ELEM (POMO) TRADITIONAL LIFEWAYS SCENARIO

Clear Lake[1]

Clear Lake Pomo Hunter on a tule raft[2]

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AESE, Inc
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[1] Photos by *Charles Webber*, posted at http://calphotos.berkeley.edu/cgi/img_query?where-genre=Landscape&query_src=photos_landscape_index&rel-location=like&where-location=clear+lake&rel-plant_comm=like&where-plant_comm=&where-continent=any&where-country=any&where-state=California+%282716%29&rel-county=eq&where-county=any&where-collectn=any&rel-photographer=eq&where-photographer=any&rel-kwid=equals&where-kwid=
[2] CURTIS, Edward Sheriff, The Hunter - Lake Pomo; http://www.donaldheald.com/browse18.html

1. INTRODUCTION

This document presents the Elem (Southeastern Pomo) exposure scenario [‘Scenario’], at Clear Lake, California.

An exposure scenario is a narrative and numerical representation of the interactions between human receptors and their immediate environment. Exposure scenarios include media-specific and pathway-specific exposure factors that reflect the degree of environmental contact for each medium and each exposure pathway, expressed as the frequency, duration, and intensity of contact. If environmental contamination is present, the exposure factors are used to estimate human exposure, expressed as the dose of each contaminant to the person for whom the exposure scenario is developed. The dose of each contaminant is combined with its toxicity to develop and estimate of health risk to the person. Exposure factors can also be used to develop environmental standards to ensure that natural resources are safe to use.

The Elem Scenario, like other Tribal scenarios, has been developed to reflect traditional lifestyles and diets. Even though many Tribal lands have been lost and resources degraded, there are generally more traditional or subsistence practices followed by Tribal members than the general non-native population realizes. Additionally, the objective of many Tribal governments, inlcuding the Elem government, is to regain land, restore resources, and encourage more members to practice healthier (i.e., more traditional) lifestyles. Therefore, the objective of subsistence exposure scenarios is to describe the original lifestyles and resource uses under baseline environmental conditions, not to present a current snapshot of restricted or suppressed uses, because the intent is to restore the ecology so that original pattern of resource uses is both possible (after resources are restored) and safe (after contamination is removed).

The format for this scenario starts with a general description of baseline natural resources that are (or should be) present in the study area. These baseline conditions include the “potential natural vegetation” of the local ecosystem. Depending on current natural resource conditions, this may include a description of the early contact era, conditions that currently exist in reference areas within a tribe’s ecoregion, or a combination. Then, the scenario describes the activities that traditional people undertake to survive and thrive in that local ecosystem, including hunting, gathering foods and medicines, fishing, making material items, farming or gardening, raising livestock, irrigating, and various cultural and domestic activities that comprise a traditional subsistence lifestyle. Finally, this information is used to develop the exposure factors in the format used in risk assessment, such as ingestion rates of various foods, soil ingestion, water ingestion, and inhalation.

1.1 Methods for Scenario Development

1.1.1 Comparison of Methods

For the general United States population, an exposure scenario is typically designed to describe an upper bound (generally around the 75th percentile) of the population being assessed. Some individual exposure factors are the 90th or 95th percentile; others are mean values. In the case of Tribal exposure scenarios, there are no Tribal-specific databases of subsistence activities, resources, or diets as there are for the general United States population. Cross-sectional surveys of current Tribal populations will not generate that data for subsistence lifestyles because much resource use has been suppressed due to loss of land and access, awareness of contamination, prosecution by the dominant society, and many other reasons. This means that large and accurate statistical distributions for subsistence exposure factors are not available and cannot be developed unless only a fully subsistent subset of the Tribe is studied, and this is not possible because the traditional subisstent members resist being studied and measured. Therefore, ranges of exposures, or specified percentiles of exposure are not possible to calculate. Rather, the scenario is reconstructed as a reasonable representation of the traditional subsistent lifestyle, equivalent to a central tendency of this lifestyle rather than a statistical upper bound.

Because these large databases are not available and cannot be constructed, a top-down approach is taken. For example, a complete diet based on surveys of the uses of the typical 200+ natural resources available and used with an ecoregion is not attempted. Rather, a calorically complete (2000kcal/day) food pyramid is developed that identifies the major staples and their rough percentages in the original diet. Similarly, there is no attempt to develop an average day by tracking hundreds of individual activities for many people. Rather, this scenario is derived from an understanding of the ecology and lifestyle.

The process for developing traditional subsistence scenarios, and thr format for this document, follows the general sequence:

Environmental setting – what resources are (or should be) available;

Lifestyle description – activities and their frequency, duration and intensity, based on anthropological and ethnohistorical literature (with confirmatory interviews with the Tribe's culture department);

Diet (indirect exposure factors), based on anthropological and ethnohistorical literature (with confirmatory interviews with the Tribe);

Exposure pathway identification; and

Direct exposure factors (exposure to abiotic media) – iterative crosswalk between pathways and direct exposure factors; cumulative soil, water, air, and dietary exposures.

1.1.2 Subsistence Lifestyles

"Subsistence" refers to the hunting, fishing, and gathering activities that are fundamental to the way of life of many indigenous peoples. It also recognizes that today's subsistence economies utilize traditional and modern technologies for harvesting and preserving foods as well as for distributing the produce through communal networks of respect, sharing, and bartering. Currencies include money, goods, services, obligation, and respect. Subsistence embodies cultural values that recognize both the social obligation to share as well as the special spiritual relationship to the land and resources. This relationship is portrayed in native art and in many ceremonies held throughout the year."[3] The following is a useful explanation of "subsistence," taken from the National Park Service:

[3] National Park Service: http://www.cr.nps.gov/aad/cg/fa_1999/Subsist.htm

"While non-natives tend to define subsistence in terms of poverty or the minimum amount of food necessary to support life, native people equate subsistence with their culture. Among many tribes, maintaining a subsistence lifestyle has become the symbol of their survival in the face of mounting political and economic pressures. It defines who they are as a people. To Native Americans who continue to depend on natural resources, subsistence is more than eking out a living. While it is important to the economic well-being of their communities, the subsistence lifestyle is also the basis of cultural existence and survival. It is a communal activity. It unifies communities as cohesive functioning units through collective production and distribution of the harvest. Some groups have formalized patterns of sharing, while others do so in more informal ways. Entire families participate, including elders, who assist with less physically demanding tasks. Parents teach the young to hunt, fish, and farm. Food and goods are also distributed through native cultural institutions. Most require young hunters to distribute their first catch throughout the community. Subsistence embodies cultural values that recognize both the social obligation to share as well as the special spiritual relationship to the land and resources. This relationship is portrayed in native art and in many ceremonies held throughout the year."[4]

In economic terms, a subsistence economy is one in which a dollar currency is limited because many goods and services are produced and consumed by the same families or bands. However, other currencies, including tangible items such as trade beads or other items and intangible tiems such as future obligations, knowledge, and respect, also serve as media of exchange for goods and services. Today, dollar currency is limited, but important, so many indigenous families include members whose role is to acquire various types of wealth. For example, subsistence in an Arctic community includes the following:

"The modern-day subsistence family depends on the tools of the trade, most of which are expensive. Snowmobiles, gasoline, guns, fishing nets, and sleeping bags are necessities. Subsistence households also enjoy many of the modern conveniences of life, and are saddled with the economic demands which come with their acquisition. Today's subsistence family generates much-needed cash as wage-labourers, part-time workers and trappers, professional business people, traditional craftmakers, and seasonal workers. A highly-integrated interdependence between formal (cash-based) and informal (barter and subsistence-based) economic sectors has evolved."[5]

1.1.3 Subsistence Exposure Factor Development

Once the activities comprising a particular subsistence lifestyle are known, they are translated into a form that is used for risk assessment. This translation captures the degree of environmental contact that occurs through activities and diet, expressed as numerical "exposure factors." While the portals of entry into the body are the same for everyone (primarily via the lungs, skin, mouth), the amount of contaminants may be increased and the relative importance of some activities (e.g., basketmaking, wetlands gathering), pathways (e.g., steam immersion or medicinal infusions) or portals of entry (e.g., dermal wounding) may be different than for the general population. Methods of food preparation, storage, and cooking can require vigorous exertion (such as grinding corn), or involve traditional storage methods (e.g., open-air drying or smoking) or cooking methods (e.g., cooking over an open fire or on hot rocks, or pit cooking). There are also many unique exposure pathways that

[4] National Park Service: http://www.cr.nps.gov/aad/cg/fa_1999/Subsist.htm
[5] http://arcticcircle.uconn.edu/NatResources/subsistglobal.html

are not accounted for in scenarios for the general public, but may be significant to people with certain traditional specialties such as basket or pottery making, flint knapping, or using natural medicines, smoke, smudges, paints and dyes. These activities may result in increased dust inhalation, soil ingestion, soil loading onto the skin for dermal exposure, or exposure via wounds, to give a few examples.

Foraging theory data from the anthropological literature is particularly useful for developing exposure scenarios because the major dietary and resource staples may be described, as well as how much time and effort is needed to obtain them. For example, each of the major activity categories includes activities that result in exposure to soil, and therefore to soil ingestion. By estimating the relative amount of time spent in activities that result in high, medium, or low soil exposure for each activity category, an overall soil ingestion rate can be estimated. However, there is no attempt to be overly quantitative in enumerating the myriad activities and resources in each category – this implies more precision than is warranted and is likely to include proprietary information that cannot be released. Lastly, a review of existing literature (paleomedical, biomedical,archaeological, anthropological and other disciplines) enables a double-check to determine whether multiple lines of evidence leads to a similar point for each exposure factor.

2. Environmental Setting

This section is intended to provide a general introduction to habitats and plant communities that are present in Elem territory. Baseline environmental conditions are approximated in this section. This is not a fixed year, but rather a condition of natural resources. In the case of Elem, baseline conditions refer to the early-contact time period when there were still ample resources and minimal land loss. For the Elem, this time period extends to as recently as 100 - 200 years ago, before the era of the large California irrigation projects and development of the California interior and the Clear Lake region.

2.1 The Elem People and their Environs

The California Culture flourished most vigorously in the larger river valleys and around Clear Lake, where ample food such as acorns, tubers, game and fish allowed time for material culture and a complex social structure to develop (Brown and Andrews, 1969). In the interior valley between the inner and outer Coastal ranges and including Clear Lake, the river valleys originally were filled with grass over 6 feet tall, with large game "so abundant like flocks of sheep" (Barrett, 1952). The overall territory of the Pomo peoples is north of San Francisco Bay approximately 130 miles north to south and 100 miles east to west. Pomo environments include the coastal and redwood belts, river valleys, and the Clear Lake area where Elem is located. It reaches from the coast to the Sacramento River in the interior California central valley (Baumhoff, 1978; Barrett, 1908).

Habitation around Clear Lake began at least 10,000 to 12,000 years ago (Willig et al., 1988; McLendon, 1978). Each cluster of village communities (or 'tribelet') was slightly different from the next, resulting in a wide range of cultures and seven languages. Elem, the largest of the southeastern Pomo villages, was located on Rattlesnake island (or Sulphur Bank Island) in Clear Lake, and two other smaller villages on Clear Lake ((McLendon, Handbook; Brown and Andrews, 1969; Willig et al., 1988).

The Elem culture exploits a wide range of resources and ecological niches. The Elem territory includes several vegetation zones, which allows the people to take advantage of seasonal diversity of resources (Heizer and Elasser, 1980). Clear Lake basin was characterized by unusual resource abundance which allowed or encouraged a complex social structure and beautiful artisanship (White, 1998; McLendon, 1977). Resources were so abundant that people did not have to travel far to obtain all they needed (McLendon, 1977). Travel between Clear Lake villages was invariably by balsa (tule stems bound together into boats).

Clear Lake is located in an area of California characterized Mediterranean climate, by considerable rainfall in winter and a long, hot, dry period in summer (mediterranean climate) (McLendon, 1977). The vegetation in the Elem area includes a few aquare miles of pine-fir forest, 150 square miles of oak woodland, and 53 square miles of chaparral types, as well as lake-marsh-riparian zones with "gallery" forests of oak, cottonwood, and willow along streams (Baumhoff, 1963; White et al., 2002; Anderson et al., 1997). The Elem area has two streams with Clear Lake cyprinid runs in spring (chi or Clear Lake hitch[6], pike minnow and sucker), and midsummer lakeshore runs of tule perch, Sacramento perch and blackfish.

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[6] Clear Lake Hitch, *Lavinia exilicauda chi* are a 'Species of Special Concern' in California. Clear Lake hitch are in the minnow family. Adults reach lengths of up to 14 inches and exceed one pound in weight. Clear Lake hitch

Briefly, the vegetation types and major species around Clear Lake are as follows (Goodrich 1980; White et al., 2002):

Originally there were very large marshes of willows and tule on Clear Lake, with large nesitng and spawning areas. The margins of the lake were almost completely surrounded by a fringe of tules, which have an "impressive number of uses" including houses, boats, clothing, plates, mats, diapers, beds, and food (Brown and Andrews, 1969).

Along the streams, the pepperwood or California laurel (*Umbellularia californica*) is much used. The willow (*Salix argyrophylla)* is particularly important as a basket material. Groves of alder (*Alnus rhombifolia*) are found near mountain streams and near springs. The wild grape (*Vitis californica*) occurs in the alder groves.

Dry slopes and hills typically have patches of mixed evergreen – oak, madrone (*Arbutus menzeii*), Douglas fir, pepperwood, with chestnut, other oaks, maple, and hazelnut in lesser quantities. The understory is manzanita, berries, other browse, plus grasses and forbs, with meadows with bulbs and clover.

Oak woodlands are dominated by black oak, often with ponderosa pine, Douglas fir, canyon live oak, madrone, scrub oak, and manzanita. Oak woodland: oaks, maple, and buckeye . The understory is mostly grass. One of the most common and striking trees is the white oak (*Quercus lobata*), which provided a great amount of food, both because of abundance and because of the "excellent flavor of the acorns." Other oaks of importance include the California black oak (*Q. california*), the Pacific post oak (*Q. garryana*), the tan-bark oak (*Q. densiflora*) and the maul oak (*Q. chrysolepis*).

Oak grassland contains blue oak (*Q. douglassi*), with gray pine, California buckeye, toyon, poison oak, and various grasses (*Bromus* spp, wild oats, fescue, filaree (*Erodium*), bluegrass (*Poa spp*), three-awn (*Aristida*), and needlegrass (*Stipa*).

