USDA Forest Service
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Southwestern Region

Farming and Food at Elden Pueblo (*Pasiwvi*)

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Visitors to the Elden Pueblo Heritage Site on the Coconino National Forest often ask how people grew or collected enough provisions to support their families in this approximately 60 room pueblo. Food means survival, and there were three major ways to accumulate enough to eat: hunting, gathering, and agriculture.

The first indigenous people in the Americas were experts at hunting and gathering, which included tracking herds of large animals, capturing small mammals and birds, and foraging seasonally for plants. This required knowledge of the land and its resources – wisdom passed down through generations by communicating what was safe to eat and what should be avoided.

The practice of agriculture, which allowed families to stay in one place, dramatically transformed how people used the land. A reliable source of food that could be stored through lean times encouraged the building of permanent communities. However, in challenging environments such as the different climate zones around what is today's Flagstaff, the land could only support so many individuals. Any climate change or influx of newcomers could tip the balance and pressure the society.

Elden Pueblo is recognized by the Hopi people and other Ancestral Pueblo descendant communities as an ancestral village occupied from around 1080 to 1275 A.D. To the Hopi people, Elden Pueblo and the surrounding landscape is known as *Pasiwvi (Pah-see-oo-vi)* which means "The place of coming together", or, "The place where decisions were made."

The Hopi refer to their ancestors as *Hisat'sinom*, or, "The Ancient People", and they have many migration stories and traditions that connect them with other indigenous people across the American Southwest and from what is today's Mexico. Since the early 1900s, archaeologists have referred to these residents and cultural group as the Sinagua, an early Spanish name for the San Francisco Peaks, the *Sierra Sin Agua*, or, "Mountains Without Water." Elden Pueblo is the Euro-American name given to the site in 1916 by Mary-Russell F. Colton of the Museum of Northern Arizona.

Biological Zones and Setting

Elden Pueblo is situated on an alluvial fan in a ponderosa pine and Gambel oak community. Gambel oak is a common component of ponderosa pine forests where the soils are rocky. The understory shrubs in the community include cliffrose, rabbitbrush, sumacs, serviceberry and broom snakeweed. This represents a montane environment at 7,000 feet altitude with cold winters, cool summers and soils that are stony, well-drained and vulnerable to erosion.

There is an average of 20 to 25 inches of precipitation annually with only 90 to 120 frost-free days a year, although this varies. The last killing frost is generally recorded in late May, with below-freezing temperatures as late as mid-June.

In addition to a favorable microclimate, other advantages to the location of Elden Pueblo are proximity to water (permanent springs and the Rio de Flag) and nearness to several trade routes through the region, connecting people to other Ancestral pueblos and facilitating the exchange of goods, strengthening family

and extended clan connections, and encouraging the open exchange of ideas.

The rain shadow created by Mount Elden creates a milder climate than the surrounding pine forest and is similar to the pinyon-juniper zone several miles to the east. In addition, the number of frost-free days expands from 90 on average at Elden Pueblo to approximately 160 frost-free days starting just a half-mile to the east to an open park area called Doney Park. This warmer zone extends northeast to another large park area off Highway 89, and on to Bonito Park near Sunset Crater.

The Mount Elden area may also be characterized as a "banana belt" with a unique climate advantage. Banana belts are located on the east side of a mountain where the prevailing winds come from the west and the zones have warmer weather, especially in the winter. When the down-sloping wind loses altitude, the air pressure rises and this causes warming and drying, and a zone where diverse plants like agave or yucca may flourish.

The neighboring landscape around Elden Pueblo consisted of deeper, less rocky soils and was dissected by washes that channeled rainwater into open park areas. The expansive forest landscape, sloping down to these alluvial parks, supported an abundance of wildlife including deer, mountain sheep, bear, coyote, squirrel, gopher, rabbit and wild turkey. Agriculture was possible along some of the washes, and there is evidence of stone check dams across these cuts that would have effectively slowed and retained snowmelt and rainwater for farming plots. As fields were cultivated, more animals would be drawn to the growing plants, offering hunting opportunities but also probably some crop depredation.

