

Historical Shifts in Native American Subsistence Strategies: An Examination of Store Ledgers from Owens Valley

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Issues of resource intensification and subsistence change have long been important topics in archaeology, especially in the Owens Valley and the broader Great Basin. However, shifts in historical diets have been largely neglected as a potential source of data that can inform models of subsistence change. This paper explores dietary preferences and shifting economic patterns among native populations during the early history of the Owens Valley (ca. 1870–1920), using a number of unpublished archival materials, including store ledgers, newspapers, and population records. Information from these documents reveals that Native Americans were selective consumers of Euroamerican foods and purchased only a limited suite of items. These purchases largely conformed to predictions derived from the diet breadth model, and primarily centered on highly-ranked foods such as flour, sugar, bacon, and lard. Regularly purchased store-bought foods generally ranked higher than traditional plant resources, most of which were rapidly abandoned during the historic period.

THE OWENS VALLEY AND WESTERN GREAT BASIN have witnessed considerable archaeological research through both academic and cultural resources management endeavors. This research has contributed a significant body of data with which to address issues of prehistoric resource intensification and subsistence change (Basgall and Delacorte 2003, 2011, 2012; Basgall and McGuire 1988; Basgall et al. 2003; Bettinger 1975, 1977; Delacorte 1990, 1999; Delacorte and Basgall 2002; Delacorte and McGuire 1993; Gilreath 1995). Little attention, however, has been given to the potential contribution of historical data to these regional research issues. Historical shifts in the aboriginal diet can provide new information on the mechanisms and processes surrounding subsistence change. Furthermore, historical data permit a rigorous, non-subjective test of diet breadth models that are often difficult to replicate with archaeological data.

This study uses unpublished archival resources from the Owens Valley to reassess current models of subsistence change. Data are derived from store ledgers, newspapers, oral histories, and other documents from

the Owens Valley, circa 1870–1920 (Fig. 1). Given the relatively late timing of Euroamerican settlement in the region, the Owens Valley provides a unique setting in which to examine the integration of native peoples into the local economy and their increasing dependence on store-bought foods.

LATE PREHISTORIC AND ETHNOHISTORIC SETTLEMENT AND SUBSISTENCE PATTERNS

The interpretation of post-contact changes in aboriginal diet and culture is contingent on the broader cultural context of the region. The late prehistoric interval (1,350–100 B.P.) was a period of dynamic shifts in settlement and subsistence. Major transitions that occurred included the use of environments that were previously uninhabited or used only occasionally, and the development of costly, labor-intensive resource procurement and processing strategies.

The Haiwee Period (1,350–650 B.P.) is noted for the emergence of intensive pinyon exploitation, evident in specialized pinyon camps and rock-ring storage

