In 2014, the French Fire burned nearly 14,000 acres in the Sierra National Forest in the Upper San Joaquin River basin. Subsequent survey in areas of atypical surface exposure resulted in documentation of over 60 prehistoric and protohistoric sites, many associated with Western Mono heritage. We summarize the results of this post-fire survey and contextualize this data by applying a major Central Place Foraging settlement model developed for the area by Chris Morgan. We explore the applicability of seasonal settlement types and construct foraging radii using least cost analysis based on evidence of acorn caching.

On July 28, 2014, the French Fire began as an abandoned campfire in the Rock Creek tributary of the San Joaquin River (Figure 1). It quickly spread across the rugged and heavily forested Rock Creek drainage, crossing Forest Road 4S81 and continuing up canyon to Mile High Vista and Mammoth Pool Reservoir. The fire moved west toward Shuteye Peak, then south, threatening several small communities, before being contained 12 days later. The fire burned 13,832 acres of the Sierra National Forest (SNF) and three acres of private land. In this area, several episodes of fire activity have occurred, though none on the scale of the French Fire. Within the past 112 years, 14 fires have been recorded within the fire boundary. Figure 2 displays these fires by decade, with the largest being the Source Point Fire of 1939, burning over 15,000 acres. Of the total French Fire acreage, 2,887 acres, or 21%, had previously burned.

Following the French Fire, the SNF developed a recovery and reforestation treatment plan. Fortunately, the SNF had a strong crew of seasonal archaeologists on hand and was able to dispatch them for survey ahead of the post-fire treatments. In this paper, we summarize the results of the archaeological survey and use this fire-defined study area to explore some recent ideas about late prehistoric settlement. Our discussion is organized in two parts. First, we offer an overview of the survey results with specific attention to the effects of post-fire visibility. We include a summary of new sites discovered, newly identified features, and site updates. We briefly highlight a few selected sites. Second, we make a preliminary attempt to contextualize French Fire data within a prominent regional settlement model by creating least-cost paths for large milling station sites in or adjacent to the French Fire area relative to acorn cache locations.

EFFECTS OF FIRE ON ARCHAEOLOGICAL SURVEY RESULTS

The French Fire burned in the foothill and lower montane ecozones, from the floor of the San Joaquin River valley to nearly 6,000 feet above mean sea level (amsl). Typical vegetation in the foothills (to 3,500 ft. amsl) includes grasslands and a woodland community of blue oak, gray pine and chaparral. The lower montane zone includes ponderosa and Jeffrey pine, black oak, sugar pine, incense cedar and white fir, as well as a thick bear clover groundcover. In either zone, the ground is often covered by grass, duff, or downed tree debris. Chaparral and shrub, the density of which has increased in recent decades, not only normally inhibits visibility but can completely preclude pedestrian movement. The fire resulted in an intense burn with significant but variable vegetation removal at the ground and mid-story levels. Site access and ground surface visibility were greatly enhanced, though survey records indicate that ash and burned tree debris inhibited visibility.

Because a considerable portion of the French Fire area was previously surveyed, we have a unique opportunity to assess the effects of post-fire ground surface exposure on archaeological survey
results. Over 8,000 acres of the French Fire had been surveyed in multiple projects between 1977 and 2009, with the majority of survey occurring over 30 years ago (between 1977 and 1980). Of a total of 4,199 acres surveyed after the French Fire, 83 percent (3,477 acres) had been previously surveyed.

Survey results suggest the effects of fire exposure were fairly significant (Potter 2015). A total of 59 previously unidentified archaeological sites were identified during post-fire inventory. More than half of these (n=31) were found in previously surveyed areas. The majority of newly recorded sites are related
Figure 2. Map of French Fire area with previous wildfire locations.

to Native American culture. Prehistoric sites include 28 sites with milling stations, 16 sites with acorn caches, and 16 sites with lithic scatters. Twenty-two newly recorded historic sites include trash scatters, historic campgrounds, road segments, trail segments, telephone line segments, and a site related to historic road construction. One site remains unidentified as to component and function.

In addition to recording new sites, Forest Service (FS) archaeologists revisited many previously recorded sites in the French Fire area during this survey. Fire effects to the landscape likely contributed to observation of new features. We updated records for over 27 percent (n=29) of sites with prehistoric
components (n=106) based on new features documented or artifacts observed, lack of artifacts observed, significant location offset, or no original data recorded. The size of 20 percent of the sites (n=21) were increased to incorporate additional artifacts and/or features. The most significant additional type of feature identified post-fire was house pits (n=29), which appear to have been relatively difficult to discern through pre-fire heavy bear clover. Seven new milling stations at two sites were also identified. In addition, lithic scatters, midden, tools and ground stone not previously observed were added to site records.