Warmer Climate Zones

The sunnier, exposed areas to the south of Mt. Elden supported plants normally found in semi-arid lands and lower elevations, including prickly pear cactus and banana yucca. Today there are also clusters of Parry's agave or century plant on the south slopes of Mt. Elden 1.5 miles west of the Elden Pueblo in the warmer, sheltered boulder fields. Could indigenous farmers have brought these plants to northern Arizona for cultivation or is it a naturally occurring population? Roasted agave hearts were once an important food source for Native residents of the Verde Valley and other pinyon-juniper locales to the north and south.

As agave is native to Arizona, it may be that these farmers translocated plants from other areas where both native and domesticated agave grow, especially in the Verde Valley. Researchers from the Desert Botanical Garden in Phoenix, Wendy Hodgson and Andrew Salywon, have identified five species of domesticated agave in central and northern Arizona, all in proximity to archaeological sites. Their work builds on the contributions of botanists Arthur Phillips III and Rick DeLamater who first suggested and researched the possibility of these hybridized species.

Strategies for Productive Agriculture Near Elden Pueblo

There were three strategies for agriculture that were successful in these open park areas and remain in use today for Hopi and other traditional farmers. Many still practice dry farming, the first strategy, which depends on natural rainwater, uses no irrigation and relies on residual moisture in the soil from snowmelt and rain. However, dry farming can be a challenge during periods of prolonged drought. Native farmers selected the plants best adapted to local climates resulting in the varieties of maize, squash, beans, cotton

and other crops still grown today.

Ak-Chin farming, or *tsivokvasa* in Hopi, is the second strategy and utilizes the rich soil deposited at the mouth of an arroyo, gully or wash. These floodplain fields are also planted off the side drainages that empty in the open park areas, such as near Doney Park. Several deep arroyo cuts are to the north of Elden Pueblo and, in the past, emptied directly to the open parkland area.

The Akimel O'odham and the Tohono O'odham people of southern Arizona were, and still are, master farmers who developed hundreds of miles of irrigation canals in the Sonoran Desert. Ak-Chin is an O'odham word that translates to "mouth of the wash", or, "place where the wash loses itself." Planting downslope from a wash allows seasonal floodwaters from winter snows or summer rain to glide over the crops, a natural and effective form of irrigation that allows water the time to soak in. *Tsivokvasa* as an agricultural strategy is very effective with gentle rains but, as the washes become deeper and deeper, can be riskier in northern Arizona's high intensity monsoon storms.

Stone check dams or terraces, the third farming strategy, are constructed along a slope and this decelerates the rapid flow of water, allowing crops to flourish while rejuvenating the soil with new deposits. As the terraces fill and water and soil cascades over the stone linear borders, the growing area is replenished. There is evidence of stone check dams in the washes north of Elden Pueblo, and extensive features along slopes in the Verde Valley.

Visitors to the Hopi Mesas today marvel at corn thriving in sand dunes, but this is another very successful approach to farming. The sand cover not only acts as a mulch, but also keeps residual moisture from winter and spring moisture at the roots. In much of northern Arizona, the natural soil includes caliche, a hardened natural cement that binds calcium carbonate with clay, gravel and other materials.

When combined with natural rainwater, this material compacts the surface to an almost impermeable layer, and growing plants can be challenged by this hard stratum; a sand mulch is easier for living plants to thrive in and push up toward the sun. The closest sand dunes to Elden Pueblo would be in the Little Colorado River Valley near Homol'ovi State Park in Winslow, another Ancestral Hopi site.

Researching the Plants

Starting around A.D. 1050, when the climate became moister and cooler, people began moving to the site of today's Elden Pueblo, first constructing pit houses and then later in time, masonry structures, or pueblos. One cultural reason the site may have been chosen was to allow participation in ceremonial responsibilities for the sacred San Francisco Peaks (*Nuvatukya'ovi)* but also proximity to open, fertile land where crops might flourish.