Chaparral is a patchy composite of scrub oak, chamise-dominated brush, and ceanothus-dominated brush.
Oak chaparral includea scrub oak, leather oak, and live oak, with whiteleaf manzanita, California buckeye, Jepson ceanothus, chamise, and sargent cypress.
Chamise-dominated chaparral contains chamise, with wedgeleaf ceanothus, Eastwood manzanita, creeping sage, toyon, Stanford manzanita, and Fremont silktassel.
Ceanothus-domiated chaparral contains ceanothus, common manzanita, hoary manzanita, bracken, foothill ash, and chamise

2.2 Watersheds

Many Tribal homelands are defined in terms of watershed boundaries with the water source in the center (rather than the western habit of using rivers as peripheral boundaries). This is because native peoples use entire river valleys with their ranges of elevation from the river

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are a unique subspecies; the word "chi" acknowledges the name given to this species by Pomo Indians, the native people of the Clear Lake basin. http://www.nativefish.org/articles/hitch.php bottoms to the boundary ridges or mountains, and utilized the associated seasonal patterns of resource availability.

California watersheds are shown below (Figure 1).

http://cwp.resources.ca.gov/browser/

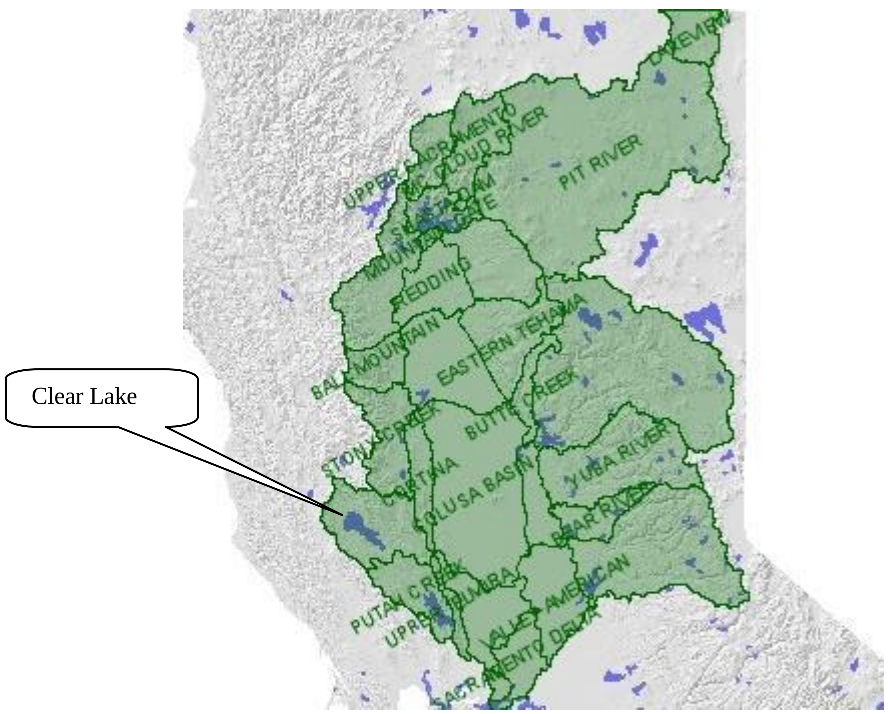
Figure 1 California watersheds

The lefthand panel indicates the location of the Sacramentio River watershed (Figure 2). The middle and right-hand panels show the Clear Lake region (Cache Creek).

(http://cwp.resources.ca.gov/browser/

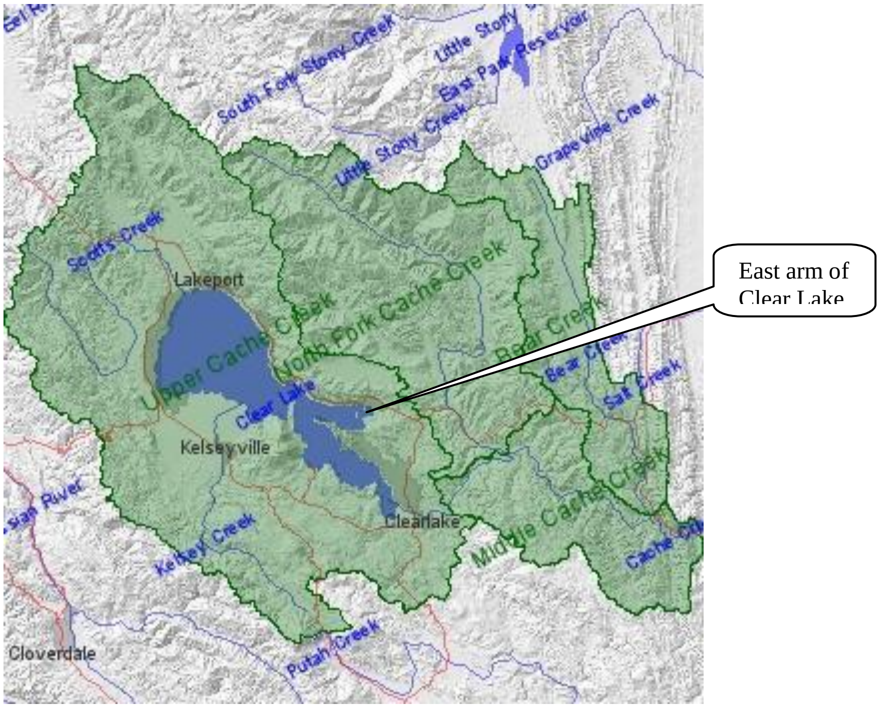
Figure 2Clear Lake region

Enlargements of the thumbnails are shown below (Figure 3).



http://cwp.resources.ca.gov/browser/search.epl?idnum=05;name=;mode=

Figure 3 Sacramento River basin, from



http://cwp.resources.ca.gov/browser/search.epl?idnum=05513;name=;mode=

Figure 4 Cache Creek subregion

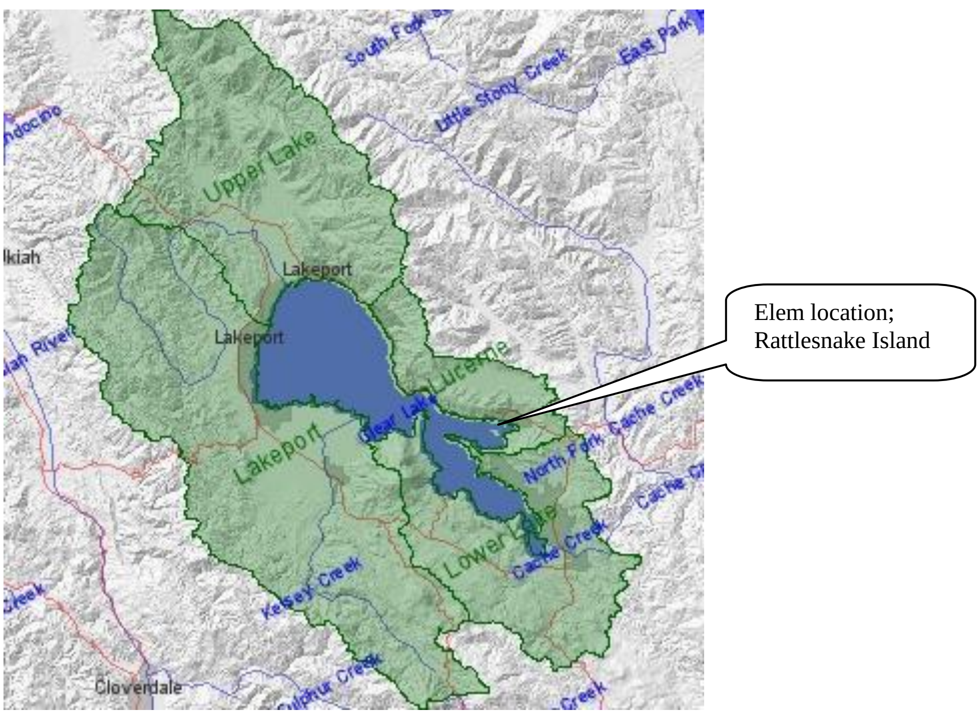
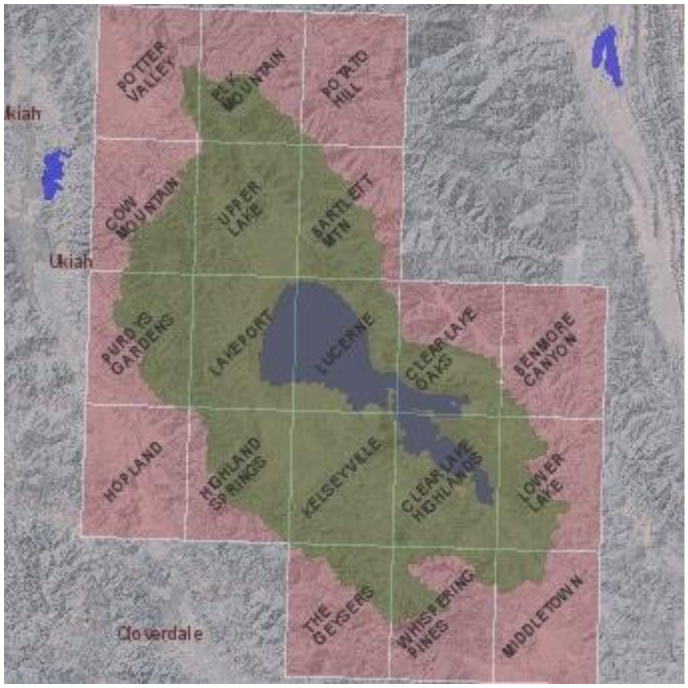


Figure 5 Upper Cache Creek subregion.

Rare species identified by the California Department of Fish and Game presently occuring in the Clearlake Oaks and Clearlake Highlands quads shown below are from the following web page: http://cwp.resources.ca.gov/browser/cnddbQuery.epl?quadcode=3912216&quadname=Clearlake%20oaks



USGS Quad: Clearlake oaks (3912216) Species information provided by WHDAB **Close**

Elm Code	Scientific Name	Common Name	Fed Status	Cal Status	Sensitive
AFCQB07010	Archoplites interruptus	Sacramento perch	None	None	N
PDERI04271	Arctostaphylos manzanita ssp. elegans	Konocti manzanita	None	None	N
CTT61420CA	Great Valley Mixed Riparian Forest	Great Valley Mixed Riparian Forest	None	None	N
AFCJB19011	Lavinia exilicauda chi	Clear Lake hitch	None	None	N
PDAST5N0F0	Layia septentrionalis	Colusa layia	None	None	N
PMPOT03160	Potamogeton zosteriformis	eel-grass pondweed	None	None	N

USGS Quad: Clearlake highlands (3812286) Species information provided by WHDAB **Close**

Elm Code	Scientific Name	Common Name	Fed Status	Cal Status	Sensitive
AFCQB07010	Archoplites interruptus	Sacramento perch	None	None	N
PDERI04271	Arctostaphylos manzanita ssp. elegans	Konocti manzanita	None	None	N
CARA2520CA	Clear Lake Drainage Resident Trout Stream	Clear Lake Drainage Resident Trout Stream	None	None	N
CTT52410CA	Coastal and Valley Freshwater Marsh	Coastal and Valley Freshwater Marsh	None	None	N
ABNRB02022	Coccyzus americanus occidentalis	western yellow-billed cuckoo	Candidate	Endangered	N
IICOL5A010	Dubiraphia brunnescens	brownish dubiraphian riffle beetle	None	None	N
ARAAD02031	Emys (=Clemmys) marmorata marmorata	northwestern pond turtle	None	None	N
PDPLM03020	Eriastrum brandegeeae	Brandegee's eriastrum	None	None	N
PDAPI0Z0W0	Eryngium constancei	Loch Lomond button-celery	Endangered	Endangered	N

PDAST650A0	Harmonia hallii	Hall's harmonia	None	None	N
IIHYM68020	Hedychridium milleri	None	None	N	
PDLIN01020	Hesperolinon bicarpellatum	two-carpellate western flax	None	None	N
PDROS0W010	Horkelia bolanderi	Bolander's horkelia	None	None	N
PDAST5L010	Lasthenia burkei	Burke's goldfields	Endangered	Endangered	N
AFCJB19011	Lavinia exilicauda chi	Clear Lake hitch	None	None	N
PDPLM0C0E1	Navarretia leucocephala ssp. bakeri	Baker's navarretia	None	None	N
PDPLM0C0E4	Navarretia leucocephala ssp. pauciflora	few-flowered navarretia	Endangered	Threatened	N
PDPLM0C0E5	Navarretia leucocephala ssp. plieantha	many-flowered navarretia	Endangered	Endangered	N
CTT44131CA	Northern Basalt Flow Vernal Pool	Northern Basalt Flow Vernal Pool	None	None	N
CTT44133CA	Northern Volcanic Ash Vernal Pool	Northern Volcanic Ash Vernal Pool	None	None	N
PMPOT03160	Potamogeton zosteriformis	eel-grass pondweed	None	None	N
AAABH01050	Rana boylii	foothill yellow-legged frog	None	None	N
PDCRA0F020	Sedella leiocarpa	Lake County stonecrop	Endangered	Endangered	N

2.3 General Environmental Setting

"The entire region abounds in oaks of many kinds, and it is from these that the chief supply of vegetable food of the Indians was derived."

The basic premise of understanding ecologically-based lifeways is that people adapt their activities and diets to their local ecological region in order to survive and prosper. Therefore, the description of the environmental setting begins with the identification of natural ecological zones, or ecoregions. Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components (Bryce et al., 1999). Ecoregions are general purpose regions that are critical for structuring and implementing ecosystem management strategies across federal agencies, state agencies, and nongovernment organizations that are responsible for different types of resources in the same geographical areas (Omernik et al., 2000).

Ecological diversity is strongly related to its varied climate, terrain, geology, and soil, and largely track the watersheds and physiographic regions shown above. In North America, several broad climatic zones are recognized, roughly corresponding to temperature and moisture gradients. North American vegetation types roughly track these same zones, such as the marine west coast, Mediterranean California and northwestern forested mountains relevant to the Elem scenario. Because these zones are defined by dominant vegetation types, the composition of plant and animal species is fairly predictable for the dominant species. Local differences in geology (soils and deeper substrates), elevation, aspect, and climate (light, temperature, precipitation and wind), and water (streams, wetlands) affect individual plant associations.

A hierarchical scheme has been adopted for different levels of ecological regions, and is being used by the US Environmental Protection Agency (USEPA)[7]. Level I is the coarsest level, dividing North America into 15 ecological regions. Level II divides the continent into 52 regions. At level III, the conterminous United States has 84 (USEPA, 2005). Methods used by the USEPA to define the ecoregions are explained in Omernik (1995, 2004), Omernik et al. (2000), Gallant et al. (1989); and Bailey (US Forest Service)[8]. The approach used to compile these ecoregion maps is based on the premise that ecoregions can be identified through the analysis of the spatial patterns and the composition of biotic and abiotic characteristics that affect or reflect differences in ecosystem quality and integrity (Wiken, 1986; Omernik, 1987, 1995). These characteristics include physiography, geology, climate, soils, land use, wildlife, fish, hydrology, and vegetation including "**potential natural vegetation,**" defined by *Kuchler* as vegetation that would exist today if human influence ended and the natural vegetation were restored (including the earlier fire regime of mixed natural and indigenous origin, and natural flooding).