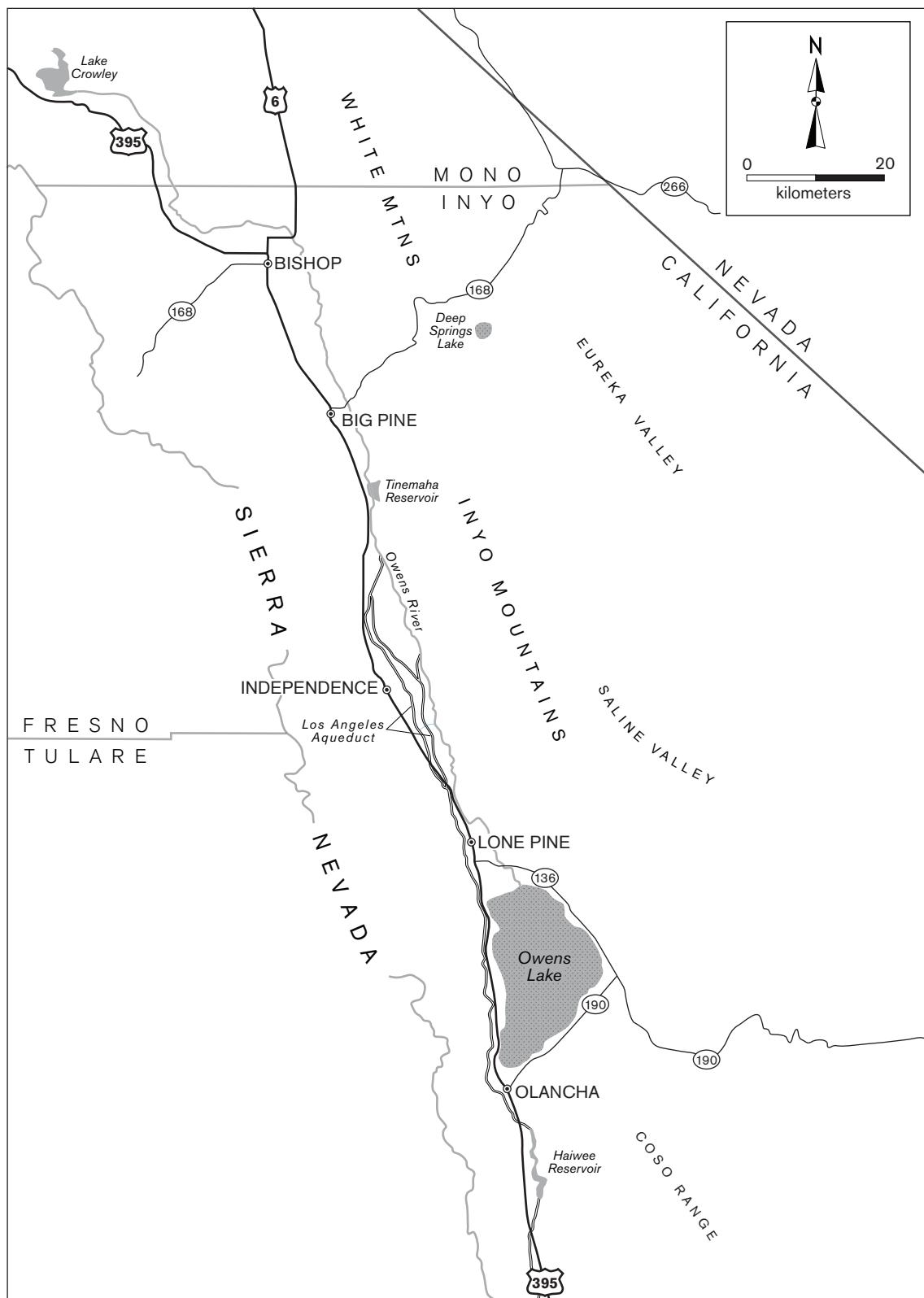


Figure 1. Study area.

facilities in the uplands (Bettinger 1976; Delacorte 1990). Although the alpine zone was certainly used by earlier populations for hunting, these areas began to be occupied on a regular, seasonal basis during the Haiwee interval, a transition apparent in the appearance of alpine villages (Bettinger 1991; Delacorte 1990). This signals a shift from the logistical use of high elevations for primarily hunting to an intensive, residential focus on a wide variety of resources.

These intensive subsistence-settlement strategies continued into the Marana Period (650–100 B.P.). Toolstone diversity profiles show a higher frequency of local materials, implying that settlements were increasingly tethered and mobility curtailed. Regular use of marginal, previously neglected environments, such as the alpine zone of the White Mountains (Bettinger 1991) and the arid Volcanic Tablelands just north of the valley (Basgall and Giambastiani 1995), continued and probably intensified during the Marana Period. In the lowlands, there is ample evidence of mass harvesting and processing of small seeds (Basgall and Delacorte 2003; Basgall and Giambastiani 1995; Delacorte 1995, 1999; Gilreath and Hildebrandt 1997), a costly strategy that can substantially increase resource yields. In addition to plants, Marana populations incorporated a number of high-cost, low-return animal resources in their diets, including small mammals, fish, birds, and freshwater mussels (Delacorte 1999; Delacorte and Basgall 2002). Arguably, the ethnographically-described village pattern emerged sometime during or shortly after this interval, with populations inhabiting large lowland village sites during spring, summer, and sometimes winter months, moving to upland pinyon camps in the early fall. The size and stability of lowland encampments is more problematic, with some researchers suggesting that large ethnographic villages were a post-contact phenomenon resulting from an influx of people from adjacent regions in pursuit of wage-labor opportunities (Basgall and Delacorte 2003; Delacorte 1990, 1999, 2002; Delacorte and Basgall 2004; Service 1962).

Ethnographic studies of the Owens Valley Paiute (Steward 1933, 1938) describe a hunter-gatherer population of approximately 1,000 individuals, though this figure has been debated (Wilke and Lawton 1976). Most of the population was concentrated in villages in the better watered, northern portion of the valley,

from Bishop to Big Pine, but sizable villages were recorded throughout the valley near Sierran streams. Most resources were available within a 20-mile radius of villages and were acquired on a daily basis. Subsistence focused on a wide variety of plant, animal, and wetland resources, but as in late prehistoric times, there was a significant focus on wild plant foods, especially small seeds (e.g., rice grass, goosefoot, wild rye) and pine nuts. Following exceptionally productive pinyon harvests, Paiute families might spend the winter in the pinyon-juniper zone, subsisting on cached nuts supplemented with wild game.

Shifts in settlement location were generally predicated on the seasonal availability of subsistence resources. Summer was spent at lowland villages collecting seeds and hunting game. In the fall, groups focused on pine nuts, a staple that could potentially sustain populations through the resource-poor winter. Although some hunting occurred at pinyon camps, most activities concentrated on the harvesting, storage, and processing of pine nuts. By the end of winter, with pinyon and seed stores depleted, families returned to the lowlands in search of the first greens of spring. Although greens were never a major component of the Paiute diet, they played a crucial role as a hedge against starvation (see Coville 1892).

SETTLEMENT OF THE OWENS VALLEY AND THE EMERGENCE OF A WAGE-BASED ECONOMY

Euroamerican settlement of the Owens Valley had dramatic effects on the indigenous population of the region. Although the Owens Valley was a thoroughfare for travelers bound for gold-rich areas in eastern California and western Nevada during the late 1850s (Chalfant 1933; Walton 1992), Euroamerican settlement of the region began in earnest with the inception of local mining operations in 1860. Soon thereafter, homesteads were established near Bishop, Laws, Big Pine, and Lone Pine, and while relations with the Owens Valley Paiute were initially peaceful (see Cragen 1975; Guinn 1917), the expansion of mining and ranching activities rapidly upset traditional economies. Loss and destruction of land, game, and wild plant resources contributed to growing tensions between aboriginal and white populations, culminating

in the war of 1861–1862 and the subsequent removal of more than 900 native inhabitants to the San Sebastian reservation near Fort Tejon in southern California (Wilke and Lawton 1976). Many of those removed to the reservation had returned to the valley by 1866.