Recently, Northern Arizona University (NAU) researchers Dr. Andrea Hunter, Karen Wright, Jennae Biddiscombe and Colleen Crawford studied plant remains at Elden Pueblo. The scientists had four research questions: what wild plants were used for food; did the diet change through time; was there a difference between wild and domesticated foods; and what was the corresponding environment during the

200 or so years people lived at *Pasiwvi.*

The team analyzed soil samples using a water flotation method in which soil samples are placed in water so heavier soil sinks to the bottom while the charred plant remains float to the surface. Plant remains were then identified through a microscope.

The researchers reported a broad diversity in the use of plants through time, and were not surprised when maize, or corn, topped the results with over 5,000 botanical pieces identified. Maize was hybridized from teosinte, a tropical grass still found in Mexico, Guatemala and Honduras.

As a domesticated plant, maize may have been introduced to the Colorado Plateau anywhere from 100 B.C. to 300 A.D. even though growing conditions must have challenged early farmers. But through a long process, hybridization produced varieties of maize that adapted to the arid landscape, and variations are still cultivated today. The crop is very reliable as long as there is sufficient moisture and protection against animal predation. These master farmers knew their lands and successfully planted crops based on observation and experience, passed on through generations.

Maize is a remarkably diverse food and can be ground into a meal, parched, roasted or boiled. The kernels can be stored for a very long time, especially after being roasted and dried. At the same time, the adoption of ceramic vessels not only allowed safe, rodent-free storage, but encouraged families to boil nutritious stews for a large group, adding herbs, meat, greens and stretching available protein.

Smaller plots of maize could have been grown in terraced gardens near the washes on either side of *Pasiwvi*. The fluctuations in temperature, precipitation and depletion of soil nutrients would have been a constant concern to these first farmers, and maybe the best strategy was to grow maize at lower elevations, where temperatures were warmer, and then transport the harvest back to the pueblo.

Cultivated Versus Collected

Certain plants seem to have been optimal for the climate and growing conditions around *Pasiwvi* and also may reflect food preferences. Other than maize, squash or gourds were the second most identified plants. Cultivated squash has thick flesh that is less bitter and less fibrous than this plant's wild progenitors, with thinner rinds and nutritious seeds that can be toasted. The interior can be boiled or baked and even dried. Gourd shells could be used for utensils, such as bowls, canteens, carrying containers or musical instruments.

The botanical remains of the common bean suggest this plant was a cultivated food source at *Pasiwvi*. These beans, when dried, are related to what we today call kidney or pinto beans, and are optimal for long-term storage. Until the 1960s, pinto beans were a major cash crop for farmers using the park areas north of Flagstaff for cultivation. In addition to beans, 82 cotton seeds and plant remains were identified by the NAU team, with spun and woven fibers from cotton used to create textiles.

Several weedy annual plant species were collected and used at *Pasiwvi* for valuable seeds and plant parts. These plants included goosefoot, amaranth or pigweed, and grama grass. Goosefoot and amaranth have nutritious starchy seeds that could be ground or parched, and grama grass stems could have been used for

basketry and brushes.

Recovered nut shells suggest that Arizona black walnut, pinyon pine nuts and Gambel oak acorns were all food sources at *Pasiwvi*. The nuts could be boiled, roasted or dried and then ground into flour. Walnut Canyon is located 6 miles to the southeast where the environment is noted for its walnuts and pinyon. Picture Canyon, approximately 1.5 miles east of today's Elden Pueblo, is a designated natural and cultural preserve. Petroglyphs and native plants, including the Arizona black walnut, can be seen along a loop trail, open to the public.

Experimental Garden

There is evidence of stone check dams in several drainages to the north and east of Elden Pueblo, suggesting that the Sinagua farmed in the higher elevations using water conservation strategies. Crops would have supplemented the bounty from nearby park areas, such as Doney Park. In 2019, Elden Pueblo Project instructor Walter Gosart duplicated a Sinagua-style farm plot near Elden Pueblo, successfully diverting and retaining water to grow Hopi corn here.