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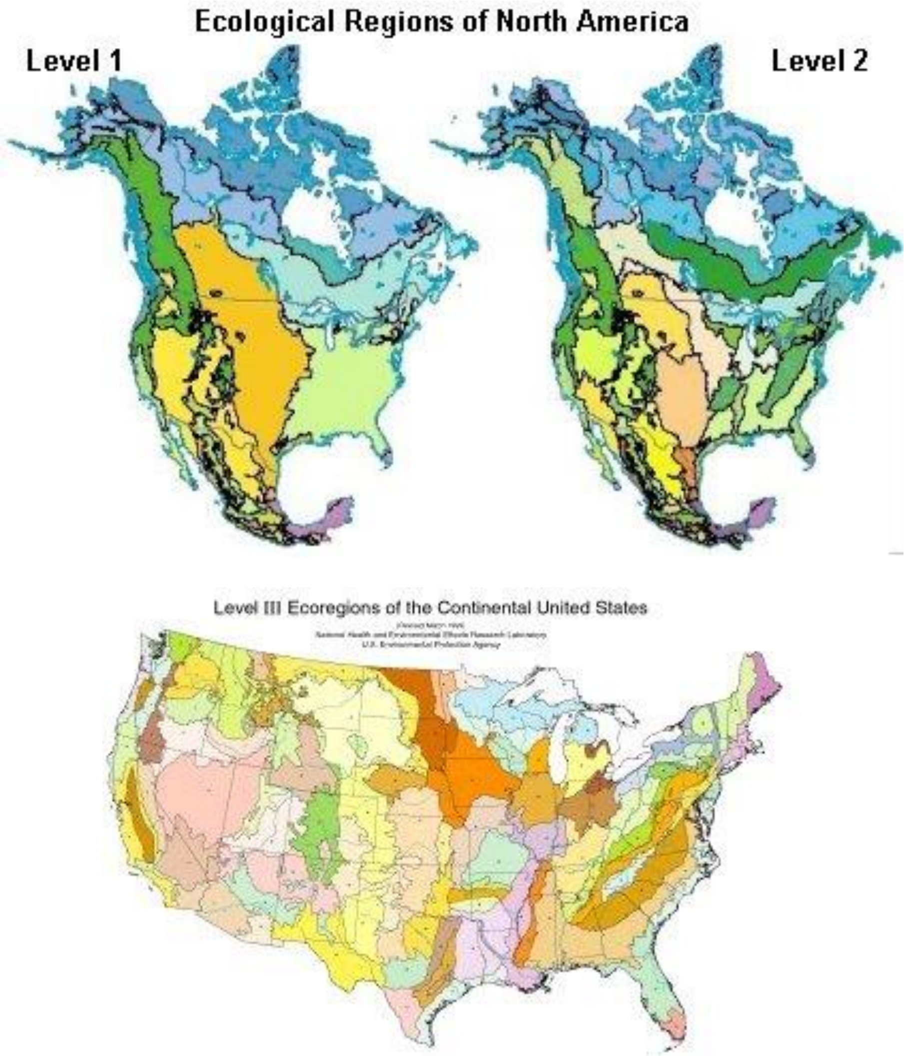
[7] http://www.epa.gov/wed/pages/ecoregions.htm and http://www.cec.org/files/PDF/BIODIVERSITY/eco-eng_EN.pdf

[8] USFS Bailey province ecology: http://www.fs.fed.us/land/pubs/ecoregions/intro.html



from: http://www.epa.gov/bioindicators/html/usecoregions.html

Figure 6 Level 1, 2, and 3 Ecoregions

2.3.1 Ecoregion Delineations and Vegetation Types:

Within the general Pomo territory the ecoregions have been refined down to Level III detail. The ecoregions that exist in this area are listed below from coarsest description (Level I) to a more precise description (Level III):

6 Northwestern Forested Mountains (Level I)
6.2 Western Cordillera (Level II)
6.2.11 Klamath Mountains (Level III)

7 Marine West Coast (Level I)
7.1 Marine West Coast (Level II)
7.1.8 Coast Range (Level III)

11 Mediterranean California (Level I)
11.1 Mediterranean California (Level II)
11.1.1 Southern and Central Chaparral and Oak Woodlands (specific to the Clear Lake area) (Level III)
11.1.2 Central California Valley (Level III)

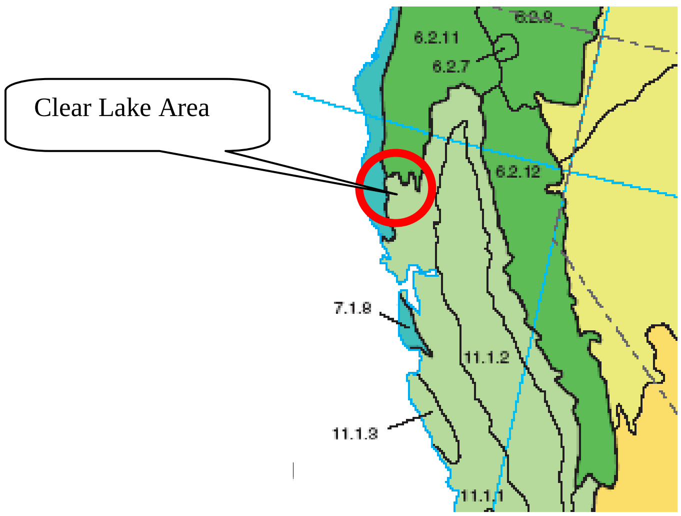


Figure 7 Level III ecoregions

Northwestern Forested Mountains (6)
Marine West Coast (7)
Mediterranean California (11)
http://www.epa.gov/wed/pages/ecoregions/na_eco.htm#Level%20II

Level I and Level II Ecoregions: Northwestern Forested Mountain and Western Cordillera

The Level I and II ecoregions are large and encompass many subtypes and subregions. The boundaries of the Northern Forest ecological region extend from Alaska south through southern Yukon, interior British Columbia and the Alberta foothills, through northern California and across into Nevada. The highest mountains of North America are a part of this ecological region. The mosaic ecosystem types include some of the continents most diverse, ranging from alpine tundra to dense conifer forests to dry sagebrush and grasslands (CEC, 1997). Wide valleys and lowlands separate extensive mountains and plateaus. Moraine covers most of the plains and valleys with fluvial and lacustrine deposits. The mountains consist largely of colluvium and rock outcrops. At higher elevations numerous glacial lakes occur (CEC, 1997). Soils are variable, encompassing shallow soils of alpine sites and nutrient-poor forest soils of the mountain slopes, as well as soils suitable for agriculture and those rich in calcium that support natural dry grasslands (CEC, 1997).

Climate characterization of the ecological region are also highly variable dependent on elevation. The climate is subarid to arid and mild in southern low valleys, humid and cold at higher elevations within the central reaches, and cold and sub arid in the north. Moist Pacific air and the effect of orographic rainfall control the precipitation pattern such that both rain shadows and wet belts are generated, often in close geographic proximity to each other (CEC, 1997).

The region escaped extensive glaciation which provided long periods of relatively favorable conditions for species to adapt to specialized conditions. Shifts in climate over time have helped make this ecoregion a junction and transition zone for several major biotas, namely those of the Great Basin, the Oregon Coast Range, the Cascades Range, the Sierra Nevada, the California Central Valley, and the Coastal Province of Northern California (Ricketts, 1999). Vegetative cover is extremely diverse: alpine environments contain various herb, lichen and shrub associations; whereas the subalpine environment has tree species such as lodgepole pine, subalpine fir, silver fir, grand fir, and Engelmann spruce. With decreasing elevation, the vegetation of the mountainous slopes and rolling plains turns into forests characterized by ponderosa pine; interior Douglas fir; lodgepole pine and aspen in much of the southeast and central portions; and western hemlock, western red cedar, Douglas fir and western white pine in the west and southwest (CEC, 1997).

The rugged coastal mountains of northwestern California and southwestern Oregon harbor one of the four richest temperate coniferous forests in the world, with complex biogeographic patterns, unusual community assemblages, and up to seventeen different species of conifers in one square mile. Many of the pines and firs here live for hundreds of years and provide habitat for the marbled murrelet, northern goshawk, and spotted owl. Some trees, such as the Brewer spruce and Port Orford cedar, are ice-age survivors and are found nowhere else on Earth.

Level III Northwestern Forested Mountain and Western Cordillera Ecoregion: Klamath Mountains (6.2.11)

The most specific Level III ecological description relevant to the Elem Pomo territory is the Klamath Mountains Ecoregion. This ecological region is physically and biologically diverse. Highly dissected, folded mountains, foothills, terraces, and floodplains occur and are underlain by igneous, sedimentary, and some metamorphic rock. The mild, subhumid climate of the Klamath Mountains is characterized by a lengthy summer drought. It supports a mix of northern Californian and Pacific Northwest conifers (USEPA, 2006b)

The rugged coastal mountains give this region the nickname "the Klamath Knot." Within the ecoregion, varied habitats range from wet coastal temperate rain forests to moist inland forests and includes the largest concentration of wild and scenic rivers in the United States. The diverse habitats that make up this ecoregion are filled with unusual communities and many species found nowhere else in the world. An estimated 3,500 native plants species are found here (National Geographic, 2005). The extraordinary biodiversity of this ecoregion may be due to the fact that the region escaped extensive glaciation during recent ice ages, providing both a refuge for many species and long periods of relatively favorable conditions for species to adapt to specialized conditions. The mosaic of habitats in this region includes the highly toxic serpentine soils, hosting many specialized plants. Rivers and streams here teem with freshwater mussels, nine species of native salmon and trout, and many species of snails and salamanders that are restricted to small areas.

Level I and Level II Ecoregions: Marine West Coast

This large ecological region covers the mainland and offshore islands of the Pacific Coast from Alaska south to central California. The wettest climates of North America occur in this area. It is characterized by mountainous topography bordered by coastal plains, and contains all of the temperate rain forests found in North America (CEC, 1997).

Mountainous topography dominates, cut through by numerous fjords and glacial valleys, and bordered by coastal plains along the ocean margin. Igneous and sedimentary rocks underlie most of the area. Colluvium and morainal deposits are the main surface materials. The soils are largely leached, nutrient-poor forest soils. The Queen Charlotte Islands and the part of Vancouver Island that escaped glaciation are unique because they now contain many endemic species: that is, ones that are peculiar to those habitats. Ice-free coastal waters are associated with the narrow continental shelf and slope. The region has some of the most productive rivers for salmon production and there are many important estuaries (CEC, 1997).

The nearness of the Pacific Ocean moderates the climate. This maritime influence is responsible for a high level of precipitation, long growing season and moderate temperatures. The annual precipitation ranges from as little as 600 mm in the Gulf of California (Baja) and San Juan Islands to over 5,000 mm along the north coast of British Columbia and Alaska. Overall the windward slopes typically receive between 1,500 to 3,000 mm of precipitation per year (CEC, 1997).

Variations in altitude create widely contrasting ecological zones within the region. They range from mild, humid coastal rain forest to cool boreal forests and alpine conditions at higher elevations. The forests in of this ecoregion are among the most productive in the world, characterized by large trees, substantial woody debris, luxuriant growths of mosses and lichens on trees, and abundant ferns and herbs on the forest floor (Ricketts, 1999). Riparian forests of this ecoregion are quite distinct from the Douglas fir-hemlock forests. Broadleaf species such as black cottonwood and red alder replace the otherwise ubiquitous conifers along the many rivers and streams of the Pacific Northwest. Occasional grasslands, sand dune and strand communities, rush meadows and marshes, and western red cedar and alder swamps, these last often formed by beaver activity, break up the conifer forests (Ricketts, 1999).

The temperate coastal forests are composed of mixtures of western red cedar, yellow cedar, western hemlock, Douglas fir, amabalis fir, Sitka spruce, California redwood and red alder. Although Douglas fir is the most abundant species at lower elevations, western hemlock is the major climax species. Douglas fir typically dominates young forests because of its relatively large and hardy seedlings and rapid growth rate (Ricketts, 1999). The central pacific coastal areas experience frequent clouds and fog, with most precipitation occurring in the winter (Ricketts, 1999). In the drier rain-shadow areas, Garry oak and Pacific madrone occur with Douglas fir. Sub-alpine forests are characterized by mountain hemlock and amablis fir (CEC, 1997).

Redwoods range from central California to the Oregon border and are typically found within 40 miles of the coast. Redwood groves are patchily distributed among a variety of natural communities found within this coastal belt, including Douglas fir-tan oak forests, oak woodlands, closed-cone pine forests, bogs, and coastal grasslands. Redwood groves have the greatest biomass accumulation known for any terrestrial ecosystem. They are globally unique forests. Redwood-dominated forests tend to occur in valley bottoms, where there is abundant fog drip, alluvial soils, and floods about every thirty to sixty years (Ricketts, 1999).

Level III Marine West Coast Ecoregion: Coast Range (7.1.8)

The most specific Level III Ecoregion relevant to the Elem Pomo is the Coast Region. Highly productive, rain-drenched coniferous forests cover the low mountains of the Coast Range. Sitka spruce forests originally dominated the fog-shrouded coast, while a mosaic of western red cedar, western hemlock, and Douglas fir blanketed inland areas. The most distinguishing feature of the Northern California Coastal Forests ecoregion is its redwood trees, generally found within 40 miles (65 kilometers) of the coast. The ancient redwood trees that dominate the Northern California Coastal Forests ecoregion are among the biggest, tallest, and oldest trees in the world. The life that flourishes within these ancient forests is highly diverse. In fact, only a few other forests in the world can compare in terms of their complex structure and biodiversity. From the luxuriant growth of moss and fungi on the forest floor to the rare marbled murrelets that nest only in ancient trees, these towering giants support communities of plants and animals much more diverse than those found in younger forests. On uplands where fire disturbance was once more common, a diversity of other big trees mix with the giant redwoods. These include Douglas fir, grand fir, western red hemlock, Sitka spruce, western red cedar, tanoak, bigleaf maple, California bay, and Port Orford cedar. These forests contain a rich understory of herbaceous plants, shrubs, treelets, ferns, and fungi, as well as a great diversity of animal life.