We highlight a few sites showing known or possible Native American occupation. Several sites are noteworthy. All but one was newly recorded in post-fire survey. They include the following:

- An undisturbed small residential site situated on a knoll, with four house pits, two bedrock milling stations, and a sparse lithic scatter. A scatter of historic artifacts in and around the house pits represents occupation into the 1930s.
- An acorn cache site consisting of four rock rings on a large granite outcrop with an extensive view of the San Joaquin River canyon and nearby mountain peaks.
- A small rockshelter with a pictograph and associated milling station.
- A prehistoric and historic site, possibly protohistoric, with house pits (n=3), cache remains (n=2-3), a milling station, a rock alignment, several small pits, and a monolithic boulder cut with crescent shapes; pestles, manos, steatite sherds, obsidian cores, debitage, a scraper, a Humboldt point, and blue glass trade beads. The most diverse historic artifact assemblage in the French Fire area was noted here and includes cut nails, bottle glass, window glass, a metal kettle and cooking pan, and a knapped piece of brown bottle glass. This site may offer some of the best potential for continuous occupation from the protohistoric through historic periods.
- An unusual site with two large, upright granite slab rings (six feet in diameter) on low mounds and early twentieth century artifacts, including shovel heads (n=3), a sanitary can, and a small glass jar (post-1930). Survey records suggest relationships between this site and others with similar historic artifacts.
- A site with no milling station, but five house pits, obsidian tools (including Humboldt and Desert Side-notched points) and debitage, a steatite pipe fragment, and the remains of a trail segment.

**MODELING LATE PREHISTORIC SETTLEMENT**

With a brief look at the post-fire survey results, we now turn to the task of placing the French Fire data in the context of prehistoric settlement. The fire area actually falls within an area covered by one of the most important settlement models developed for the central Sierra. Morgan (2006, 2008, 2009a, 2009b, 2010, 2012) employed central place theory to create a multi-faceted portrait of late prehistoric settlement, especially for the Western Mono. Following on earlier classification concepts (e.g., Jackson’s [1984] K-site model), Morgan focused on key features of sites, most prominently bedrock milling stations. He identified “winter settlements” and spring/summer “principal settlements” as critical residential components within montane mobility strategies. Morgan constructed an argument for logistical settlement from these residential bases by modeling their spatial relationship to acorn caches. The relationship was established using least-cost path modeling in a Geographic Information System (GIS) application.

A key concept in Morgan’s research involves dispersed acorn storage as a strategy enabling the characteristic Mono pattern of dispersed spring/summer camps, some well above snowline, and lower elevation aggregation hamlets during the winter. To demonstrate the importance of this storage practice, Morgan constructed foraging radii by creating least-cost paths between acorn caches and settlement areas. Of particular concern in Morgan’s analysis are “winter settlements,” defined as large sites or groups of sites, identified by a minimum of 101 bedrock mortars as well as midden soils and/or housepits (2008:252). Morgan also defined “principal settlements” as sites or site clusters more than 350 m from
winter hamlets and containing 14 or more bedrock mortars, a lithic scatter, and/or midden soils. For the purpose of modeling mobility and storage, Morgan focused on winter settlements.

Geographically, the French Fire actually corresponds well with Morgan’s research (Figure 3). Out of more than 600,000 acres considered in his dissertation, Morgan constructed foraging radii for a relatively small area along the western side of the San Joaquin River where he identified three winter settlements. It turns out that two of these (Hogue Ranch and Rock Creek) are within the French Fire and one (Logan Meadow) is just north of the burned zone. In our analysis of the French Fire data set, we employ these settlements and add two (Shakeflat and Placer) (Figure 4). The latter are previously recorded sites with evidence of intensive processing. Shakeflat is within the French Fire area and is included despite its lack of midden soil or housepits. The Shakeflat site record was actually updated in the post-fire survey, with five new milling stations identified, bringing the total number of mortars to 101. Placer is outside of the French Fire burn zone (approximately 1.3 km) but well within foraging limits of the fire zone. With 182 bedrock mortars at five stations, as well as midden soils, the site clearly constitutes a winter settlement. Both Shakeflat and Placer are situated at or near the snowline (Placer, 4,160 ft. amsl; Shakeflat, 4,680 ft. amsl), suggesting their winter use may have been limited in some years. Accordingly, we simply label these as settlement areas, with the basic assumption that these relatively large food processing facilities were at least occasionally provisioned with stored acorns.

With our updated dataset, we applied least-cost path analysis. We used all five large residential sites as our origin points and created least-cost paths to sites with acorn caches. Acorn cache features are archaeologically defined by rock ring foundations typically found on open south or southwest facing granite exposures. In addition to those in the fire zone, we added previously recorded caches from adjacent areas west of the San Joaquin River. At this point, many of the prehistoric sites in the French Fire survey data drop out of our study. Data for our analysis consist of 72 sites with acorn caches and the five residential sites.

We employed a 30m DEM slope raster and applied the Tobler’s Hiking function in ARCMAP 10.3.1 software. In this function, travel cost is based on distance and slope. When including multiple source points, ARCMAP automatically assigns destinations to nearest source locations, creating “catchments” of acorn caches for individual winter settlements (cf. Morgan 2008:253).