When indigenous farmers planted near their homes, there was usually an associated "field house", or one-room structure where someone could watch over the fields through day and night, and chase off rodents, rabbit and deer. This couldn't be done at Elden Pueblo today, and even though Mr. Gosart was able to successfully grow corn and other crops, he would arrive in the morning to find new shoots and plants were a tasty and easy meal for rabbits and grasshoppers. He was able to demonstrate, though, that corn, beans and squash could have been grown in close proximity to Elden Pueblo when people lived there and were able to share guard duties!

Elden Pueblo and nearby Picture Canyon have been inventoried by botanists from the Plant Atlas Project of Arizona, a state-wide partnership between the Arizona Native Plant Society, Grand Canyon Trust, Desert Botanical Garden, Northern Arizona University and the U.S. Forest Service. In 2020 and 2021, biologist Heather Green and botanists Barbara Phillips and Nancy Brian identified the locations of many native plants flourishing today at Elden Pueblo. These plants included Fremont's goosefoot, Indian paintbrush, heron's bill, sunflowers, wolfberry, prickly pear, rabbitbrush and gilia, among many others. By collecting this information, the scientists helped demonstrate the longevity and cultural value of these heritage plants.

Traditional Gardening Today

The legacy and knowledge of the Sinagua (*Hisat'sinom)* continues to inspire today as traditional agriculturalists sustain and revive practices that have worked for millennia. Water conservation, soil conservation, natural pest deterrents, and learning from experienced farmers who know the land is crucial to success in agriculture.

The study of ethnobotany highlights the significance of native plants in all regions of the world, and cultural uses. Plants supply food, medicines, textiles, brushes, construction materials, dyes, paint, cordage, matting, ceremonial uses, soap, chewing gum, beverages and seasonings for the community.

As families work together to plant seeds, harvest and then store crops, there is cooperation, camaraderie

and sharing even when there are adverse growing conditions, and especially when the food supply is challenged.

Today, programs sponsored by the Hopi Cultural Preservation Office and the Natwani Coalition, a program of the Hopi Foundation, work to promote the importance of farming as a cultural practice (http://www.hopifoundation.org). Hopi visitors to Elden Pueblo have often commented that gardens grow much more than just plants – gardens also grow people as families communally tend the land, harvest the crops, process for the future and share the values of the people along with the bounty.

And when the corn stalks have finished producing, the plant is laid to rest and put down on the earth by the farmers and their families, the corn stalks going back to the land and nurturing the soil for future generations.