Level I and Level II Ecoregions: Mediterranean California

This ecological region extends 1,300 km from Oregon in the north to Baja California Norte in the south. It abuts the Pacific Ocean on the west and the Sierra Nevada and deserts to the east. It is distinguished by its warm and mild Mediterranean climate, its shrubland vegetation of chaparral mixed with areas of grassland and open oak woodlands, its agriculturally productive valleys (CEC, 1997). The most specific ecological description of the Elem Pomo territory is the Mediterranean California region, at the boundary of the Northwestern Forested Mountains and Marine West Coast ecoregions. The ecological region is comprised of a mixture of mountains, hills, tablelands and plains. It occupies an area of tectonic instability at the interface of the North American and Pacific tectonic plates and contains a variety of active faults. The coastal ranges contain a series of linear mountain ranges with crests averaging 600–1,200 m with interspersed valleys. The central valley is a broad trough containing the Sacramento and San Joaquin rivers that drain into the delta area and San Francisco Bay. The flat valley is filled with large quantities of silt, sand and gravel washed down from surrounding mountains. In Southern California, the rugged transverse ranges form the northern border of the Los Angeles Basin, and include the highest peak in the region, Mount San Gorgonio at 3,506 m. The peninsular ranges have peaks of 1,500–3,000 m and include the San Jacinto, Santa Ana and Laguna mountains of Southern California, and the Sierra Juárez and Sierra San Pedro Martir of Baja California. Lower hills, valleys and coastal terraces parallel the coast, and there are several islands across the Santa Barbara and San Pedro channels. Soil patterns are complex, mostly dry, and weakly developed with high calcium concentrations.

This ecological region is the only portion of the continent with a dry summer Mediterranean climate. This climate is characterized by hot, dry summers and mild winters, with precipitation associated with winter frontal storms from the Pacific Ocean. The average summer temperatures are above 18ºC and average winter temperatures are above 0ºC. Annual precipitation is 200–1,000 mm depending on elevation and latitude, and falls mostly from November to April. The Clear Lake area receives somewhat less precipitation than the San Francisco average of 500 mm. There is a great annual variability of total precipitation, and extreme droughts are not uncommon. Coastal fog is common, particularly from May through July. The frost-free period ranges from 250 days in the north and on uplands to 350 days along the southern coast (CEC, 1997).

The Mediterranean California region is characterized by mostly evergreen shrub vegetation called chaparral, plus patches of oak woodland, grassland, and some coniferous forest on upper mountain slopes. The chaparral has a thickened, hardened foliage resistant to water loss, and forms a cover of closely spaced shrubs 1 to 4 m tall. Common shrubs include chamise, buckbrush or ceanothus, and manzanita. Coastal sagebrush, summer-deciduous plants that tolerate more xeric, or dry, conditions than the evergreen chaparral, are found at lower elevations (CEC, 1997).

The central valley of Mediteranean California originally supported a diverse array of perennial bunchgrass ecosystems including praries, oak-grass savannas, and desert grasslands, as well as a mosaic of riparian woodlands, freshwater marshes, and vernal pools. In its original state, it comprised one of the most diverse, productive, and distinctive grasslands in temperate North America. Perennial grasses that were adapted to this cool-season growth dominated the habitats. Most growth occurred in the late spring after winter rains and the onset of warmer and sunnier days. Interspersed among the bunchgrasses were a rich array of annual and perennial grasses and forbs, the latter creating extraordinary flowering displays during certain years. Some extensive mass flowerings of the California poppy, lupines, and purple owl clover still occasionally occur in several areas and are now best known from Antelope Valley in the Tehachapi foothills (Ricketts, 1999).

Level III Ecoregions: Southern and Central Chaparral, Oak Woodlands, Central California Valley (11.1.1)

The most specific ecological descriptions of the Elem Pomo territory are the Southern and Central Chaparral and Oak Woodlands and the Central California Valley Ecoregions:

SOUTHERN AND CENTRAL CHAPARRAL AND OAK WOODLANDS

The primary distinguishing characteristic of this ecological region is its Mediterranean climate of hot dry summers and cool moist winters, and associated vegetative cover comprising mainly chaparral and oak woodlands; grasslands occur in some lower elevations and patches of pine are found at higher elevations. Most of the region consists of open low mountains or foothills, but there are areas of irregular plains in the south and near the border of the adjacent Central California Valley ecological region that this region encircles.

Many species of oaks are native to this area: blue, scrub, coast live, canyon live, golden-cup, valley, interior live, and maul. In several areas within this ecoregion, a base of serpentine rock supports several species of pines and cypresses, including Sargent and

McNab cypress, as well as leather oak, interior silktassel, milkwort streptanthus, and Muir's hairstreak, all plants that thrive in areas where this type of rock is common.

Mammals are diverse in this area, making up 10 percent of the 60 endemic species found here -- the largest number of endemic mammals in any ecoregion in the United States or Canada. Sonoma chipmunks, Suisun shrews, salt marsh harvest mice, and many species of kangaroo rats all call the area home. A variety of plethodontid, or lungless, salamanders also live here, including five endemics. Scrub jays, acorn woodpeckers, and wrentits are three of the area's 100 species of birds. Unusual invertebrates found here include army ants, ancient bristletails, and land snails.

This ecoregion supports over 2000 species of plants in addition to trees. This is probably due to the fact that the area is a mosaic of grasslands, chaparral shrublands, open oak savannas, oak woodlands, serpentine communities, closed-cone pine forests, pockets of montane conifer forests, wetlands, salt marshes, and riparian forests. The ecoregion also ranges in elevation from 300 feet (90 m) to 3,000 feet (900 m). Oak woodland and chaparral are the most common plant communities. In the ecoregion's valleys are found foothill pines, California buckeye, manzanita, redbud, and chamise.

CENTRAL CALIFORNIA VALLEY

These flat plains havie long, hot dry summers and cool moist winters which distinguish this ecological region from neighboring regions that are either hilly or mountainous, forest or shrub covered. California's Central Valley was once a large temperate grassland with bunch grasses, the California Central Valley grasslands ecoregion, which was formerly home to great herds of grazing pronghorn and Wapiti; some writers have referred to it as "America's Serengeti". California Central Valley once supported incredibly diverse habitats, including desert areas, prairies, savannas, woodlands, marshes, vernal pools (seasonal wetlands), and an immense river delta.

The grasslands of the California Central Valley once provided plentiful food for pronghorn, elk, mule deer, California ground squirrels, and kangaroo rats. Their predators included coyotes, mountain lions, ringtails, bobcats, and San Joaquin Valley kit foxes, which are now a federally endangered species found only in the southern California Valley foothills. River areas were lined by a wide swath of trees such as willows, western sycamores, box elders, Fremont cottonwoods, and valley oaks. These riparian forests provided stopover points and breeding areas for huge flocks of birds migrating all the way from the tropics. They were also home to the valley elderberry longhorn beetle, now a federally endangered species. Some vernal pools are also the home of the rare Delta green ground beetle. The marshes of the valley's delta area provided food and shelter for thousands of waterfowl during the winter.

3. REGIONAL ECOLOGICAL LIFEWAYS

This section describes the ecologically-based lifeways and traditional resource uses that comprises the traditional Elem subsistence lifestyle. In economic terms, a subsistence economy is one in which typical currency is limited because many goods and services are produced and consumed by the families or bands that produce them. However, the subsistence economy does include currencies of goods, services, knowledge, obligation, and respect, as well as ‘money’ or symbols of work that are used to ‘buy’ goods or services whose use is displaced in time and space from their production. Examples of money include wampum and, today, dollars. However, wealth could be measured in other ways, including the security that comes from an abundance of respect that ensures that resources will be provided to the family even in lean times, as well as in community well-being and sensory loading from the beautiful and aromatic natural surroundings.

Subsistence activities include traditional and modern technologies for harvesting and preserving foods as well as for distributing the produce and cash through communal networks of sharing and bartering. Stored foods include dried fish, seeds, acorns, buckeyes, pepperwood nuts, with seasonal supplementation with fresh vegetal foods such as berries, clover, roots and bulbs. Everyone participates in subsistence activities, and most had additoinal specialties such as knowing all the uses of a particular resource (Gifford, 1926).

3.1 Traditional Resource Management

Early settlers who arrived in central California saw a verdant carpet of grass with scattered live oaks and manzanita bushes that reminded them of a well tended garden. This is because California was not “wilderness” but many carefully managed habitats and plant communities that supported large populations through exceptionally effective extractive and storage technology (Blackburn and Anderson, 1993). Throughout the state, many areas were cared for by families and knowledge was passed on to each generation. Individual families took care of individual oak trees. Mosaic vegetation and biodiversity were deliberately encouraged. Cultivating favored plants in different patches was common among all of the Pomo tribes, as well as weeding, pruning, irrigation, sowing, selective harvesting, and tilling. Methods for gathering mimic natural disturbance; for example, the root harvest tool (digging stick) does not harm the resource, but loosens the soil. Pomo women also weeded sedgebeds to loosen the soil and remove impediments to rhizomes radiating from each plant, promoting the untangled, long underground stems desireable for basketry material (Anderson, 1973; Anderson, 1997). Coppicing (encouraging annual shoots of basket materials) was also practiced.

Natural fire caused by summer lightning strikes not associated with rain are an important component of the Mediterranean climate. Until suppression policies around 1900, late summer and eraly fall fires were an expected natural event, with a natural fire interval of 10-50 years in each location (in addition to more frequent fire regimes employed by the native peoples). Thus, intense destructive fires were rare. California plants not only evolved with fire, but some require fire. Without fire, brush can become dominant. With fire, grasses and young shoots provide deer browse. The chaparral also becomes dense and reduced in browseability without fire, and forbs are inhibited. Certain species were known to better with annual burning, others did better with burning every several years, and so on (Anderson et al., 1997; Lewis, 1993). Native people understood the relation of plant and fire cycles and employed fire to maintain browse, reduce catastrophic fire hazard, and encourage germination of native plants and growth of native forbs. Undergrowth was controlled so forests were more open, meadows were kept clear, and marshes were deliberately fired to clear out dead plants, control disease and insects, and increase breeding areas and diversity.

3.2 Diversity of Resources and Annual Resource Cycles

The Clear Lake culture was centered on acorns, fish, game, and tule, and the year was structured around major resources. The annual natural cycle starts with fish runs in February and March. The lake was "teeming with fish" although fishing occurred primarily during spawning runs when each fish species in succession moves close to shore or into streams to spawn (McLendon, 1977) After the first fish runs, the first greens were ready, followed by young tule shoots and then angelica shoots and other early greens. In May-June the first tubers were ready for digging. A third tuber, Indian carrot, was ready in June-July. Manzanita berries ripened in late June – July, and were eaten fresh or dried and stored to be eaten in pinole during the winter. In July gooseberries and blackberries ripened, and freshwater clams were boiled and eaten. In July and August tule roots were collected, peeled and eaten. In spring and summer traps were set for various birds and small animals such as ground squirrels. Rabbits, deer and squirrels were hunted year round. In August – September wild cherries and grapes were ripe, and the grains for pinole were collected and stored. In the fall honey was collected. In October the acorns were ready. Buckeyes were gathered in November, then peppernuts, Indian tobacco, and dried milkweed stems (for twine). During the winter, stored food plus fresh birds, rabbits, deer and waterfowl were eaten (McLendon, 1977)

About 230 plant species are documented as used by Pomo bands in edible, medicinal, or material forms (Goodrich, 1980; Heizer and Elasser, 1980; Holmes 1975). Almost every kind of nut, berry, seed, bulb, and root was utilized in one way or another, as well as many kinds of leaves and young sprouts which were consumed as greens, flavorings, teas, or medicines (Barrett, 1952; Stewart 1943; Bibby 1992; Loeb 1926; McLendon, 1977). Goodrich documents that various Pomo bands used 11 species of plants for bread, 19 fruits, 11 greens, and around a dozen for pinole and/or atole. Many plants have pharmacologically active compounds for a wide range of ailments or conditions, including diabetes (black huckleberry leaves, *Vaccinium ovatum*), and many plants have both nutritional and medicinal qualities. Many plant species have material uses, including 14 materials used in baskets, 3 for fish poison, 4 for glue, and 5 for rope.

Acorns were the primary plant food, followed by roots and bulbs, seeds & nuts, berries, and greens (in that order), plus teas, medicines, sweets, salt and pepper, and tobacco (McLendon in Handbook). With the exception of the poisonous *Zygadenes,* all the bulbous plants were used foor food. A dozen kinds of bulbs were used (*Calochortus, Brodiaea, Allium, Hookera,* others), and the bulbs of various species of lilies were very important and more abundant in this region than in almost any other part of the state (Barrett 1908). Seeds included *Chenopodium* (chia), *Clarkia*, *Gallium* (bedstraw), *Madia* (tarweed), *Marah* (wild cucumber), *Pinus sabiana*, *Quercus*, Scirpus (tule), *Trifolium* (clover), *Umbellularia* (bay), *Vulpia* (fescue grasses), ans the Helianthae tribe of sunflowers. Berries include manzanita, strawberry, gooseberry, raspberry, thimbleberry, blackberry, elderberry, toyon, salmon berry, salal berry, and currant. Greens include clover, angelica, anise, poppy, fiddlehead, tule shoots and roots (3 species), and many others. Condiments included salt and pepper (pepper balls gathered from the pepper or bay tree, roasted, hulled and ground), and anise roots.

3.3 Dietary staples

Staple foods are those that are abundant, reliable, and/or storable. The foods that meet those requirements in the Clear Lake area are acorns, large game mammals, roots, seeds, and fish (Baumhoff, 1963). The stored foods were acorns (56%), fish (28%), and small seeds (14%). Acorns, seeds and nuts were most often made into the two staple forms of food, atole and pinole[9], that were used throughout California. A "typical meal was dried fish and acorn mush," and the components are available year-round in fresh and stored forms. The was supplemented with fresh meat or waterfowl when available, and fresh greens, roots, bulbs, berries, and fruits in season (McLendon and Lowy, 1978); McLendon, 1977).

Acorns

Acorns furnished the main article of diet and are the most characteristic California staple. Preference of various species of acorns depends on the use to which the acorns were to be put. In order of preference, the oaks are tan oak (*Lithocarpus densiflora*), black oak (*Quercus kellogii*), blue oak (*Q. douglasii*), valley oak (*Q. lobata*), coast live oak (*Q. agrifolia*), oregon oak (*Q. garryana*), Englemann oak (*Q. engelmannii*), maul oak (*Q. chrysolepis*), interior live oak (*Q. wislizenii*), and scrub oak (*Q. dumosa*) (Baumhoff, 1978).

Certain oak trees or patches of trees belonged to individuals (Barrett, 1952). A family could easily collect several ton of acorns. During an actual collection period, 100 pounds of acorns could be gathered in an hour, producing 50 pounds of kernels. The tan oak and black oak seed crop is about 125 pound per tree. The Oregon oak (*Q. garryana*) can produce 200 pounds or more per tree. Other species are also prolific, but some tend to have irregular crops (Baumhoff, 1963).