The results for Logan Meadow (Figure 5), Hogue Ranch (Figure 6), and Rock Creek (Figure 7), all of which are archaeological as well as ethnographically documented sites, indicate substantial acorn catchment areas with caches distributed primarily in the foothill ecozone. As for the sites of Placer (Figure 8) and Shakeflat (Figure 9), least-cost analysis likewise identifies well defined catchments. Shakeflat’s catchment notably extends into the lower montane ecozone. These results are generally consistent with Morgan’s analysis, in that acorn cache catchments appear to be viable archaeological constructs. Our results, however, do not replicate Morgan’s in terms of cache-to-settlement associations and paths constructed.

We evaluate our least-cost path results in light of two key elements—distance and capacity. Based on Morgan’s (2009b) analysis and in keeping with ethnographic data on foraging behavior, acorn caches should fall within 5 km of a winter settlement. Our analysis yields a mean distance of settlement to cache of 2.73 km, well within this range (Table 1). There is at least one outlier at Hogue Ranch, where the least-cost analysis includes a cache some 10 km distant, beyond ethnographically documented daily foraging limits of 9.4 km (Morgan 2008). We suspect that this outlier belongs to a separate catchment area that aligns with an unmapped settlement area to the south. We know of two candidate sites in this area that may qualify as winter settlements.

In terms of capacity, we employ Morgan’s (2012) approach to estimate the capacity of catchments by multiplying an estimate of 725 kg of acorns per cache by the number of cache features. Morgan estimates that a minimum capacity of 4,798 kg is necessary to sustain a typical Mono settlement for a winter. All five of the major milling station sites assessed here, including Placer and Shakeflat, show adequate capacity and much more (Figure 10). Excess capacity appears common for Mono catchments, likely intended to account for annual variation in mast yields as well as changes in use of winter settlements.
Table 1. Statistical summary of distance measures for each settlement area.

<table>
<thead>
<tr>
<th>Settlement</th>
<th>No. of Cache Sites</th>
<th>Mean Distance</th>
<th>Max Distance</th>
<th>Min Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shakeflat</td>
<td>14</td>
<td>0.919</td>
<td>2.613</td>
<td>0.295</td>
</tr>
<tr>
<td>Rock Creek</td>
<td>18</td>
<td>1.877</td>
<td>3.368</td>
<td>0.514</td>
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<tr>
<td>Logan Meadow</td>
<td>10</td>
<td>3.533</td>
<td>5.843</td>
<td>1.797</td>
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<tr>
<td>Placer</td>
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<td>3.956</td>
<td>5.943</td>
<td>1.932</td>
</tr>
<tr>
<td>Hogue Ranch</td>
<td>13</td>
<td>3.764</td>
<td>10.764</td>
<td>0.626</td>
</tr>
</tbody>
</table>

Figure 3. Morgan’s (2008) least-cost path catchment areas compared to the French Fire area (corresponding settlements indicated by black lines).
Figure 4. Settlement areas employed in least-cost path analysis.
Figure 5. Least-cost path analysis results for Logan Meadow settlement (brown indicates foothill ecozone, green indicates lower montane).
Figure 6. Least-cost path analysis results for Hogue Ranch settlement.
Figure 7. Least-cost path analysis results for Rock Creek settlement.
Figure 8. Least-cost path analysis results for Placer settlement.
Figure 9. Least-cost path analysis results for Shakeflat settlement.
SUMMARY

In summary, the benefits of an event like the French Fire for archaeological survey are fairly clear. Wildfires briefly open windows onto the forest floor. Exposure provides a rare degree of insight that can be leveraged for enhancing archaeological inventory. With regard to late prehistoric settlement, while we have raised some questions and noted some variation, we believe we have at least tentatively validated Morgan’s model with respect to relating dispersed acorn caching to large milling station sites. As for those sites beyond the larger settlement or the acorn cache, we are left with a robust set of data within the French Fire. For example, we can identify 22 “principal settlements,” as well as several smaller processing sites. Some of these principal settlements have extensive milling stations with mortar counts as high as 83 (note that winter settlements have a minimum of 101 mortars and principal settlements have a minimum of 14 mortars). It is interesting to note that the only examples of “heavy” debitage are associated with these sites—none with winter settlements. Likewise, housepits are more likely to be associated with principal settlements. And of course it is important to note that our temporal control over these sites is rudimentary at best. Diagnostic projectile points in the French Fire data set include Pinto, Humboldt, Elko, Sierra, Martis, Rosegate, Cottonwood, and Desert Side-notched forms. Further refinement of milling station site chronology and function is clearly needed.

![Catchment Capacity (kg)](image)

*Figure 10. Estimated acorn cache storage capacity by settlement catchment.*
REFERENCES CITED

Jackson, T.L.

Morgan, Christopher
2006 Late Prehistoric Territorial Expansion and Maintenance in the South-Central Sierra Nevada, California. Unpublished Ph.D. Dissertation, Anthropology Department, University of California, Davis.

Potter, Erin