The restoration of peace renewed immigration to the Owens Valley—populations grew, towns were established, and farming/ranching ventures flourished. Agricultural growth profoundly altered the environment—grazing destroyed native grass stands, livestock introduced new diseases to wild fauna, creeks were diverted to irrigate farmland, and development denuded large areas and restricted access to important water and plant resources (Baugh 1937; Billings 1951; Harper 1986; Wehausen 1983). Although the rapid development of Owens Valley constrained aboriginal subsistence practices, a chronic labor shortage created new opportunities for Paiute people in the form of wage labor. By 1869, a large majority of the population was engaged in various forms of seasonal wage labor, working as ranch hands, farm laborers, miners, laundresses, and service workers, constituting a vital labor force that local Euroamerican farmers and ranchers came to depend upon (Chalfant 1933; Michael 1993; Walton 1992). In fact, many of the historical villages recorded by Steward (1933, 1938) were located adjacent to a ranch or town. Generally, Native Americans in the Great Basin actively pursued wage labor and were apparently willing to move where work was available, despite the fact that they were usually paid less than their white counterparts (Downs 1966; Hattori 1975; Knack 1987, 1996; Lynch 1978; Malouf 1966; Steward 1933, 1934, 1938; Wells 1983).

The role of native labor in the regional ranching economy remained important until the early twentieth century (Steward 1933), when the city of Los Angeles purchased most of the local water rights. By the 1920s–1930s, ranching largely ceased to be a viable pursuit and most livestock operations were shut down. Collapse of the regional economy limited employment for the Owens Valley Paiute (Ford 1930; Ostrom 1953), as evidenced by the increasing rate of unemployment during the early twentieth century (Table 1). More than three-quarters of the native population was engaged in farming or ranching during the early history of the Owens Valley; by 1930, this number had dwindled to thirty-three percent, with more than half of the adult population unemployed.

Table 1
NATIVE AMERICAN EMPLOYMENT IN OWENS VALLEY

| Census Year | Total Native American Population over 16 years of age | Working as Farmers or Other Laborers | | Unemployed or No Occupation Listed | |
|-------------|---|--------------------------------------|------|------------------------------------|------|
| | | n | % | n | % |
| 1880 | 384 | 309 | 80.5 | 56 | 14.6 |
| 1890 | — | — | — | — | — |
| 1900 | 557 | 232 | 41.7 | 191 | 34.3 |
| 1910 | 491 | 172 | 35.0 | 121 | 24.6 |
| 1920 | 391 | 112 | 28.6 | 198 | 50.6 |
| 1930 | 398 | 132 | 33.2 | 222 | 55.8 |

Note: Data taken from U.S. Federal Population Schedules for Inyo County.

Disruption of aboriginal subsistence pursuits and the integration of Paiute people within the Euroamerican economy resulted in an increasing reliance on store-bought goods. In many cases, manufactured implements and mass-produced foods replaced much of the traditional lithic and subsistence economy. Ethnographically important foods (e.g., seeds) that could be easily replaced by analogous foods (e.g., flour) obtained from the local store were generally the first resources to be abandoned. However, several aspects of the traditional diet were retained, most notably the hunting of large and small game, and the fall pine nut harvest. These shifts in the aboriginal diet provide a previously unexplored means of examining subsistence change, especially with regard to resource choice and the principles that may govern those choices.

HISTORICAL SUBSISTENCE CHANGE

Prehistoric resource intensification and subsistence change have long been important research issues in Owens Valley and Great Basin archaeology. In addition to documenting food choice and purchase patterns among the Owens Valley Paiute, historical documents provide fine-grained data with which to test behavioral ecological models. Historical data are especially well-suited to models that rely on calculations of energetic costs and caloric returns, such as the diet breadth model, given that calories per dollar can be directly expressed as a function of labor; i.e., the potential calories gained per hour, or other comparable unit, of work. These measures

allow the cost and return of store-bought goods to be compared with those of traditionally exploited foods.

Simply stated, the diet breadth model presumes that hunter-gatherer and other populations will make use of resources that maximize their caloric and/or other returns in relation to labor. Generally speaking, high-return, low-cost foods (e.g., large game) are viewed as highly ranked and consistently exploited, whereas foods of limited value that require extensive effort to obtain/process (e.g., small seeds) are perceived as low-ranked resources and used only sparingly. If these predictions hold true, the initial use of store-bought goods should be limited to foods that provide the highest return relative to the purchase cost. Moreover, the store-bought goods involved should replace only those traditional foods that had an equal or lesser economic return, or had become unavailable (or inaccessible) during historical times. Inexpensive store-bought flour would be expected, therefore, to replace wild seeds that were costly to collect and process (cf. O'Connell and Hawkes 1981). Domestic meat, poultry, and cooking oil that would have substituted for wild game and other high-ranked foods would never have been purchased unless their cost was less than traditionally exploited animal resources. Patterns following these predictions would provide support for optimal foraging theory and its applications. Conversely, purchases that deviated from these expectations might suggest that optimal foraging theory, and its corollary assumptions, needs to be refined to incorporate additional variables such as prestige and other social factors.

In their study of contemporary Alyawara foraging patterns, for example, O'Connell and Hawkes (1981) found that acculturation and the introduction of European foods had a profound impact on aboriginal subsistence pursuits. Alyawara populations were largely dependent on government-supplied or store-bought foods such as flour, sugar, tea, and canned meat. Though traditional subsistence activities, such as hunting, continued after European contact, foraging was restricted to a limited group of plant resources. Notably absent from this group were seeds, which comprised a substantial portion of the Alyawara diet prior to contact. Viewed in light of optimal foraging theory, the exclusion of seeds reflects a shift away from high-cost, low-return resources in favor of inexpensive, easily obtained alternatives such as flour (O'Connell and Hawkes 1981).