Every old photograph of Elem villages shows multiple granaries on stilts (Baumhoff, 1963). The smallest granaries were roughly the size of a 50 gallon barrel. A typical granary for a family of 6 measures 5 x 12 ft, holding 2440 kg (Heizer and Elasser, 1980). Acorn granaries were lined with wormwood or bay leaves to repel insects and worms (Fagan, 2003). Acorns in the shell could be stored up to 2 years. Because acorns as staples require intense harvesting when ripe, as well as storage of large amounts of acorns, the granaries were located at permanent settlements; or rather permanent settlelments or home bases were located near oak forests (Fagan, 2003). Acorns are labor-intensive to shell, winnow (to remove the skin), and pound, taking much longer than grass seeds. It takes 3 hours to convert 6 pounds of shelled acorns into 5.3 pounds of flour. A day's hard pounding provided enough flour for a family for several days. After pounding, the tannic acid is leached out, and the leached meal can be boiled as mush or baked as bread (Baumhoff, 1963).

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[9] Atole is a thick souplike food (mush) made from ground parched acorns or many other nutlike seeds. Pinole is the fine flour made from parched seeds. Balanophagy – acorn eating

Other nuts and seeds

Grass seeds, though abundant, also require intensive processing – hulling (breaking shells if large), milling (coarse grinding), and grinding into flour (Fagan, 2003). Pinole was the fine flour or meal made from parched, ground seeds such as tansy-mustard, chia, or many of the grasses and flowering annuals; this was eaten dry, pinch by pinch, or made into a mush with water. The meal also can be dampened and made into balls and eaten raw or cooked (Balls, 1962; Barrett, 1952).

Ground buckeye balls were also leached, but much more thoroughly, often for months. Pine nuts (digger and sugar pines) were eaten raw or roasted. California Bay nuts were picked in the spring, roasted and shelled, ground and stored for winter. Hazelnuts (and shoots for baskets) were gathered from carefully-managed patches.

Fish & Game

"While considerable fishing was done by the Pomo on the rivers, such as the Russian and Gualala, and off the rocks of the ocean shore, this profession reached its greatest complexity and perfection among the Clear Lake Pomo, who extensively used the rafts made out of bound tules, and developed elaborate nets and fish traps." At Clear Lake, also, fishing was more clealy a specialized profession where certain men did nothing but fishing and traded their catch for other things they needed. Often they fished all night when the fish fed. Fish were grilled, baked, and dried and smoked (Brown and Andrews, 1969). Large game included mule deer and black tail deer, Roosevelt and tule elk, and pronghorn antelope (Baumhoff, 1963).

Salt.

Various inland seepages occur where salt-bearing water (percolating upward through salt beds) evaporates and leaves crystallized salt on the surface of the soil. Often the crude salt is dissolved and recrystallized, which by chemical analysis is 99.2% NaCl. The crude salt is 28% insoluble material, still used raw and is still quite palatable (Mauldin, 1975). Sea salt was obtained during trips to the coast.

Clay used in bread.

It was a common culinary practice to mix ferruginous clay with acorn meal (one pint of clay to 3 quarts flour). The clay is referred to as 'Indian baking powder' (masil) and is somewhat sweet and helps the cake stick together. This clay is 10% FeO_2 by weight. The purpose of this clay was to convert the tannic acid of the acorn meal into an insoluble compound formed at the baking terperature, by reaction of the tannic acid with iron oxide (Mauldin, 1975; Stewart, 1943; Holmes 1975; Selinus et al., 2005).

4.0 Foraging Theory and the Regional Diet

Kelly (1995) describes the concepts of eco-cultural lifestyles, also known as foraging theory. In the 1960s to 1980s the "Man the Hunter" concept (with males providing most of the provender) prevailed due to a previous archaeological emphasis on hunting and warfare artifacts (Lee and Devore, 1968). This gave way in the 1980s and 1990s to a more balanced foraging model that emphasized plants as much as meat (and equality of genders in contributing to survival), and a relatively peaceful and secure "original affluent society" (Sahlins, 1972). The latter concept is supported by data (Kelly, 1995; Winterhalder, 1981) on the amount of time required to obtain survival necessities and to raise children, and the typically abundant amount of time available for socializing, education, ceremonies, material items, leisure, recreation, oratories, and so on. However, hunter-gatherers are not over-nourished, and face seasonal or cyclical shortages even though outright starvation is rare. The lifestyle is also "physically demanding" (Kelly, 1995), giving rise to discussions about the number of calories available or required as well as about the activity levels used to develop exposure factors.

Efficiency or return rate for specific resources in specific habitats is estimated using foraging theory by evaluating the amount of calories expended in getting food (search costs) by means of hunting, gathering, or fishing relative to time spent or calories obtained. Foraging information is typically presented as return rates, or net calories obtained per hour of effort. Additional factors such as biodiversity, abundance, and patchiness or continuity of resources result in time allocation decisions that are intentionally or unintentionally made by foraging societies, such as optimal diet breadth, optimal foraging area, and optimal foraging group size for a particular ecosystem (Winterhalder, 1981). Depending on the evaluation methods used in a particular study, this return rate data may include (1) time and calories spent in preparing to hunt, fish, or gather (e.g., making nets), (2) time and/or calories spent in the actual activity, and (3) time spent in the processing of the resource after obtaining it. The drawback of oversimplifying foraging solely to caloric efficiency is that micronutrients (vitamins, minerals, specific amino acids, and fatty acids), medicinal or pharmacologically active compounds, other nutritional requirements, and non-nutritional attributes such as aroma or dye or material uses are often not considered (Lindstrom, 1992). Similarly, many plants and animals have multiple uses or are co-located with other resources; therefore, caloric calculations must not ignore the way that people actually make decisions about where to go or what to gather, or the reasons they seek to obtain particular resources.

4.1 Foraging Studies for Central California

4.1.2 Broughton (1988) and White (2002)

Broughton (1988) evaluated the fauna of the Sacramento Valley, and developed a diet breadth model. White (2002) reviewed this approach and identified problems with this and other foraging models. For example, seasonal competetition affects choices if two resources are ready at the same time. Also, the "lonely forager" assumption are not generally applicable since resources are gathered by groups with different people procuring different resources. The Broughton model was modified by White to be suitable to the Clear

Lake area (by omitting salmon and pronghorn), although it still includes only animal resources (Table 1).

Table 1 Acquisition estimates

White's modification of Broughton's animal-based acquisition estimates (NAR – net acquisition rate)

Rank	***Resource.***	***Total kcal/indiv per animal***	***Pursuit hrs/kg***	***Processing hrs/kg***	***NAR Kcal/hr***
1	Tule elk	10,7248	0.0015	0.012	35749
2	Deer	42,900	0.0015	0.04	24710
3	Jackrabbit	1,103	0.025	0.05	14437
4	Cottontail	637	0.04	0.083	9391
5	Squirrel	309	0.085	0.1	5865
6	Duck	630	0.095	0.32	2342
7	Freshwater fish (slow water)	160	0.2	0.05	816

White then critiques these figures in several ways:

1. He concludes that they do not hold for the Clear Lake Basin. In particular, fish were greatly underestimated because they were not evaluated as they would be taken during spawning runs. Fish (hitch, blackfish, pike) were actually one of the highest ranked resources, at least during the various spawning seasons.

2. Turtles were not included, whereas they actually comprise a substantial fraction of small game bones in sites in appropriate locales, and more common in some assemblages than lagomorphs.

3. Over time, the ratios of fish to large game can change considerably for many reasons, including uses of non-edible parts such as bones for tools, etc.

4. Mollusks were not included, whereas they were used widely (western ridge mussel, *Gonidea angulata* and California floater mussel, *Anodonta californiensis*).
Clear Lake mussels were gathered by feeling them with bare feet.

4.1.2 Baumhoff (1963)

Baumhoff estimated acorn and game production from vegetation maps, which showed 22 vegetation types (in 1945). He reconstructed a pre-contact resource map from vegetation information, original soil maps, and historic range land studies. He identified vegetation types and rated them for acorn and game production, and identified stream miles and rated them for fish production. He then determined the size of each vegetation type and stream miles available to individual tribes, and weighted them according to productivity of game, acorns, and fish. For example, 60 square miles of chaparral, which ranks as a secondary acorn source, gives an index of 30 for acorns (60 mi^2 x ½). However, it ranks very high in game production, which is weighted double, giving a game index of 120, for a total index of 150 for 60 acres of chaparral. For individual Tribes, Baumhoff estimated the acreage of each vegetation type was, as well as the number of stream miles suitable for primary, secondary, or tertiary fish production.

Clear Lake is immediately surrounded primarily by oak woodland and chaparral, with nearby grassland and pine-fir forest. Oak woodlands rank at the highest level for the combination of game and acorn production, while grassland ranks highest level in game but lower for acorn density. Baumhoff ranks production of Clear Lake fisheries as equivalent to a secondary salmon stream in terms of total poundage. The Southeastern Pomo had 200 square miles of upland availalble, primarily oak woodland. He concludes that the ranking of resource availability for the Southeastern Pomo was as follows: game ranked slightly ahead of acorns, which ranked ahead of fish in terms of overall productivity. The central California Tribes generally used acorns and game more than fish; however, the Tribes immediately around Clear Lake used all three. Baumhoff estimated that Tribes living on primary salmon rivers relied on acorn : game : fish in an estimated ratio of 3 : 2 : 3. We extrapolate from this to a Clear Lake ratio of 3 : 2 : 2, accounting for a secondary rather than primary fish quantity.

4.2 Dietary Estimates

The approach used in describing an overall diet is to use the information about major resources present in the study area, foraging theory information, and information from the existing literature and interviews. An overall total caloric diet with rough proportions of different food groups in a typical traditional diet is shown below (Figure kk). This diet is reconstructed from information about what the traditional diet actually was, rather than what it might be today if USDA recommendations about daily intakes were followed substituting wild for domesticated foods.

The steps for reconstructing the Elem diet are:

1. Review foraging theory information presented above specific to the Tribe, the local ecosystem, and, if available, for the specific location under consideration;
2. Review ecological information for a rough estimate of resource abundance of natural resources under baseline conditions;
3. Review interviews and other ethnographic sources for supporting information of species and abundance, habitat types, human activity levels, and methods of obtaining, preparing and using resources;
4. Develop overall percentages of major food categories and major staples within the total diet;
5. Estimate calories provided by the diet, and compare estimates of percentages of quantities and percentages of calories;
6. Refine estimates of major staples and food categories after considering information about medicines, sweeteners, and other often-overlooked food/medicine types; macronutrients, and other factors.

The general order of vegetal resources used, in order, are acorns, roots and bulbs, seeds & nuts, berries, greens, and a general category for teas, medicines, sweets, salt and pepper, and tobacco (McLendon, 1978). The general order of animal resources is fish, large game, fowl, small game, shellfish, insects, and turtles. Heizer and Elasser (1980) combined vegetal and animal resource use into an approximate overall diet (Figure 8), based on earlier work, particularly Baumhoff, but also earliers authors who measured what was being stored.

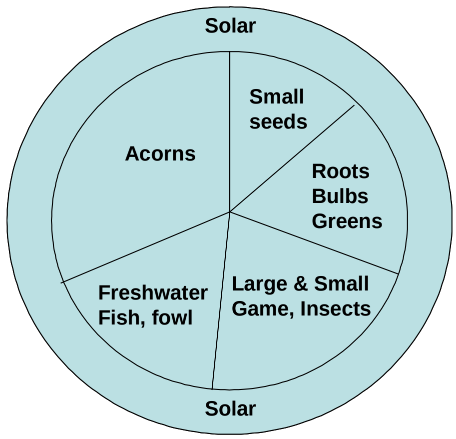


Figure 8 Diet estimate (Heizer and Elasser, 1980)

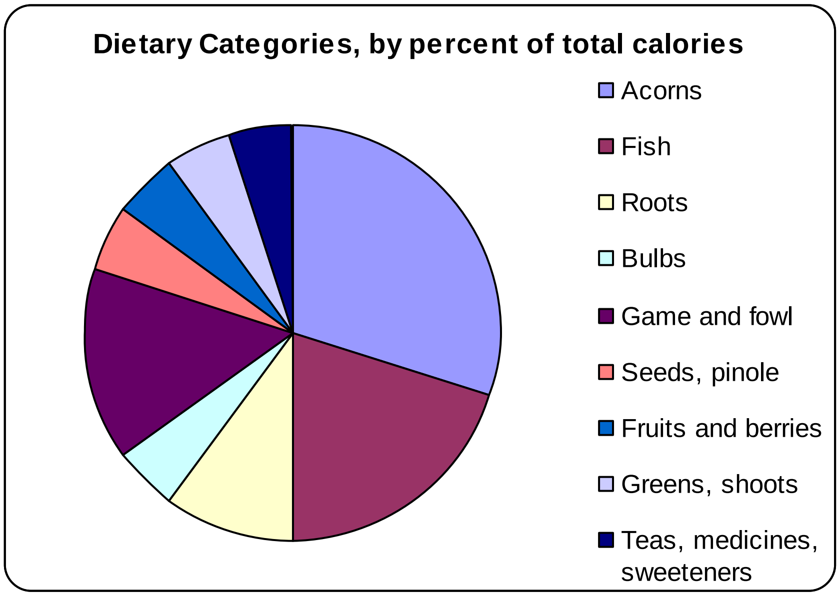
4.2.1 Percentage Estimates of Food Categories and Nutritional analysis

A brief nutritional analysis is presented here in order to cross-check the amounts eaten with an estimate of macronutrients that would be provided. This is done to ensure that a full amount of calories is accounted for, and the diet is roughly balanced within the ranges of other foraging diets. Based on the discussion above, an estimate of the complete diet is shown below in Table 2. Each food category is converted to calories, and then to grams per day. It is impossible to be more quantitative than a rough estimate of overall percentages given the lack of data on native foods—nutritional data on native foods are almost totally lacking. Therefore, all of the information in Table 2 is from the USDA database (except where noted) for an average member of the same or nearest plant or animal family (the "representative species" column in Table 2). Wherever specific information is available from the USDA database, such as for game species, it is used. Where possible, the data for fresh or cooked foods matches the form of native plants eaten. It is recognize that domesticated species of plants have been bred for certain characteristics such as low fiber content, more sweetness, and other characteristics. Tribal members often refer to wild varieties as "stronger" than domesticated varieties, but the actual nutritional or biochemical attributes that this refers to are not known. Figure 9 illustrates the derived diet by percent of calories and by grams per day. The latter illustration is more comparable to conventional food pyramids, which are shown by number of servings.

Table 2 Summary of estimated relative proportions of dietary foods.