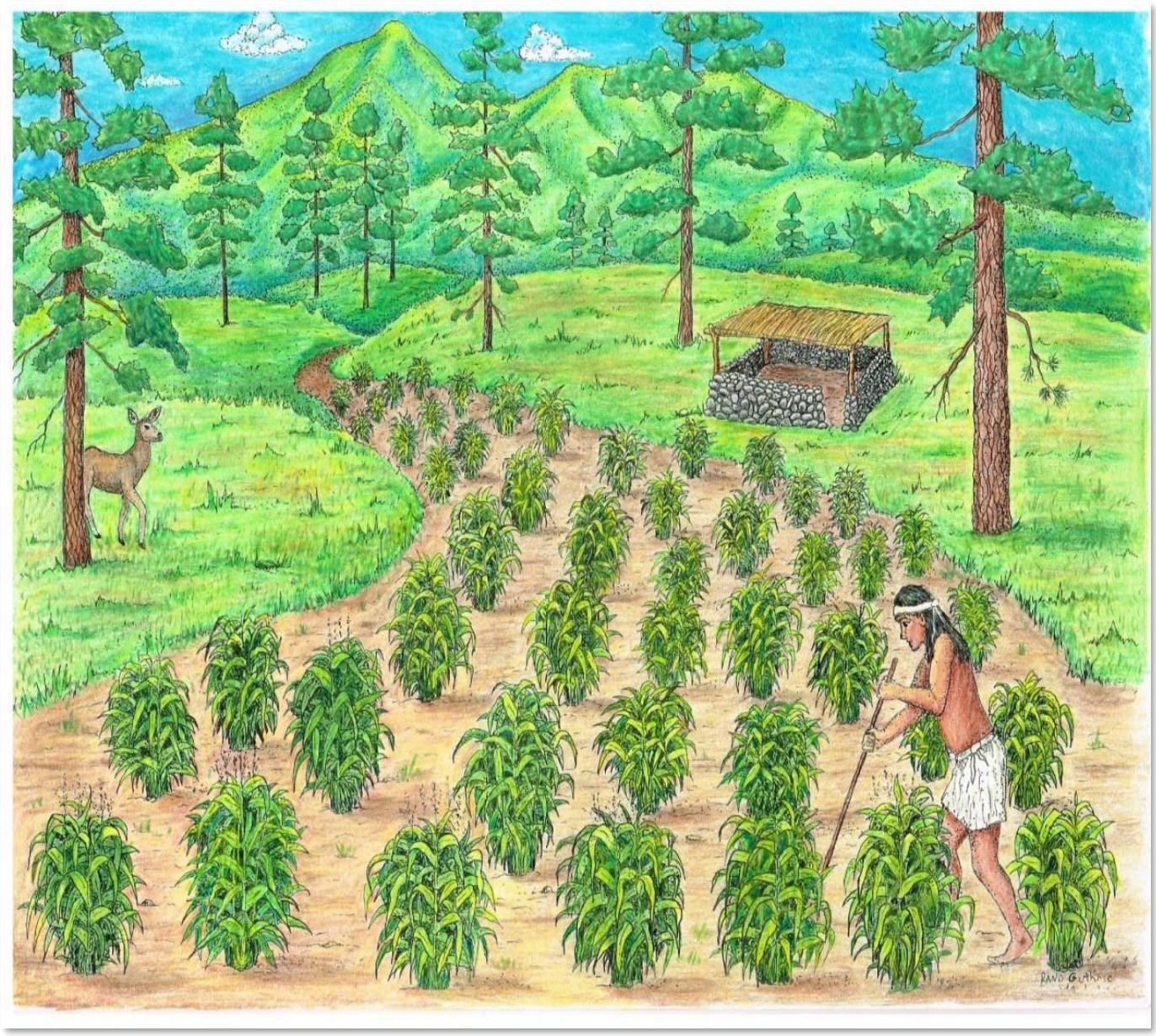
The Doney Park area in the 1970s, photo taken from the Mt. Elden Lookout tower. This was probably the main farming area for residents at Elden Pueblo and could have supported dry farming, Ak-Chin farming and stone terraces or grids designed to channel and retain natural rainwater. There was evidence of grids and terraces in this area before development in the 1980s.

Elden Pueblo sits at the base of Mt. Elden in an alluvial fan between two climate zones.

Depressions, top, approximately one meter (39 inches) wide, photographed in the 1980s near Moon Crater east of Doney Park, are possibly early farm plots with cinders as the mulch on the surface. The depressions are in rows, and capture and hold water that percolates down to the root and probably protect against strong winds. The view above is of the surface and today, native grasses grow in the center of each depression probably because water collects and is retained there.

Linear borders for farming and water retention in the cinder fields north of Sunset Crater.

Dry Farming: an artist's interpretation of successful dry farming beneath the cinder hills east of Doney Park. A one-room field house near the garden offered shade and a place to guard against deer, rabbit and other hungry animals looking for a free meal. Traditional farmers, in the past and today, know how to take advantage of the best farming soils in the area with deep, rich deposits. Corn was and still is planted in clumps, which protects it from the strong spring winds. From the mid to late 1800s to the 1960s, these open park areas were utilized for commercial potato and bean farming.