The results of the Alyawara research correspond with many of the predictions offered in the present study.

Differences in men's and women's foraging goals may also be apparent in the store ledgers. If men and women do, indeed, seek to optimize different fitness goals, it ought to be reflected in their store purchases. Women, as risk-minimizing foragers who seek to provision their offspring, should purchase foods that are calorically rich yet inexpensive, such as flour and sugar. Apart from differences in cost, these store-bought foods are, in many respects, analogues to the costly but dependable women's resources exploited in prehistoric times (i.e., small seeds). If men, on the other hand, were acting to increase mating opportunities, they might be expected to purchase costly items that require correspondingly greater labor to obtain, but are of potentially greater "prestige value." While one or both of these scenarios may be plausible, it is equally possible that no distinction between men's and women's purchases will be evident in the store ledgers. Part of this reflects the fact that women are rarely mentioned in the ledgers, perhaps due to sociocultural norms, so that these documents provide a perhaps less than accurate depiction of women's activities. Still, if men frequently purchased foods that can be reasonably associated with women (i.e., flour), the activity/influence of the latter on subsistence strategies might be reconstructed.

RESULTS

Groceries are chosen so fastidiously that the [Native American] buyer insists on his preferred brand of flour or whatever commodity he purchases [Chalfant 1933:88].

Examination of eleven store and family ledgers from the Owens Valley (Table 2), curated at the Eastern California Museum in Independence, resulted in a detailed record of commercial subsistence pursuits, including the type and quantity of foods and other goods purchased by Paiute customers. All of the major Owens Valley settlements are represented in the sample, although the ledgers from the Charles Meysan Store in Lone Pine provide most (76%) of the data. The ledgers span nearly fifty years, with most transactions occurring during a 20-year interval between 1882 and 1902. Over

Table 2
LEDGERS EXAMINED

| Accession Number | Location | Ledger Name | Years | Entries Referring to Native Americans | Percent of Total |
|------------------|---------------|----------------------|-----------|---------------------------------------|------------------|
| 1991.52 | Bishop | Unknown | 1889-1890 | 44 | 3.6 |
| A333 | Bishop | Unknown | 1892-1893 | 9 | 0.7 |
| A451 | Bishop | Unknown | 1899-1901 | 51 | 4.1 |
| 1981.30 | Big Pine | Albion Eugley Store | 1896-1897 | 101 | 8.2 |
| 1974.34.11 | Independence | Charles Mulholland | 1900-1908 | 24 | 1.9 |
| 1978.779 | Georges Creek | Mary Lacey | 1895-? | 21 | 1.7 |
| 1978.780 | Georges Creek | J.W. Lacey | 1895-? | 2 | 0.2 |
| 1991.29 | Lone Pine | Charles Meysan Store | 1864-1869 | 1 | 0.1 |
| 1991.30 | Lone Pine | Charles Meysan Store | 1882-1890 | 627 | 50.8 |
| 1991.31 | Lone Pine | Charles Meysan Store | 1889-1902 | 307 | 24.9 |
| 1978.783 | Lone Pine | Unknown | 1886-1891 | 48 | 3.9 |
| TOTAL | | | | | 1,235 |

1,200 transactions involving the Owens Valley Paiute were recorded in these documents.

The store ledgers document a broad selection of food and other items available to customers; however, native consumers bought only a limited subset of these goods (Table 3). Over one third (36%; $n=449$) of all Paiute transactions involved food, mostly baking ingredients (i.e., flour, sugar, baking powder, yeast powder). This is a common pattern among aboriginal populations during the early historic period (cf. Hattori 1975; Knack 1987; O'Connell and Hawkes 1981; Wells 1983). Other foods, such as bacon/lard, crackers, and canned fish, were purchased in substantially smaller quantities, and were probably not a major part of the diet. Items purchased on even fewer occasions, including candy, eggs, and dairy products, likely represent the idiosyncrasies or tastes of only one or a few individuals, and are of correspondingly less interest.

As might be expected given the prominence of seeds in the precontact diet, flour was the most frequently purchased food ($n=115$), accounting for just over 25% of all food purchases. Between 1882 and 1902, Paiute customers purchased over 6,000 pounds of flour at an average cost of \$0.04 per pound or \$2.00 per 50-pound sack. Most flour purchases were made directly by native customers, instead of being purchased on their behalf by Euroamericans. Thus, when given the opportunity to conduct store business, flour was the primary food purchased by native peoples.

Sugar was another popular food item, representing nearly one-fifth of all food purchases ($n=79$; 17%). Most was bought in 2.5-pound quantities at an average cost of \$0.15 per pound, making it one of the less expensive commodities, accounting for only \$36.25 (10%) of the money spent on food. In all, 244.5 pounds of sugar was charged directly to accounts belonging to nearly half of the Native Americans identified in the ledgers, with only 10 of the 79 sugar purchases made by Euroamericans on behalf of Paiute employees/friends.

A total of 60 purchases involved baking or yeast powder, mostly from the Meysan Store in Lone Pine. Baking powder averaged \$0.50 per pound and was available in one-pound and half-pound cans. The half-pound size was the most frequently purchased, comprising 11 of the 16 cans bought. The price of yeast powder never varied during the study interval; half-pound cans cost \$0.25 each, and one-pound cans were correspondingly priced at \$0.50. As there was no price incentive for purchasing the larger size can, it is not surprising that nearly all purchases involved the smaller, half-pound can, only one of which was usually purchased. Transactions involving multiple cans of yeast never exceeded five small cans, and rarely more than two cans were purchased at a time. Yeast powder was generally charged to individual accounts ($n=41$), suggesting that it was a preferred, or even required, item in Paiute larders for the preparation of daily staples such as bread or bread-like products.

