glenn J.
 1980 A Reassessment of the Nutritional Value of *Pinus monophylla*. *Journal of California and Great Basin Anthropology* 2(1): 132-136.
 1982 Pine Nuts as an Aboriginal Food Source in California and Nevada: Some Contrasts. *Journal of Ethnobiology* 2(2): 114-122.
- Forcella, Frank
 1978 Irregularity of Pinyon Cone Production and Its Relation to Pinyon Cone Moth Predation. *Madroño* 25: 170-172.
- Lanner, Ronald M.
 1981 The Pinyon Pine: A Natural and Cultural History. Reno: University of Nevada Press.
 1983 The Expansion of Singleleaf Pinyon in the Great Basin. In: *The Archaeology of Monitor Valley, 2: Gatecliff Shelter*, David Hurst Thomas. *American Museum of Natural History Anthropological Papers* 59(1): 167-171.
- Ligon, J. David
 1978 Reproductive Interdependence of Pinyon Jays and Pinyon Pines. *Ecological Monographs* 48(2): 111-126.
- Little, Elbert L., Jr.
 1938 Food Analysis of Piñon Nuts. *Southwestern Forest and Range Experimental Station Research Notes* No. 48.
 1941 Managing Woodlands for Piñon Nuts. *Chronica Botanica* 6(15): 348-349.
- Madsen, David B.
 n.d. Great Basin Nuts: A Short Treatise on the Distribution, Productivity, and Prehistoric Use of Pinyon. In: *Anthropology in the Desert West: Essays in Honor of Jesse D. Jennings, C. J. Condie and D. D. Fowler*,

- eds. Salt Lake City: University of Utah Press (in press).
- 1981 The Emperor's New Clothes. *American Antiquity* 46(3): 637-640.
- Mirov, N. T.
1967 *The Genus Pinus*. New York: Ronald Press.
- Sargent, Charles Sprague
1937 *Manual of the Trees of North America*. Boston and New York: Houghton Mifflin.
- Steward, Julian H.
1937 Linguistic Distributions and Political Groups of the Great Basin Shoshoneans. *American Anthropologist* 39(4): 625-635.
1938 Basin-Plateau Aboriginal Sociopolitical Groups. Bureau of American Ethnology Bulletin No. 120.
- Thomas, David Hurst
1971 Prehistoric Subsistence-Settlement Patterns of the Reese River Valley, Central Nevada. Ph.D. dissertation, University of California, Davis.
1972 A Computer Simulation Model of Great Basin Shoshonean Subsistence and Settlement Patterns. In: *Models in Archaeology*, David L. Clarke, ed., pp. 671-704. London: Methuen.
1973 An Empirical Test for Steward's Model of Great Basin Settlement Patterns. *American Antiquity* 38(2): 155-176.
1981 God's Truth in Great Basin Archaeology? *American Antiquity* 46(3): 644-648.
1983 The Archaeology of Monitor Valley, 1: Epistemology. *American Museum of Natural History Anthropological Papers* 58(1).
- United States Department of Agriculture
1974 *Seeds of Woody Plants in the United States*. United States Department of Agriculture Forest Service Agricultural Handbook No. 450.
- Wells, Helen Fairman
1983 Historic and Prehistoric Pinyon Exploitation in the Grass Valley Region, Central Nevada: A Case Study in Cultural Continuity and Change. Ph.D. dissertation, University of California, Riverside.
- Wheat, Margaret M.
1967 *Survival Arts of the Primitive Paiutes*. Reno: University of Nevada Press.



A Cache of Mesquite Beans from the Mecca Hills, Salton Basin, California

JAMES D. SWENSON

During the winter of 1972, a ceramic olla or storage jar containing a cache of honey mesquite (*Prosopis glandulosa* var. *torreyana*) beans was recovered from a small wind- and water-eroded rockshelter (CA-RIV-519) in the Colorado Desert. The site lies within the ethnographic territory of the Desert Cahuilla (Barrows 1900: 25; Kroeber 1925: 694; Strong 1929: 37; Bean 1978: 575). This report describes the rockshelter and the vessel and its contents, and provides a short discussion of the cultural context in which the cache occurred.

THE SITE

The Mecca Hills flank the northern margin of the floor of the Salton Basin in southeastern California. Numerous steep-sided canyons and washes drain southwesterly out of the hills onto the floor of the Salton Basin. CA-RIV-519 is a small, north-facing rockshelter formed by wind and water erosion in the south wall of an unnamed canyon located between Thermal and Painted canyons (Fig. 1). The rockshelter is situated 6.4 km. from the mouth of the canyon at an elevation of 128 m. above sea level. Although within the range of the Creosote Bush Scrub plant