Calorie estimates are from the USDA nutrient database (http://www.nal.usda.gov/fnic/foodcomp/search/). One pound = 454 grams.

Resource	***Estimated percent of annual diet***	***% x 2000 kcal = daily calories***	***Calorie estimate per 100 grams of representative species***	***Daily amount (grams/day)***
Acorns	30	600 kcal	Dried acorns & acorn flour - 500	120
Fish	20	400 kcal	Mixed trout, cooked - 190	200
Roots, tubers, rhizomes, corms	10	200 kcal	Raw Chicory root - 73 Potato (baked tuber) - 93	250
Bulbs	5	100	Leek, onions and bulbs (bulb & leaf) – 31	360
Game (large and small) and waterfowl, other animal species	15	300 kcal	Deer, roasted - 158 Rabbit, wild, roasted – 173 Quail, cooked - 234	200
Seeds, pinole, atole	5	100 kcal	Raw dried sunflower seeds – 570; Sesame seed flour - 526	20
Fruits and berries	5	100 kcal	Raw elderberries - 73	140
Greens, shoots	5	100 kcal	Raw dandelion greens – 45 Raw watercress - 11	333
Teas, medicines, sweeteners	5	100 kcal	Honey - 304	36
totals	***100%***	***2000 kcal***	***-***	***1660 g (3.6 lbs)***



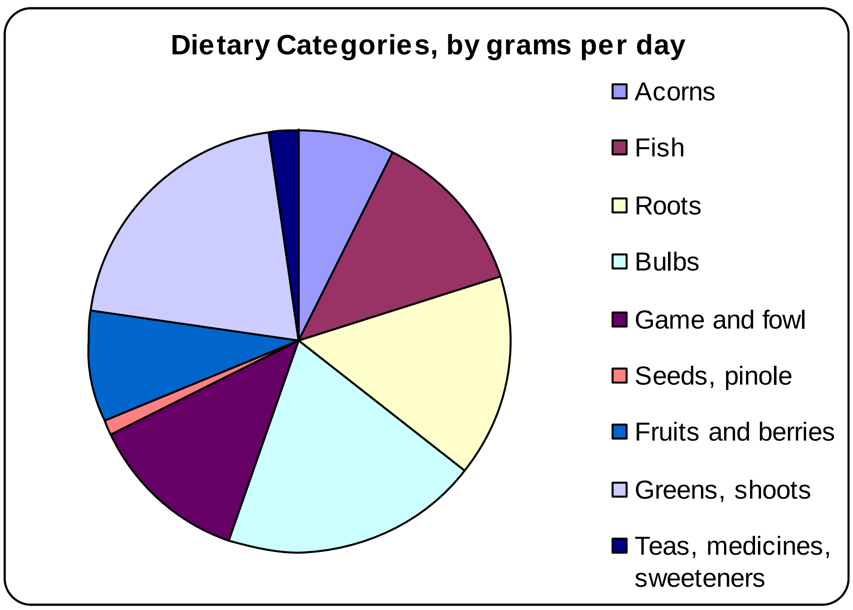


Figure 9 Diet by percent and grams per day

A closer examination of a primary food, acorns, illustrates some of the issues with estimating food group totals. Many investigators have evaluated the nutritional quality of acorns, but early reports in the anthropoligical literature frequently did not report whether their estimates were based on unshelled nuts (a stored form), the flour (stored for shorter periods), or fresh nuts versus parched or dried. Dried acorn whole nuts (without the shell) and ground acorn flour have 500 kcal/100g. Raw acorn nuts (without the shell but fresh) contain 387 kcal/100g[10].

Tables 8, 9, and 10 show the nutritional analysis from three analyses. The difference in water content between the Baumhoff and Heizer analyses, compared to the USDA data, suggests that the Baumhoff analysis was done with dried acorns, while the Heizer and Elasser analysis was done with fresh acorns.

Table 3 Nutritional conetne of hulled acorns

(Baumhoff, 1963)

Species	Water %	Protein %	Fats %	Fiber %	CHO %	Ash %
Lithocarpus	9	2.9	12.1	20.1	54.4	1.4
Q. lobata	9	4.9	5.5	9.5	69	2.1
Q. garryana	9	3.9	4.5	12.0	68.9	1.8
Q. douglasii	9	5.5	8.1	9.8	65.5	2.1
Q. chrysolepis	9	4.1	8.7	12.7	63.5	2.0
Q. agrifolia	9	6.3	16.8	11.6	54.6	1.8
Q. kellogii	9	4.6	18.0	11.4	55.5	1.6
For comparison:						
barley	10.1	8.7	1.9	5.7	71.0	2.6
wheat	12.5	12.3	1.8	2.3	69.4	1.7

Table 4 Nutritional content of acorns

(Heizer and Elasser, 1980).

Species	Water %	Protein %	Fats %	Fiber %	CHO %
Q kellogii	31.4	3.44	13.55	8.6	41.81
Q lobata	40.8	3.2	3.6	6.15	44.9
Q douglasii	33.6	4.0	5.9	7.15	47.8

Table 5 USDA information on raw acorns, dried acorns, and acorn flour

Quercus spp. (http://www.nal.usda.gov/fnic/foodcomp/Data/SR14/sr14.html)

Form	Water %	Protein %	Total Lipid %	CHO %	Ash %
Raw nuts	27.90	6.15	23.86	40.75	1.35
Dried nuts	5.06	8.10	31.41	53.66	1.78
Full fat flour	6.00	7.49	30.17	54.65	1.69

[10] USDA database (http://www.nal.usda.gov/fnic/foodcomp/search/)

5.0 EXPOSURE FACTORS

5.1 General Approach

Exposure factors reflect the activity levels and resource use of the lifestyle scenario under evaluation[11]. Exposure factors for both direct and indirect pathways are developed. Indirect pathways include exposure via the oral ingestion of food and medicine (see previous section). This section focuses on direct pathways: to direct inhalation, dermal exposure, or ingestion of water, air, dust, sediment, and soil (including soil on the outside of food or added through cooking).

Default exposure factors have been developed for conventional suburban, urban, occupational, and recreational scenarios based on national statistics. The approach to developing a tribal scenario is not to inventory every activity and every resource, but to provide an overall estimate of the general activity levels, anchored with specific information as available. The basic assumption is that the traditional way of life is an active outdoor lifestyle that is somewhat physically demanding, even with some modern conveniences. Subsistence foragers (both genders) perform a combination of aerobic (high heart and ventilation rates), strength, endurance, and stretching-flexibility daily activities, as well as more sedentary work and resting.

The exposure factors here are general to traditional subsistence lifestyles, regardless of their location. The conceptual steps in this process are:

1. Understand the lifestyle and the activities that comprise the lifestyle, and are required to obtain necessities and engage in the community culture.
2. Describe the day, the year, and the lifetime of men and women to identify any significant differences in activity levels between genders or ages.
3. Cross-walk activities with exposure pathways on the basis of frequency and duration of major activities, activity levels, and degree of environmental contact.
4. Estimate cumulative direct exposure factors as average daily amount of air inhaled and water and soil ingested.

5.2 Major Activities

Tables 6-8 show the thought process for considering the wide range and numerous activities associated with the major activity categories (hunting, fishing, gathering, and sweatlodge use). Tables 6 and 7 list a number of individual activities within each major category; this is included because most non-Indians have not learned much about traditional lifestyles and the complexity of daily life. Table 8 shows the connection between activity categories. In actuality, many activities are sequential – for example, a resource might be gathered in one location, used in a second location to make an implement or basket, and taken to a third location for use in hunting or fishing[12]. The activities shown in Table 8 are so interconnected that it is virtually impossible to separate a lifestyle into distinct categories, but they are presented as separate as an illustration.

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[11] http://cfpub2.epa.gov/ncea/cfm/recordisplay.cfm?deid=85843

[12] This is similar to the Cultural Ecosystem Stories concept developed Terry Williams (Tulalip Tribes) with the associated software, ICONS (see, for example, http://www.epa.gov/owow/watershed/wacademy/wam/comresource.html).

Table 6 Traditional activity categories.

Examples of activities involved in major categories are given to illustrate their complexity, as well as the interconnections between categories. The category of gathering includes both vegetal food procurement and basketmaking.

Hunting	***Purification***	***Gathering***	***Fishing***
Learn skills	Learn skills, songs	Learn skills	Learn skills, TEK
Making tools	Build lodge from natural materials	Previous gathering	Make nets, poles, platforms, tools
Ritual bathing	Gather rocks	Make baskets, bags	Travel to location
Vigorous activity in hunting	Chop firewood	Hike to areas	Catch fish, haul out
Pack meat out	Prepare for use, get water	Cut, dig, harvest	Clean, can, hard dry, soft dry, smoke, eat whole fish or fillet or liver or other parts or soup
Process	Use Lodge, sing, drink water, inhale steam and smudges	Carry out items	Return carcasses to ecosystem, use as fertilizer
Scrape hides	Close area & fire	Wash, peel, process, split, spin, dye	
Tan, use other parts		Cook and eat or make product or medicine	
Cook, smoke, dry, eat meat and organs			

Two additional activities are briefly described here due to their importance, which is relevant to the amount of time spent on them as well as the amount of environmental contact during these activities.

<u>Beads and mineral uses.</u>

The Elem were the primary bead-makers in central California. Bead (money) makers were a partly specialized class of men who obtained the raw materials and made it into various items (McLendon et al., 1978). Beads were used for ceremonial donation, money, funerary donations, trade, debts, trespass, payment for work done, and payment of fines (Barrett, 1952). Clamshell (*Saxidonus nuttalli*) and magnesite money-beads were regarded as small change and strung on strings, while magnesite cylinders were counted individually. Clam shell discoid beads were made by rubbing the outer surface down to the white inner layer, then breaking the shell into fragments. The fragments were chipped into rough-edged discs, and each disc was drilled with a snowberry shaft fitted with a chert point. Magnesite discs were made essentially the same way with the addition that the magnesite was buried under a fire to impart a pleasing color that ranged from pink to brick red to chocolate brown,or variegated. Discs were strung on wire grass for final shaping by sandstone as a strand. Magnesite cylinders were ¼ to 2 inches in diameter and 1 to 3 inches long. Silica exposure associated with this occupation is unknown.

Everyone used obsidian from abundant local sources (Mt. Konocti on the southern shore of Clear Lake) to make arrowheads and other tools. Chert, jasper, flint, steatite, chalcedony, petrified wood and quatrz crystals were also used for various purposes. Chert is harder andused for drills and harder arrowheads. Steatite (soap stone), magnesium mica, and talc were used. Pumice was used as an abrasive such as for softening deer hides. Cinnabar was used for body paint.

Baskets and plant uses. Pomo baskets are world-reknowned as exceptionally fine baskets, with different styles of basket for different uses, some water tight. Materials included willow used as the warp (shaped, sorted and dried). Woof was sedge root (dried, split down the middle, hung up for a year), redbud bark, bulrush root, often dyed black, and digger pine root fibers (Brown and Andrews, 1969). Black color in baskets roots of carex (razor grass) were buried in black oak ashes. One medium grass basket required 3750 grass stalks from previously burned or pruned plants; 5 *Apocynum* stalks make one foot of cordage; a 40-foot deer net used fibers form 35,000 plants.

Table 7 Major activity categories

Activity Type	***General Description***
Hunting	Hunting includes a variety of preparation activities of low to moderate intensity. Hunting occurs in terrain ranging from flat and open to very steep and rugged. It may also include setting traplines, waiting in blinds, digging-out small game, climbing, etc. After the capture or kill, field dressing, packing or hauling, and other very strenuous activities occur, depending on the species. Subsequent activities include cutting, storing (e.g., smoking or drying), etc.
Fishing	Fishing includes building weirs, scooping minnows, hauling in lines (we assume that large nets are not used in small drainages), gaffing or gigging, wading (for shellfish), followed by cleaning the fish and carrying them to the place of use. Activities associated with smoking and constructing drying racks may be involved.
Gathering	Women gathered plants “perhaps within a day’s walk from camp” using a digging stick, knife, and basket for carrying resources back to camp. A variety of activities is involved, such as hiking, bending, stooping, wading (marsh and water plants), digging, bundling, carrying, and climbing over a wide variety of terrains.
Ritual Purification (Sweatlodge)	Sweatlodge building and repairing is intermittent, but collecting firewood is a constant activity. Cold and hot springs were used for therapeutic healing.
Materials Use and Food Preparation	Many activities of low to high intensity are involved in preparing materials for use or food storage. Some are quite vigorous such as pounding or grinding seeds and nuts into flour, preparing meat, and tanning hides, This category includes basketmaking, which is an example of a very important activity with its own set of prescribed activities.

Table 8 shows the cross-walk between activity categories and exposure pathways, with examples of how exposure factors are derived from knowledge about activities, interlinked resources and ecosystem stories, and the technical literature. Again, this is an iterative process that relies on multiple lines of evidence. This is not a complete listing of activities. It shows an example of the thought process used to iteratively cross-walk exposure pathways and categories of subsistence activities. In each case a gap identification step may be necessary, and greater uncertainty may require placeholder values until data is obtained. The last column (“totals”) shows exposure pathway totals (such as soil ingestion) that are estimated by estimating across activity categories. This is not a statistical summation but rather a judgement based on multiple lines of evidence.

Table 8 Exposure considerations for activity categories

	Hunting and associated activities	***Fishing and associated activities***	***Gathering and associated activities***	***Ritual purification and associated activities***	***Material and food use and processing***	***<u>Totals</u> for major exposure factor categories***
Food, Medicine, Tea, other biota ingestion (diet)	*n* deer /yr diet; Total large-small game, fowl. Organs eaten	*n fish* /yr diet; Total pounds or meals/day-wk-yr; Organs eaten.	Includes foods, medicines, teas, etc.	No food, but herbal particulates are inhaled.	Both as-gathered and as-eaten forms; cleaning and cooking methods.	Must account for all calories. Extra factor for 100-200 plant species; parts eaten
Soil, sediment, dust, and mud ingestion	Terrain types such as marsh with more mud contact; Degree of dermal contact;	Sediment contact, dust and smoke if drying; weir construction in mud.	External soil on plants; cooking method such as pit cooking; ingestion when gathering.	Includes building the sweat lodge and getting materials.	Includes incidental soil remaining on foods; pit cooking.	Must also include living area, unpaved roads, regional dust, local dust-generating activities.
Inhalation rates	Days per terrain; Exertion level; hide scraping; load & grade.	Exertion level – nets and gaffing methods; cleaning effort.	Exertion level for load and grade; or gardening. Include making items.	Includes building the lodge, chopping firewood, singing.	Exertion level for pounding, grinding, etc.	Must account for exertion levels; smokes and smudges.
Groundwater and Surface water pathways	Drinking water; wash water; water-to-game pathways.	Drinking water; incidental ingestion	Drinking water, cooking water, etc.	Steam in lodge; drinking water during sweat.	Soaking, possibly other uses.	Must account for climate, sweat lodge, ritual bathing.
Dermal exposure	Soil, air and water pathways, plus pigments etc.	Immersion considerations.	Same as hunting.	Immersion with open skin pores.	Includes basketmaking, wounds.	Must consider skin loading and habitat types.