Table 3
NATIVE AMERICAN PURCHASES AND TRANSACTIONS

| | Bishop | Big Pine | Independence-Lone Pine | Total |
|---------------------------|------------|------------|------------------------|--------------|
| Food Purchases | | | | |
| Flour | 7 | 8 | 100 | 115 |
| Sugar | 2 | 2 | 75 | 79 |
| Baking Powder | 1 | — | 14 | 15 |
| Yeast Powder | — | — | 45 | 45 |
| Dairy Products | 1 | — | 5 | 6 |
| Eggs | — | — | 3 | 3 |
| Salt | — | 1 | 9 | 10 |
| Fruit & Vegetables | 1 | — | 10 | 11 |
| Crackers | 1 | 1 | 26 | 28 |
| Grain | — | — | 4 | 4 |
| Canned Fish | — | 3 | 20 | 23 |
| Beef | 1 | 1 | 2 | 4 |
| Bacon & Lard | — | — | 46 | 46 |
| Coffee | 1 | — | 54 | 55 |
| Tea | — | — | 3 | 3 |
| Whisky | 1 | — | 1 | 2 |
| Food Subtotal | 16 | 16 | 417 | 449 |
| Non-Food Purchases | | | | |
| Tobacco | 2 | 2 | 28 | 32 |
| Household/Clothing | 21 | 15 | 185 | 221 |
| Tools/Hardware | 2 | 3 | 69 | 74 |
| Other | 3 | — | 32 | 35 |
| Unknown | 4 | 4 | 58 | 66 |
| Cash/Order | 56 | 51 | 92 | 199 |
| Payment | — | 10 | 149 | 159 |
| Non-Food Subtotal | 88 | 85 | 613 | 786 |
| TOTAL | 104 | 101 | 1,030 | 1,235 |

Bacon and canned lard were the most frequently purchased animal products, accounting for ten percent of all food transactions ($n=46$) and over half of the meat purchased (63%). Paiute customers purchased a total of 293 pounds of bacon and lard. Slab bacon cut to the customer's specifications was purchased 30 times, for a total of 238 pounds of meat. It was relatively expensive, ranging between \$0.13 and \$0.21 per pound ($\bar{x}=\$0.17/\text{lb}$), more than four times the cost of flour. Customers purchased an average of eight pounds of bacon per transaction, though the amount varied from one to as much as 18.3 pounds. Lard was purchased

only 16 times on Paiute accounts, amounting to just 55 pounds. It was available in 2.5-pound and 5-pound cans of comparable price per pound, offering no financial incentive to purchase the larger can. As such, it is not surprising that 10 of the 16 lard purchases involved the smaller, 2.5-pound, not the larger 5-pound can.

Most bacon and lard was purchased on Paiute, not Euroamerican, accounts. This may be of little significance insofar as most of the Native Americans in Lone Pine had their own store accounts. The fact that native consumers committed over a tenth of their food budget to bacon and lard, however, attests to the importance of this resource, and suggests that it played a significant role in their diet during the early historic period. Nutritionally, both bacon and lard are rich in fat, and used for flavor, grease, or frying, not as a staple food. Relatively small amounts of these products were required, and the quantities purchased were probably sufficient for quite some time.

Twenty-three purchases of canned fish are ascribed to Paiute accounts in the ledgers, including salmon, sardines, and oysters. Quantities were noted only as involving a "small" or "large" can, although information from the 1897 Sears Roebuck and Co. catalogue offer a general approximation of the quantities involved, with a small can ranging from 10 to 16 ounces, and a large can likely two pounds. Interestingly, canned fish often accompanied cracker purchases. Crackers were bought 28 times during the study interval, sold in one-pound boxes for \$0.25 and not usually available in smaller quantities. Nearly half of cracker purchases ($n=13$; 46%) were accompanied by canned salmon or sardines, suggesting that they were consumed together as a small meal or snack.

Other foods, including beef, dairy, eggs, unmilled grain, pasta, fruits and vegetables, and candy, were rarely purchased. Descriptions of these purchases were typically vague, with no information regarding the quantity purchased or the unit price. Beef, for example, was bought only four times, but the ledgers do not note the quantity or type of beef (e.g., canned, fresh) purchased. In summary, the store ledgers indicate that Owens Valley Paiute purchases, though varied, focused on only a few foods. These included flour, sugar, yeast powder, and bacon/lard, with other store-bought foods (e.g., dairy, eggs, and meat) playing a limited role. Newspapers and

oral histories (Essene 1935; Hulse 1935), along with evidence from archaeological excavations (e.g., Basgall et al. 2003; Davis-King 1998; Pierce 2003), indicate that native peoples continued to incorporate traditionally exploited foods in their diet, augmenting store-bought foods with pine nuts, deer, and fish (see also Coville 1892; Dutcher 1893).

DIET BREADTH MODEL AND THE RANKING OF HISTORICAL FOODS

These data provide an opportunity to test expectations of the diet breadth and other behavioral ecology models that are difficult to assess employing strictly archaeological data. In order to compare the costs and returns of store-bought foods and traditionally exploited foods, the ledger information was translated into cost-benefit terms of the sort employed in diet breadth models. The purchase of a unit of flour, for example, was converted into potential calories gained per dollar spent. The prevailing wage paid to native laborers could then be used to calculate the number of calories obtained per hour worked.