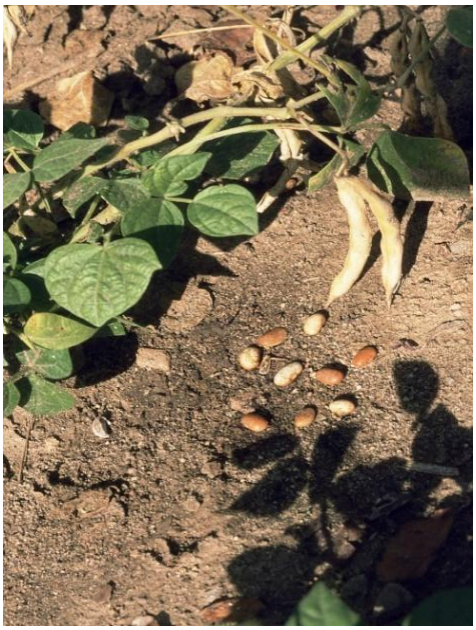
Ak-Chin (O'odham) or tivokvasa (Hopi) farming captures and utilizes seasonal monsoon water run-off and enables soil replenishing nutrients to be deposited at the mouth of a wash. This strategy was one of the most effective for growing crops, especially in the Verde Valley and central Arizona.

The use of rock terraces as a farming strategy was highly utilized in the Flagstaff area. Terraces decelerate the flow of natural rainwater and useful soil and nutrients are collected behind the alignments. The field house, right, was a place for farmers to have shelter as they watch the fields for rabbits, deer and other animals.

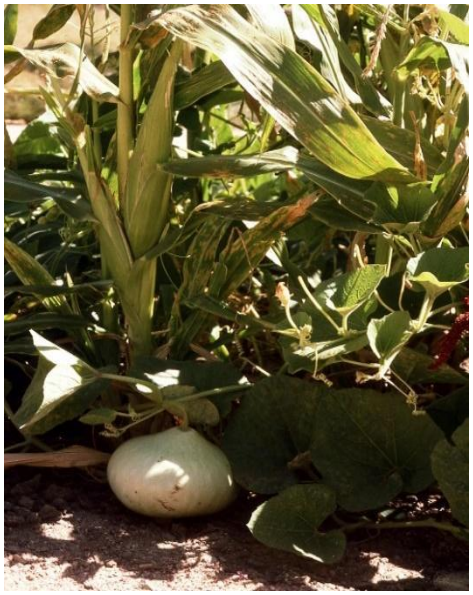
Hopi blue corn

Isleta Pueblo melon in the field

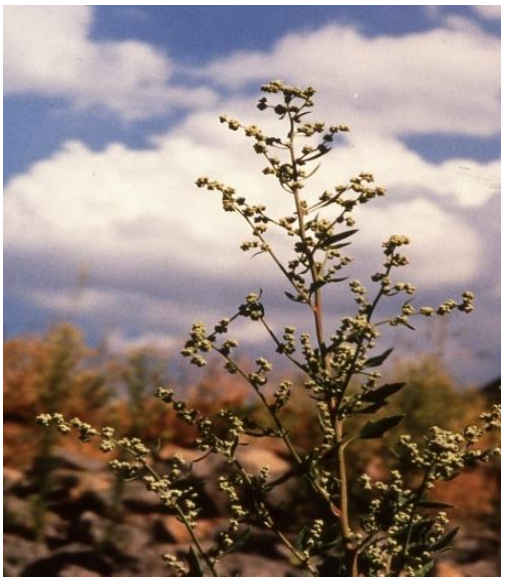
Hopi cotton



Beans



Hopi rattle gourd, corn and amaranth growing together.



Goosefoot growing near the Bilby Research Center, NAU

Photos courtesy of Karen Wright

Appendix A: This chart attempts to convey the importance of preserving Native languages, especially for the plants, animals and other natural resources in an area. Native languages reflect the heritage and culture of people along with the natural resources and landmarks of a landscape.