5.3 The Family and The Lifetime

Adult Hunter/Fisher/Gatherer. Each adult hunts (male), fishes (male), or gardens and gathers plants (female). Because these activities are roughly analogous with respect to environmental contact, they are assumed to result in the same amount of soil or sediment ingestion for males and females. General levels of exertion, relative to inhalation rate, is also assumed to be the same for males and females. The inland Pomo would make several trips to the coast each year during low tide. On the way back from gathering clamshells etc, conical baskets are filled, weighing about 130 pounds, "yet the Pomo not only average this amount per pack, but also carry strings of dried fish, kelp, and lighter articles, over precipitous trains, making only four camps along the 80 mile journey home to Clear Lake." (Hudson 1975).

Elder (ages 56-75). The elder gathers plants and medicines, prepares them, uses them (e.g., making medicines or baskets, etc.) and teaches a variety of indoor and outdoor traditional activities. The elder also provides childcare in the home. "Even old people carried immense loads gracefully and tirelessly" (Brown and Andrews, 1969). Boy chiefs were 40 or under, between 40 and 60 he was considered a young man, and at 60 or older was a man.

Cultural Activities. All persons participate in day-long outdoor community cultural activities once a month, such as pow-wows, and seasonal ceremonial and private cultural activities (averaging about 0.5 hours/day). These activities tend to be large gatherings with a greater rate of dust resuspension and particulate inhalation. Individuals also tend to be active, resulting in a greater inhalation and water ingestion rates: "the exertion of the dance was so great that perspiration showed freely on their fine looking bodies." (Brown and Andrews, 1969).

Sweat House Purification. Each village had a sweat house. "It was the custom for every Pomo man to take a sweat bath each day" (Barrett 1975). Other authors also report frequent or daily use of the sweat house (Gifford, 1926; Barrett, 1952; Brown and Andrews, 1969; Heizer and Elasser, 1980).

Seasonality. The changes in activity patterns over the annual seasonal cycle has been modified in modern times, but the ecological cycle has not, so people must still gather plants according to when they are ripe, hunt according to game and fowl patterns, and fish when the spawning runs occur. Items are gathered during one season for year-round use. While specific activities change from season to season, they are replaced by other activities with a similar environmental contact rate. For instance, a particular plant may be gathered during one month, while another month may be spent hunting, and a winter month may include cleaning and using the items obtained previously. Therefore, since activity levels are roughly equal throughout the seasons, there is no decrease in environmental contact rates during winter months.

Special Activities. It is recognized that there are special circumstances when some people may be highly exposed to individual natural resources or media. For instance, some men hunt or fish for the general community, and many people provide roots and fish and game to elders in addition to their own families. Beadmakers and basket makers may receive additional exposure through obtaining and working with their materials.

Exposure specific to basketmakers is a well-recognized problem[13], but it has not been fully researched with respect to environmental contact rates. Gathering of some plants (e.g., willows, cattails, reeds and rushes) can be very muddy, and river shore or lakeshore activities with sediment exposure may be underestimated. Washing, peeling, weaving rushes, and other activities results in additional exposure, such as dust deposited on leaves or soil adhered to roots. Some of the materials are held in the mouth for splitting, and cuts on the fingers are common. As more information becomes available, it will be evaluated to ensure that the exposure factors for each route of exposure account for this particular activity.

5.4 Exposure factors for direct exposure pathways.

A description of activities for the purposes of developing exposure factors focuses on:

- Frequency of activity
- Daily, weekly, monthly
- Duration of activity
- Hours at a time
- Number of years
- Intensity of environmental contact and intensity of activity
- For soil ingestion and dermal exposure, is the activity more than, less than, or equal to gardening, camping, construction/excavation, or sports?
- For inhalation rates and calorie needs, is the activity level more than, less than, or equal to standard EPA activity levels for specific activities with known respiration rates and caloric expenditure?

Table 9 Major exposure factors for direct pathways

Direct Pathway	***Default Suburban Lifestyle***	***Subsistence Forager Lifestyle***
Inhalation	20 m^3	**25 m^3/day.** This rate is based on a lifestyle that is an outdoor active lifestyle, based on EPA activity databases, foraging theory and ethnographic description of the activities undertaken to obtain subsistence resources as well as allotment-based food (livestock and garden). It is higher than the conventional 20 m^3/day because the activities with associated respiration rates are higher than suburban activities.
Drinking water ingestion	2L/d	**3L/d** plus 1 L for each use of the sweat lodge during ritual purification, or 4L/day total.
Soil ingestion	100 mg/d (conventional suburban); 50 mg/d (manicured suburban; less	**400 mg/d**. This rate is based on indoor and outdoor activities, a greater rate of gathering, processing, and other uses of natural resources, as well as on residual soil on grown and gathered plants. Episodic events (1 gram each) are considered, such as wetland gathering, cultural activities with higher soil contact, and so on. But this might be underestimated. It does not specifically

[13] http://www.cdpr.ca.gov/docs/envjust/documents/basketweaver.pdf

	outdoor time).	include geophagia or pica.
Dermal Exposure	Based on EPA guidance.	Must be included in the risk assessment. Greater environmental contacts must be factored in; however, suburban defaults may be used until data for traditional lifeways are developed, although a greater fraction of the skin surface and a higher dermal loading rate should be considered.
Exposure frequency	Up to 365 days per year, but varies. Hours per day varies; typically 24 hrs/d.	365 days per year. Hours per day varies; typically 24 hrs/d.
Exposure duration	30 years	70-75 years

5.4.1 Drinking Water.

Harper et al. (2002) estimated an average water ingestion rate of 3 L/day for adults, based on total fluid intake in an arid climate. In addition, each use of the sweatlodge requires an additional 1L for rehydration (24 L per year). It should be noted that water intake in an arid environment may be more than 3L per day. For example, the Army assumes that the maximum individual daily amount of drinking water required by military personnel to remain combat-effective ranges from 5 to 15 liters (L/day, depending on the climate, season, and intensity of work[14]. The Army Quartermaster assumes that military personnel in hot climates require 3 gallons per day as drinking water.[15]

5.4.2 Soil and Sediment Ingestion.

Soil ingestion includes consideration of direct ingestion of dirt, mud, or dust, swallowing inhaled dust, mouthing of objects, ingestion of dirt or dust on food, and hand-to-mouth contact. The tribal soil ingestion rate of 400 mg/day is based on a review of EPA guidance, soil ingestion studies in suburban and indigenous settings, pica and geophagia, and dermal adherence studies (a small portion of which is summarized here). For the Clear Lake climate and lifestyle, the soil ingestion rate for young children (0-6 years) is assumed to be 400 mg/day for 365 days/year. This is higher than the prior EPA default value of 200 mg/day (USEPA, 1989). This rate reflects both indoor dust and continuous outdoor activities analogous to gardening or camping (Van Wijnen, 1990), but it is less than a single-incident sports or construction ingestion rate (Boyd, 1999). It reflects a variety of soil pathways such as pit cooking, gathering and gardening, residual soil or dust on foods and medicine, localized soil-generating activities, holding natural materials in the mouth while processing or using, driving on unpaved roads, and similar considerations. The underground oven was very important. Barrett, S.A. (1952, reprinted). "A large percentage of their food, roots, berries, seeds, and even a large portion of meats, was eaten in an uncooked state."

It also considers many "1-gram days" and events such as root gathering days, tule and wapato gathering days, pow wows, rodeos, horse training and riding days, sweat lodge

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[14] http://www.nap.edu/execsumm/NI000954.html Guidelines for Chemical Warfare Agents in Military Field Drinking Water (1995).
[15] http://www.pasols.org/energy/water2.pdf

building or repair days, grave digging, and similar activities. However, this might result in an underestimation of soil ingestion.

The soil ingestion rate of 400 mg/d for all ages is the published upper bound for suburban children (EPA, 1997), and is within the range of outdoor activity rates for adults but lower than the typical 480 mg/d applied to outdoor work to allow for some low-contact days. Subsistence lifestyles were not considered by the EPA guidance, but are generally considered to be similar in soil contact rates to construction, utility worker or military soil contact levels. The US military assumes 480 mg per exposure event[16] or per field day. The UN Balkans Task Force assumes that 1 gram of soil can be ingested per military field day[17]. Anecdotally, US forces deployed in Iraq report frequent grittiness in the mouth and food. Haywood and Smith (1990) also considered sensory reports of grittiness in their estimate of 1-10 g/d in aboriginal Australians.

Simon (1998) reviewed soil ingestion studies from a perspective of risk and dose assessment. Because of their high dependence on the land, indigenous peoples are at highest risk for inadvertent ingestion, along with professions that may bring workers into close and continual contact with the soil. Simon recommends using a soil ingestion rate for indigenous people in hunters/food gathering/nomadic societies of 1g/d in wet climates and 2 g/d in dry climates. He recommends using 3 g/d for all indigenous children.

5.4.3 Inhalation Rate

The inhalation rate in the Elem scenario reflects the active, outdoor lifestyle of traditional tribal members. Long distance runners – 20 mile round trips were "regarded as so commonplace a performance as to be worth but two dollars for the round trip" (late 1800s)(Heizer and Elasser). Traditional tribal communities have no sedentary members except the frail elderly, whereas one-quarter of modern American adults of all ages report no leisure time physical activity at all.[18] An inhalation rate of 25 m^3/d is more accurate for the Tribe's active, outdoor lifestyle than the EPA default rate of 20 m^3/d (USEPA, 1997). Using EPA guidance, a median rate of 26.2 m^3/d is obtained from 8 hours sleeping, 2 hours sedentary, 6 hours light activity, 6 hours moderate activity, and 2 hours heavy activity. This represents minimal heavy activity (construction, climbing hills, etc), and is a median rather than a reasonable maximum. Unlike most other exposure factors, which are upper bounds, the inhalation rate is a median rate. This is inconsistent with the usual RME approach used in Superfund risk assessments, and could result in under-protection of children, the elderly, athletes, asthmatics, and the half of the population with above-average inhalation rates.

[16] http://www.gulflink.osd.mil/pesto/pest_s22.htm, citing US Environmental Protection Agency, Office of Research and Development, Exposure Factors Handbook, Volume I, EPA/600/P-95/002a, August 1997 as the basis for the 480 mg/d.
[17] UNEP/UNCHS Balkans Task Force (BTF) (1999). The potential effects on human health and the environment arising from possible use of depleted uranium during the 1999 Kosovo conflict. www.grid.unep.ch/btf/missions/september/dufinal.pdf
[18] http://www.cdc.gov/brfss/pdf/ 2001prvrpt.pdf and http://www.cdc.gov/brfss/pubrfdat.htm.

5.4.4 Dermal Exposures

The dermal pathway has not been fully researched for this scenario, but EPA methods[19] for dermal exposure can be used. However, a greater surface area and a greater skin loading of soil (soil adhered to skin) should be used. Two relevant papers are summarized here. Kissel, et al. (1996) included reed gatherers in tide flats in a study of dermal adherence. "Kids in mud" at a lakeshore had by far the highest skin loadings, with an average of 35 mg/cm^2 for 6 children and an average of 58 mg/cm^2 for another 6 children. Reed gatherers were next highest at 0.66 mg/cm^2 and an upper bound for reed gatherers of >1 mg/cm^2. This was followed by farmers and rugby players (approximately 0.4mg/cm^2) and irrigation installers (0.2mg/cm^2). Holmes et al. (1999) studied 99 individuals in a variety of occupations. Farmers, reed gatherers and kids in mud had the highest overall skin loadings. The next highest skin loadings on the hands were for equipment operators, gardeners, construction, and utility workers (0.3 mg/cm^2), followed by archaeologists, and several other occupations (0.15 – 0.1 mg/cm^2).

5.4.5 Children's Exposure Factors

Children's exposure factors are based on "Child-Specific Exposure Factors Handbook"[20] but scaled from the adult subsistence values for the inhalation rate. The diet is scaled for children from the food categories indicated above for adults. The soil ingestion rate for children is a constant 400 mg/day, without age stratification. If age stratification is done for other exposure factors, the Washoe Tribe can be contacted for recommendations.

[19] http://www.epa.gov/superfund/programs/risk/ragse/

[20] U.S. Environmental Protection Agency (EPA). (2002) Child-specific exposure factors handbook. National Center for Environmental Assessment, Washington, DC; EPA/600/P-00/002B. Available from: National Information Service, Springfield, VA; PB2003-101678 and http://www.epa.gov/ncea.

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APPENDIX . Supplemental Resource Information

This appendix present additional information on natural resource use from Brown and Andrews (1969), and Barrett (1952).