Flour, which accounted for more than a quarter of all food purchases, provides an illustrative example. Based on an average price of \$0.04 per pound, one dollar could purchase 25 pounds of flour. Using caloric information obtained from CalorieKing, a published database of nutritional information now available online (www.calorieking.com), this equates to 41,200 kcal per dollar. Given that Paiute farm laborers typically earned \$1.00 per day (*Inyo Register*), the return rate for flour works out to 5,150 kcal per hour, a remarkably high caloric return relative to labor.

It is important to note, however, that this return rate hinges on several key factors, including the price of flour, the daily wage, and the length of the work day (Table 4). The daily wages paid to native employees increased over time, beginning at \$0.25–0.50 in the early historic period (ca. 1870), and increasing to \$1.00 by 1890 (Johnson 2009; McCarthy and Johnson 2002; Michael 1993; Walton 1992). Wages were sometimes raised to \$1.50 per day during the pinyon season in an effort to keep Paiute laborers at work. Naturally, the return rate for flour (or other foods) would increase or decrease in response to changing wages. For example, a Paiute laundress typically

Table 4
VARIABILITY IN RETURN RATES FOR FLOUR

| Price per pound | kcal per pound | pounds per \$1.00 | kcal per day (\$0.50/day) | kcal per hour (at 8 hr. day) | kcal per hour (at 10 hr. day) |
|-----------------|----------------|-------------------|---------------------------|------------------------------|-------------------------------|
| low—\$0.03 | 1,648 | 33.3 | 27,439 | 3,430 | 2,744 |
| avg—\$0.04 | 1,648 | 25.0 | 20,600 | 2,575 | 2,060 |
| high—\$0.09 | 1,648 | 11.1 | 9,146 | 1,143 | 915 |

| Price per pound | kcal per pound | pounds per \$1.00 | kcal per day (\$1.00/day) | kcal per hour (at 8 hr. day) | kcal per hour (at 10 hr. day) |
|-----------------|----------------|-------------------|---------------------------|------------------------------|-------------------------------|
| low—\$0.03 | 1,648 | 33.3 | 54,878 | 6,860 | 5,488 |
| avg—\$0.04 | 1,648 | 25.0 | 41,200 | 5,150 | 4,120 |
| high—\$0.09 | 1,648 | 11.1 | 18,293 | 2,287 | 1,829 |

| Price per pound | kcal per pound | pounds per \$1.00 | kcal per day (\$2.00/day) | kcal per hour (at 8 hr. day) | kcal per hour (at 10 hr. day) |
|-----------------|----------------|-------------------|---------------------------|------------------------------|-------------------------------|
| low—\$0.03 | 1,648 | 33.3 | 109,757 | 13,720 | 10,976 |
| avg—\$0.04 | 1,648 | 25.0 | 82,400 | 10,300 | 8,240 |
| high—\$0.09 | 1,648 | 11.1 | 36,586 | 4,573 | 3,659 |

earned only \$0.50 per day, cutting the return rate for flour in half. Conversely, an employee earning more than \$1.00 per day could significantly increase the average return rate calculated above (5,150 kcal/hour).

Return rates would also shift depending on the length of the work day or hours required to earn a daily wage (see Table 4). The demand for wage labor, especially work associated with farming and ranching, varied throughout the year, resulting in seasonal pulses of work and correspondingly changing resource returns. During the haying or branding season, for example, the demand for Paiute laborers was generally higher and the work days longer. Finally, the price of flour fluctuated over the course of the study interval, which also changes the return rate.

Return rates were calculated for the four foods most frequently purchased on Paiute accounts: flour, sugar, bacon, and lard. Foods that were rarely purchased (e.g., meat and canned fish) were also examined to further explore food preferences (Table 5). The four staples of the commercial Paiute diet typically had much higher returns than meat and fish. Flour yielded the highest caloric return per hour worked, more than double the return for lard and nearly four times that of beef. Although fresh meat was available in both the local markets and butcheries, meat was almost never purchased by Paiute customers. Bacon and lard, however, were consistently

Table 5
RETURN RATES FOR STORE-BOUGHT FOODS

| | Price Range (per pound) | Average Price Per Pound | kcal per pound | pounds per \$1.00 | kcal per day's work (at \$1.00 per day) | kcal per hour (at 8 hr. day) |
|-----------------------------------|----------------------------|----------------------------|-------------------|----------------------|--|---------------------------------|
| Frequently Purchased Items | | | | | | |
| Flour | \$0.03–0.09 | \$0.04 ± 0.01 | 1,648 | 25.0 | 41,200 | 5,150 |
| Sugar | \$0.10–0.25 | \$0.15 ± 0.04 | 1,760 | 6.7 | 11,733 | 1,467 |
| Bacon | \$0.13–0.21 | \$0.17 ± 0.02 | 2,448 | 5.9 | 14,400 | 1,800 |
| Lard | \$0.14–0.20 | \$0.20 ± 0.02 | 4,032 | 5.0 | 20,160 | 2,520 |
| Rarely Purchased Items | | | | | | |
| Beef | \$0.05–0.13 | \$0.09 | 944 | 11.1 | 10,489 | 1,311 |
| Ham | \$0.10–0.18 | \$0.14 | 1,232 | 7.1 | 8,800 | 1,100 |
| Tongue | — | \$0.50 | 608 | 2.0 | 1,216 | 152 |
| Corned Beef | \$0.20–0.30 | \$0.25 | 976 | 4.0 | 3,904 | 488 |
| Codfish | \$0.12–0.20 | \$0.16 | 1,312 | 6.3 | 8,200 | 1,025 |
| Salmon | \$0.15–0.80 | \$0.25 | 624 | 4.0 | 2,496 | 312 |
| Sardines | — | \$0.80 | 944 | 1.3 | 1,180 | 148 |
| Oysters | \$0.25–0.53 | \$0.39 | 640 | 2.6 | 1,641 | 205 |
| Crackers | \$0.17–0.25 | \$0.20 | 1,808 | 5.0 | 9,040 | 1,130 |
| Peaches | \$0.13–0.23 | \$0.18 | 336 | 5.6 | 1,867 | 233 |
| Macaroni | \$0.20–0.60 | \$0.30 | 720 | 3.3 | 2,400 | 300 |
| Cheese | \$0.17–0.89 | \$0.25 | 1,824 | 4.0 | 7,296 | 912 |