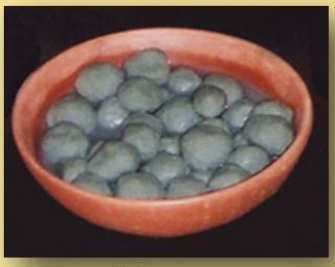
Anita Poleahla, Ferrell Secakuku, Leigh Kuwanwisiwma, Stewart Koyiyumptewa, Kristin Harned, Max Taylor, Susan Secakuku and others have dedicated much of their careers to sustaining the Hopi language for future generations through publications and educational initiatives. Many people contributed to the Hopi Dictionary, published in 1998 by the University of Arizona Press, reflecting the Third Mesa dialect. Earlier, in 1985, P. David Seaman of NAU also published a Hopi dictionary with the input of Native speakers. Emery Sekaquaptewa, Director of the Arizona State Museum was instrumental in organizing the dictionary project for the University of Arizona, along with Kenneth Hill and Mary Black.

The non-profit Mesa Media organization based in Polacca, First Mesa, has many educational posters, books, games and other publications designed to teach students of all ages the Hopi language (www.mesamedia.org). Appreciation is extended to educator Anita Poleahla for her contributions, especially in supplying the proper spelling in Hopi and including photos, names and descriptions of traditional Hopi foods.

Life Form	**Common Name**	**Scientific Name**	**Hopi Name**
Trees	Gambel oak	Quercus gambelii	**kwingvi**
	Ponderosa pine	Pinus ponderosa	**löqö**
	Arizona walnut	Juglans major	
	Juniper	Juniperus utahensis	**ngömaapi**
Shrubs	Cliffrose	Cowania stansburiana	**hunvi**
	Rabbitbrush	Chrysothamnus species	**sivaapi**
	Serviceberry	Amelanchier utahensis	**tuwvi**
	Saltbush	Atriplex species	**wuyavako**
	Cotton	Gossypium hirsutum	**pösövi**
	Sumac	Rhus trilobata	**suuvi**

	Narrow-leaf yucca	Yucca angustissima	**Mooho The root is moovi**
Wildflowers	Indian paintbrush	Castilleja lineariaefolia	**Mansi and pala'mansi**
	Scarlet bugler	Penstemon barbatus	**palakatsi**
	Hopi sunflower	Helianthus species	**aqaaqawi**
	Sunflower	Helianthus annuus	**aqawsi**
	Hopi blue corn	Zea mays amylacea	**sakwapqa'ö sakwapu**
	Sweet corn	Zea mays saccharata	**tawaktsi**
	Yellow corn	Zea mays	**takuri**
Other	Agave	Agave species	**kwantsoki (the plant kwaani (fruit)**
	Grease bean	Phaseolus vulgaris	**wimori**
	Fourwing saltbush	Atriplex canescens	**suwvi**
	Lambs-Quarters	Chenopodium spp.	**höhöla, sirwa**
	Pigweed	Amaranthus blitoides	**poosiw**
	Gourd	Lagenaria vulgaris	**tawiya**

TRADITIONAL HOPI FOODS



pövölpiki
blue marbles

somiviki
blue corn tamale

somiviki
blue corn tamale

tsukuviki

kwangwanova
sweet bread

qömi
sweet corn flour bread

pik'ami
corn pudding

tanguviki

koletviki
blue corn balls

sakwaviqavi
blue corn tortilla

sowitanguviki
tamales with rabbit meat

kutuki
parched corn

All photos and interpretation courtesy of Anita Poleahla, of Mesa Media, Polacca, AZ., www.mesamedia.org.; used with permission.

Dedicated to the research and contributions of Mesa Media co-founder Ferrell Secakuku.

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Scientists Barbara Phillips, Heather Green and Nancy Brian are active members of the Plant Atlas Project of Arizona, a statewide partnership between the Arizona Native Plant Society, Grand Canyon Trust, Desert Botanical Garden, Northern Arizona University, Museum of Northern Arizona, and the U.S. Forest Service to document the diversity and distribution of Arizona's flora. As volunteers, they inventoried the native plants at Elden Pueblo and Picture Canyon.

Note: the Hopi name for the pueblo, Pasiwvi, is used for references up to the Euro-American period when the site was named Elden Pueblo. Today, the non-profit Elden Pueblo Project hosts educational programs and cultural experiences for students from all over the country.