Resource	***Use or Knowledge***
Miscellaneous	
Salt	From seaweed and coastal trading; also from saltlicks in the interior. Miner's lettuce leaf ash is a substitute for salt.
Soap plant (Chlrogalum pomeridianum)	Soap and fish poison. Soaproot grows plentifully on rocky and hills. The roasted bulb is high in saponin and low in alkali, making a very good lathery but gentle soap for delicate fabrics and dandruff. It is also anticeptic and, as a saponin, a laxative and diuretic. It also stupifies fish (along with turkey mullein, Croton setigerus).
Pine pitch	Gum
Seaweed - Kelp and sea palm	Porphyra cakes were letting the seaweed dry in the sun and layering the leaves. The kelp bulb can be eaten raw. dried, and cooked into cakes.
Tea	Many species of leaves and berries
Sugar	From sugar pine, honeycombs, rose hips.
Tobacco (Nicotiana, with balsam and willow)	Smoked in ordinary daily life, mostly by men. Also used ceremonially.
Army worm (caterpillar).	Not every year. Eats ash leaves. Caught by digging small moats around trees; the caterpillars let go of the tree when the leaves are eaten and crawl to the next tree. They fall in the moats and are scooped up. They are drowned quickly in water and roasted in hot ashes or boiled and eaten in great quantities there; the rest are sun-dried. Barrett 1936.
Bulbs and Roots	
Brodiaea or Blue Dicks, *Tritelia laxa* (*Brodiae laxa*). Other Brodiaea were also widespread and eaten.	the most abundant and widespread of all the Indian potatoes, known as highland potato, grows in fields and hills; eaten raw or roasted.
Yellow Pond Lily	baked, and seeds used for bread and soup.
Yampah roots	washed, mashed, washed again, and cooked as potatoes. One kind was boiled until mealy.
Cowparsnips roots	Cooked like rutabagas.
Arrowroot tubers.	Baked
Indian potatoes, anise, tule	Roots, bulbs, tubers, corms. In aboriginal times, they were "superabundant." Inexhaustible supply. Many were eaten raw, others were cooked or baked. Around 20 different species.
Camas (*Qamasia leichtlinii*),	An adundant camas in rish damp meadows (more northerly than Clear Lake), blue flowers open only at nightm kargest and best of all the Indian potatoes. Generally pit cooked.
Lilies/Onions (a dozen kinds of bulbs).	Nowhere in the world is there a more characteristic abundance and variety of bulbous-rooted liliaceous plants than in California, a provision of nature by which the inhabitants have long been benefited. All are highly nutritious when cooded, and many, especially the species of Calochortus, have a very agreeable nut-like flavor when raw and is the primary below-ground food in the region.
Brodiaea (*Brodiaea grandiflora*). Small bulbs, eaten raw, June or July.	Dichelostemma capitatum (Brodiae capitatum), very common on rocky hillsides, eaten raw but sweeter when cooked in ashes. Hesperoscordum lacteum (probably Brodiae hyacinthina),

	abundant in valleys, raw or cooked.
Allium. (*Allium bolanderi)*.	Abundant along streams, small but easily gathered corms. Allium unifolium. The wild or Indian onion, grows in rish damp meadows; buld and base of the leaves are fried.
The Calochortus genus (Mariposa lilies).	Calochortus maweanus. Grass and open hillsides, corms are sweetish and eaten by children. C. pulchellus. Very common, small corms but easily gathered; raw or roasted. C. venustus. Commonest Mariposa lily, corms are sweet; called sweet potatoes.
Squaw root (Carum garnderi).	Thick roots are eaten raw, gathered in fall, not stored
Berries	
Berries: strawberry, gooseberry, raspberry, thimbleberry, blackberry, elderberry, toyon, salmon berry, salal merry, currant, raspberry, huckleberry, wild grape, chokecherry	Eaten fresh, dried, or as beverage. Several species (*Ribes*, *Vaccinium*, other). Variety of habitats.
Manzanita	pulverized and mixed with water or used for flavor in other foods. Also made into a drinkArctostaphylos manzanita (and A. tomentosa at higher elevaitons). Found universally. Berries are ground and molded into small flat cakes, no cooking necessary. Can also be used as flour.Barrett, S.A. (1952, reprinted).
Cerasus demissa (Prunus d.)	
Greens	
Leaves of Miner's lettuce, *Mimulus guttatus,* miner's lettuce Grows near springs, substitutes for lettuce; leaf ash is a substitute for salt.	early spring cowparsnip, some clovers, and others were eaten raw. Trifolium spp, clovers. Many kinds. Regarded as essential to the diet.
Ferns.	The fiddleheads (young curled tops of the bracken fern were eated raw, or roasted for a day and a half.
Flowers	Several species were eaten raw
Greens: Many species including clovers. clover, angelica, anise, poppy, tule shoots, some lupine leaves, hedge mustard, goosefoots .	Eaten raw or cooked like spinach. "The people moved out into the fields and reveled in the abundance of these greens, eating great quantities as they gathered then, and bringing them back into the village by the burden-basketful." "So greedily did the people devour these greens that it was not unusual for them to be agglicted by bloating... the eating of pepperwood cakes was said to help serve as a preventative..." The people of the lake region used several species of tule and cattails "in so many ways that it is no surprise to find them on their list of foods." The roots and tender shoods were eated as greens. The men go out swimming in May or June when the shoots are emerging from the lake bottom.Barrett, S.A. (1952, reprinted).
Nuts, Acorns	
Acorns.	White oak or valley oak. *Q. lobata* – most common, main acorn supply, best kind for bread. Can be 80 feet high, acorns can be over 2 inches long. Black oak or California oak. *Q. californica*, Considered second best for bread and soup because they are especially rich in oil Tan oak or tan-bark oak Q. densiflora. Very rich and oily. The best kind for soups and mushes.

	Shell, spread out to dey, remove thin papery covering, grind. Leaching is most often done with flour, but sometimes of the whole acorn (takes a day or more). Sand lined pits, careful not to get sand in the meal. Black bread is made from ground meal without leaching. The red earth eliminated the bitterness and makes the bread black and sweet. It keeps very well.
Peppernut: Pepperwood (California laurel).	cakes and edible husk Dry whole fruits until hull splits; husks can be eaten raw. Kernels are covered with a thin hard shell and can be stored. Shell, rast thoroughly, grind into oily meal, made into cakes and stored dry. Also eaten whole as condiment with clover and other greens, sith buckeye meal, or with acorn bread and mush. Also eaten with seaweed in coastal areas.Barrett, S.A. (1952).
Buckeyes (horse chestnut) is fairly abundant. Poisonous if not leached.	Char, hull, leach, or roasted then leached, or shell, bake, mash, dry, soaked to leach and squeezed dry again, leach thoroughly then ready to eat. Hull, peel, boil, ground, sift, leach, with coarser parts molded into balls, then leach for days.
chestnut, cinquapin, nutmeg, hazelnuts	
Conifers.	Digger pine (*P. sabiniana*) and sugar pine (*P.lambertiana*). Fairly widespread; large cones with large nuts. Sugar pine: nuts used as food, sugar as medicine. Other pine nuts were also used.Barrett, S.A. (1952). Digger pine - One of the most characteristic trees. Very large and heavy cones, sweet and oily nuts – 51% oil and 28% crude protein; cones opened by fire; cambium also eaten as a starvation food. Pitch used as healing cover for burns and sores, glue for feathers; gum that accompanies the pitch is shewed as gum and as a cure for rheumatism; roots used for large baskets; bark infusion drunk for consumption; pine oil steam as tonic.
Seeds, Grain, Pinole	
Pinole: made from grass seeds, meal, cakes. Pinole is meal made from parched, ground seeds. The meal can be dampened and made into balls; no further cooking is required. Pinole can also be made into mush.	Seeds used as pinole. (pinole is spanish for cereal meal). Any parched seeds of grains and flowers ground into flour (does not apply to nut flour). 32 different species of seeds have been identified. An important but secondary food. Seed types were kept separate and mixed according to the desired flavor. Barrett, S.A. (1952, reprinted).
Manzanita berry pinole and biscuits	Wild oats (Avena fatus or Danthonia californica, probably the latter since the former may not be native to the US) Gathered be elderly ladies. Hairs are singed, seeds parched and ground. Salt or the ash from 'certain plants' added. Pinole is any meal made from parched seeds. But the Pomo had different names for different grains and carefully mixed grains for particular flavors.
Pogogyne parviflora, name?	Seed is gathered in surprisingly large quantities and values as a sweet aromatic ingredient of wheat and barley pinole.
Blepharipappus platyglossus, tidy-tips.	A yellow daisy, seeds prized for pinole.
Achillea millefolium, yarrow. *Hemizonia luzulaefolia,*	Seeds used for pinole. the most common kind of tarweed (several different plants are called tarweed due to their exudation). Important for pinole.
Madia dissitiflora,	a typical tarweed, also used for pinole. Note that tarweed oils appear to be important for pinole texture or cookability also.
Madia densifolia,	another tarweed, also important for pinole and even more aromatic than Hemizonia.
Salvia columbariae, name?	seeds are mucilaginous and used for thickening soup.
Other Food Information	
Hunting. Do not eat rish before hunting. 4-day sweats before group hunting. Different sets of songs for each animal, fish or bird. Hunting methods – noting unique. Around Clear Lake, frequent use of large nets to rake water birds, as well as slings with clay balls, tule boats. At Clear Lake, different portions of the lake were used by individual families. Barrett, S.A. (1952).	
Methods of cooking: rock boiling in basket, baking bread and fish in underground ovens, roasting in ashes,	

broiling on hot coals, parching with coals in basket (put seeds or bird eggs in baskt with coals and shake them together). Underground oven, lined with leaves (grape, madrone, grass)	
Very small mammals were singed to get rid of the hair, eviscerated, and pounded to a pulp before being broiled (bones as calcium source). Larger animals such as rabbits were skinned before being pounded and broiled.	
Spoons made with mussell and freshwater clam (for eating mush or soups).	
Non-Food (basket, cordage, other)	
Tule. In addition to food and several specific kinds of baskets, tule was used for mats, padding, clothing, floats, slings, seaddling clothes, balsa. Two species are founf in Clear Lake, Scirpus lacustris, robustus, and cattails (Typha latifolia) There are also words for different maturities. Tules were eaten. Shoots up to a foot tall were eaten by taking the outer part off; the outer portion was shredded until fluffy and used for diapers. Tule tubers (new growth only) were peeled and eaten, Barrett, S.A. (1952).	
Cordage – dogbane (Apocynum cannabinum), milkweed (Asclepias criocarpa), Iris (Iris douglasiana, and --- (Psoralea macrostachya). Also sinew.Barrett, S.A. (1952, reprinted). Hemp (Apocynum androssemifoluem). Gows in marchy areas or damp soil, Stalk gathered in the fall. Stalks split and dried, then the woody part id broken away form the fiber. Fiber made into string by solling on the leg.	
Cattail (flag tule; Lewis & Clark called them flags; Typha latifolia) roots and shoots used as food; pollen eaten. Mats and baskets.	
Sedge. Carex spp. Roots used for baskets, since they spread by root runners. The most important roots used in baskets; strongest and most durable baskets. Sedge root baskets are made by splitting the roots into fine strands by holding one part of the root in the mouth and pulling 1/3 with each hand, so the root is split into thirds. Each stand is split into smaller thirds. Used in 3-rod coiled baskets.	
Salix argyrophylla. A shrubby white-leaved willow, common along some rivers, shoots are the best for large coarse baskets, Roots are highly prized for other kinds of baskets. Tough fibrous inner bark can be made into rope and woven. Inner bark widely used as medicine.	
Cercocarpus betuloides, mountain mahogany. Common on dry brushy hillsides. Very hard wood.	
Symphoricarpos racemosus or albus, snowberry. Grows in great abundance on level land. White waxy berries, prized for light strong wood, especially for pipestems and revolving drills.	
Iris douglasiana. The common wild iris, edges of the leaves are fine and strong as silk.	
Byracea – Alsia abietins. A moss used for baby bedding.	
Maidenhair fern (Adiantum emerginatum). Keeps ear holes open.	
Lonicera interrupta, honeysuckle, Vines used for baskets.	
Multi-Use and Medicinal Uses	
California Nutmeg (Tumicon californicum). Roasted nuts; roots used in baskets. Juniperus californica. Berries sometimes boiled and eaten. Trillium sessile giganteum, The common trillium in damp shade, tuber-like rhizomes used in medicine, but are intensely bitter. Artemesia heterophylla, wormwood. Bitter taste but aromatic aroma. Highly esteemed as medicine for colic and colds. Used in sweat bath for rheumatism. Wyethia longicaulis, sunflower. The most common sunflower. Lower part of young leaves and stems are edible; seed is very much used for pinole. Resinous root used as an emetic. Escholtzia douglasii, Californiz poppy. Fresh root is placed in the cavity of a tooth to stop toothache; extract used for	Trichostema lanceolatus, vinegar weed or tar weed. Pungent aroma like vinegar and turpentine. Known as a fish poison. Sambucus glauca, pale alder. Very abundant. Berries are acidic but eaten raw or dried; now used with sugar in pies and jelly. Dried flowers are used for fever, lotion, antiseptic, anti-itch, and sores. Wood pith for tinder; hollow shaft after pith is removed used for wistles, straws. Micrampelis marah, big root. A vine common along streams, large spherical fleshy root like a man's head, acrid and poisonous. Douglas fir (Pseudotsuga mucronata (spp?)). Long small roots used in baskets; balsamic odor vlaued as a tea. Alnus rhombifolia, mountain alder. Common, large tree in moist places, often marking springs. The bark is astringent, used as a dye, decoction used to stop diarrhea and induce sweating; fresh bark colors deerskin and basket materials when smoking. Yellwo pond lily, Nymphaea polysepsis. Grows profusely in shallow lakes and winter ponds in the coast region, but not very common in the interior. The fleshy roots are a favorite browse of deer, and the nutritious seeds are eaten whenever available.

headache. Leaves are edible. Thysanocarpus elegans. Lacepod. Seeds are used in pinole; concoction of whole plant used for stomach ache. Heteromeles arbutifolia (Photina a.) Common toyon or Christmas berry. Evergreen, berries are eaten raw but generally cooked first. Decoction of leaves and bark used for stomach ache and various aches and pains.	Butneria occidentalis (or Calycanthus o.), western spice bush, fairly common in shady places, fragrant and used for baskets. Umbellularia californica, California laurel, gorws in canyons and damp woods. Thin-shelled nuts, pungent, and sparsely used, Many uses of the leaves (the volatile oil). Cercis occidentalis, redbud. Bark and thin shoots used for baskets; not as durable as sawgrass or sedge.
Sanicule tuberosa, name? Small bulb but one of the best Indian potatoes, generally eaten raw. Arstostaphyles manzanita. Very common. The ripe fruit is dry, mealy, and very nutritious. The green berries can be eaten in small amounts to quench thirst. Ripe berries can also be soaked for a cider. Dodecatheon hendersoni, shooting star. Roots and leaves can be roasted and eaten. Apocynum cannabinum, Indian hemp. Moist soil. Inner bark is soft, silky, and exceedingly strong. Eriodictyon californicum, yerba santa. Grows profusely on dry bushy hillsides, also known as mountain balm, wild balsam, gum leaves, tar weed. Found in every household; no plant is more highly valued as medicine. Leaf is used for many things/ Amsinokia lycopsoides, name? Juicy shoots are eaten.	Croton setigerus, turkey mullein (not the tall introduced mullein). Dainty mat with bristly hairs. Small seeds in great abundance are a favorite of mourning dove. Bruised leaves are a substitute for soaproot for stupefying fish. Rhus diversiloba, poison oak. Full-blood Indians said to be impervious. Used to remove warts and ringworm. Fresh juice used for black coloration. Vitis californica. Wild grape. Used for basket rims by soaking vines in water and hot ashes, then splitting into strands. Heracleum lanatus, cow parsnip. Umbelliferous, tender leaf and flower stalks are agreeably aromatic, and are eaten as early greens after peeling away the outer covering. The basal portion of the plant is a substitute for salt. Pagio bothrys campestris, snowdrops, Crimson color at base of leaves used on cheeks; shoots and flowers are eaten, seeds gathered in alrge quantities for pinole. Monardells sheltonii, horsemint or pennyroyal. Aromatic leaves are used as tea for beverage, colic, and blood purifier. Cynoglossum grande, hound's tongue. Grated roots are antiinflamatory for burns.