purchased despite their higher cost, potentially due to their greater caloric return than other meat.

Canned foods were not particularly economical, providing little caloric return for their price. As remains true today, packaged and processed foods were often more expensive per pound/calorie than their fresh counterparts. Owens Valley Paiute probably also obtained fresh meat and produce in other ways, including barter, hunting, and growing their own fruits and vegetables. In terms of caloric returns, the high cost of canned foods resulted in substantially lower return rates than for staples like flour or sugar. Given the prohibitive costs and low rank of these products, it is not surprising that they were minor constituents in the Paiute diet.

DISCUSSION

Put simply, the purchase of store-bought foods generally conforms to the expectations of the diet breadth model. Native consumers consistently purchased those items that yielded the highest returns. The mainstays of the commercial diet included four of the five highest-ranked foods, while lower-ranked items such as meat and fish

were rarely, if ever, purchased. The caloric returns of store-bought foods are even more striking in relation to traditionally exploited resources (Table 6). Comparing the return rates for commercial and traditional/wild food resources (cf. Simms 1987) reveals several interesting patterns. Not surprisingly, wild game furnishes the highest return rates. It is important to note, however, that these returns are post-encounter estimates that include pursuit, processing, and handling but not search time. As such, the return rates for game reported by Simms (1987) may be overly generous, exaggerating the caloric returns provided by animals. Indeed, historical settlement and the reduction of many game species would have increased search times for these resources, reducing their returns still further.

As stated, flour is a highly ranked food, second only to wild game, and provides a significantly higher return than traditional seed crops. This is to be expected given the generally high procurement and processing costs associated with seeds and the typically late intensification of seed exploitation evident in the archaeological record. More interesting, however, is the fact that several types of seeds outrank most of the canned fish products,

Table 6

RANKINGS OF STORE-BOUGHT RESOURCES
COMPARED WITH TRADITIONAL RESOURCES

| Food/Resource | | kcal/hr* |
|-------------------|-------------------------------|---------------|
| Mule Deer | <i>Odocoileus hemionus</i> | 17,971–31,450 |
| Bighorn Sheep | <i>Ovis canadensis</i> | 17,971–31,450 |
| Antelope | <i>Antilocapra americana</i> | 15,725–31,450 |
| Jackrabbit | <i>Lepus californicus</i> | 13,475–15,400 |
| Cottontail Rabbit | <i>Sylvilagus nuttalli</i> | 8,983–9,800 |
| Flour | — | 5,150 |
| Lard | — | 2,520 |
| Wild Duck | various | 1,975–2,709 |
| Bacon | — | 1,800 |
| Sugar | — | 1,467 |
| Beef | — | 1,311 |
| Crackers | — | 1,130 |
| Ham | — | 1,100 |
| Shadscale | <i>Atriplex confertiflora</i> | 1,033 |
| Codfish | — | 1,025 |
| Cheese | — | 912 |
| Pine Nuts | <i>Pinus monophylla</i> | 841–1,408 |
| Canned Beef | — | 488 |
| Sunflower | <i>Helianthus annus</i> | 467–504 |
| Bluegrass | <i>Poa</i> sp. | 418–491 |
| Canned Salmon | — | 312 |
| Bulrush | <i>Scirpus</i> sp. | 302–1,699 |
| Rice Grass | <i>Achnatherum hymenoides</i> | 301 |
| Macaroni | — | 300 |
| Wild Rye | <i>Elymus cinereus</i> | 266–473 |
| Canned Peaches | — | 233 |
| Oysters | — | 205 |
| Tongue | — | 152 |
| Sardines | — | 148 |
| Squirreltail | <i>Sitanion hystrix</i> | 91 |

*Caloric returns for wild/traditional resources from Simms 1987; return rates for traditional foods includes processing/handling time.

suggesting that they were more calorically efficient than a store-bought can of oysters. Archaeological investigations (see Basgall et al. 2003; Davis-King 1998; Pierce 2003), native oral histories, and informal conversations with local Native Americans indicate that certain seed crops (e.g., rice grass, blazing star) remained important through the early historic era, despite their low caloric returns.

Bacon and lard were also among the higher ranked store-bought foods. Although both were purchased by Paiute customers, it is surprising they were not consumed by a greater percentage of the population. Bacon and lard were purchased by only 26 percent of the people who bought food, while 66 percent of them purchased flour.

As suggested, flour would have served as an obvious replacement for traditional seed crops, whereas bacon/lard had no traditional counterpart. It is also interesting that lard ranked higher than bacon, yet bacon was purchased more often than lard. Whether this reflects the availability of these items, cultural differences in taste, or some other factor remains uncertain, but it is a clear contradiction of the expectations furnished by the diet breadth model.

Pinyon occupies a noteworthy place in the rankings of traditional subsistence resources. Researchers have long debated the prehistoric importance and longevity of pinyon exploitation in the Great Basin. Much of this debate derives from Steward's (1933, 1938) characterization of pinyon as a critical subsistence resource that helped to structure Great Basin adaptations. Based on this assumption, some researchers have maintained that pinyon was always an important resource, consistently exploited since 8,000 B.P. (Jennings 1989; Reynolds 1996; Thomas 1973, 1982; Thompson and Mead 1982; Van Devender and Spaulding 1979), while others note that archaeological evidence for intensive pinyon exploitation does not emerge until approximately 1,350 B.P. (Bettinger 1976, 1989; Delacorte 1990; Eerkens et al. 2004; Pippin 1980; Wells 1983). This dispute is further complicated by differing opinions regarding the caloric return and subsistence potential of pine nuts, with some arguing that they are high-ranked (Simms 1985a, 1985b) and others maintaining that they were costly to intensively collect and process and of correspondingly low rank (Bettinger and Baumhoff 1982, 1983). Thus, the portrayal of pinyon as a "good" (i.e., high-ranked) or "bad" (i.e., low-ranked) resource has become a central point in theoretical considerations regarding the initial inception and persistence of pinyon use.

Resolution of this debate has important implications for our understanding of historical pinyon exploitation in the Owens Valley and elsewhere in the Great Basin. If pine nuts are a high-ranked, high-return resource, then it follows that historical populations would continue to exploit them. By contrast, if pinyon is a low-ranked resource, one that required extensive processing, then it should have been abandoned when other, inexpensive alternatives (e.g., flour) became widely available. Though neither position has prevailed, historical research may shed some light on this issue.

Methodological concerns notwithstanding, consider the fact that pine nuts are one of the most highly-ranked traditional seed/nut resources (Simms 1985b, 1987), even ranking above store-bought beef and ham. In the Owens Valley, the pinyon-juniper zone remained one of the few environments that was relatively untouched by Euroamerican settlement. The Owens Valley lowlands, by contrast, were extensively settled by Euroamericans, and traditional seed lands were brought under cultivation and subject to grazing, which quickly exhausted these environments. Pinyon was one of the few traditional resources that *could* be regularly harvested during the historic period (cf. Wells 1983).

Historical newspaper accounts suggest that pine nuts were often harvested for their cash/commercial value. Indeed, several articles indicate that pine nuts could be exchanged for flour, with a 50-pound sack of nuts exchanged for an equal weight of flour (*Inyo Independent* 1875; *Inyo Register* 1885; Walton 1992), with a cash value of \$2.00. In good pinyon years, pine-nutting may have offered a higher monetary (and thus caloric) return than working as a laundress or ranch hand. Furthermore, the storability of pine nuts may have allowed for greater sedentism and expansion of family size, with productive pinyon harvests sustaining families throughout the fall and winter.

The gathering and preparation of certain foods is a common way that cultural traditions are preserved, which may be another reason the pinyon harvest continued (Arkush 1992; Wells 1983). As one of the few significant traditional resources that remained viable in the face of ecological changes wrought by Euroamerican settlement, pinyon may have become increasingly important during the ethnohistoric interval. More to the point, pinyon provided a source of not only food/monetary income, but also a tie to traditional activities and values, and presented an opportunity for kinsfolk, and possibly others, to annually gather together in much the same way as during the traditional fall festival.

This study has examined how information from historical documents can further our understanding of subsistence change. Euroamerican settlement significantly transformed the Owens Valley. Productive grasslands were grazed and/or brought under cultivation, depleting many traditional subsistence resources. The Owens Valley Paiute became an essential part of the

emerging agricultural economy, and grew increasingly dependent on store-bought food/goods. The pressures of acculturation led to significant culture change in the Owens Valley, most evident in historical shifts in diet, clothing, and settlement patterns. This is in keeping with culture contact situations elsewhere in the Great Basin, where technology and subsistence are often the first things to change, while belief systems and social organization persist with less pronounced modifications.

Information from store ledgers also permits an examination of optimal foraging models. Historical subsistence shifts to store-bought foods generally conform to predictions derived from the diet breadth model. Paiute customers purchased food that was highly ranked (i.e., flour, sugar, bacon, lard) and usually avoided items with lower caloric returns (i.e., canned fish, meat). As a general rule, regularly purchased store-bought foods ranked higher than traditional plant resources, most of which were rapidly abandoned during the historic period. An interesting exception to this pattern is pinyon, which was gathered in spite of its relatively low caloric ranking. Because the Owens Valley pinyon woodland was minimally impacted by Euroamerican settlement, pine nuts may have comprised one of the few significant traditional resources that remained readily available to Native Americans. Pine nuts could also be traded for flour or sold for money, at times making them a more lucrative pursuit than wage labor. Finally, the pinyon harvest may have continued, as it does today, because it provided a link to traditional culture.

In closing, this research highlights the importance of historical documents, demonstrating how they can be used to inform a multitude of anthropological and archaeological issues. Archival materials certainly have their limitations (e.g., language, gender, and racial biases), but they provide an invaluable source of ethnohistoric details and other information, especially regarding the contact period. Although an important discipline for more than fifty years, ethnohistory is in the midst of a resurgence, inspiring recent reexaminations of ethnographic and other historical data in light of postcolonial impacts on culture and environment. Too often archaeology relies on just one or a few ethnographic accounts. There are a number of other resources available, and though many are unpublished and difficult to access, they are worth the effort.

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