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Research Article

The Potential Importance of Prickly Pear Cacti (*Opuntia spp.*) For The Island Chumash and Tongva on Alta California's Channel Islands

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Abstract

Compared to the adjacent mainland, the islands off the Pacific Coast of Alta and Baja California were long considered to be marginal for human habitation. As Channel Island landscapes and plant communities gradually recover from more than 150 years of heavy grazing and other colonial activities, however, the notion of their marginality has waned as ecological monitoring and archaeobotanical research document an abundance of plant resources. Here we explore the potential importance of another plant taxon native to the California Islands, the prickly pear cacti of the *Opuntia genus*. Prickly pear fruits (tunas), leaf pads (nopales), and spines were used by Indigenous inhabitants for food, medicines, and technological purposes. Where abundant—especially in more arid areas or during dry seasons and droughts—they could also have been a critical source of moisture as the pads and fruits both consist of roughly 90% water. An abundance of prickly pear cactus on the islands adds yet another valuable terrestrial plant species to the array of terrestrial resources available to Island Chumash and Tongva peoples in the past.

Opuntia *species have been used for centuries as food resources and in traditional folk medicine for their nutritional properties and their benefit in chronic diseases, particularly diabetes, obesity, cardiovascular diseases, and cancer. [1].*

Introduction

Archaeologists have often portrayed small islands as relatively marginal for human occupation, limited in terrestrial resources and susceptible to human impacts. California's Channel Islands—occupied for millennia by Island Chumash and Tongva peoples—are no exception, routinely described in historical and archaeological accounts as having been "depauperate" or "impoverished" in terrestrial floral and faunal resources (see Erlandson, Gill, and Fauvelle 2019; Gill 2015) [2,3]. For decades, these notions of marginality influenced archaeological interpretations of when the Channel Islands were first settled, the size of Indigenous island populations, and the stimulus for relatively intensive trade between islanders and neighboring groups (Gill et al. 2019) [4]. A dearth of island plant foods, for instance, was often cited as the impetus for islanders to mass produce a shell bead currency that facilitated exchange for plant foods from mainland groups.

Although numerous historical and archaeological accounts portray the Channel Islands as having limited fresh water and terrestrial food resources, recent archaeological, paleobotanical, and ecological research has forced a reexamination of these assumptions—especially for the Northern Channel Islands—along with many of the interpretations founded on their supposed marginality. Reexamining the biodiversity of Channel Island plant communities relative to comparably sized areas of the adjacent mainland, for instance, Gill et al. (2019b:110-112) [4] demonstrated

that the islands support a diverse array of plants that can be used for dietary, medicinal, and technological purposes. After removal of introduced livestock (sheep, pigs, cattle, horses, etc.) and other exotic animals (deer, elk, etc.) from the islands, plant communities have recovered dramatically and endemic island plant foods have been remarkably productive despite a severe 20-year drought (Gill 2016) [5].

One of the most prolific of these is a geophyte known as giant island wild hyacinth (a.k.a. blue dicks, *Dipterostemmon capitatus* [Benth.] Rydb., [*Dichelostemma capitatum* (Benth.) Alph. Wood]), which are phenomenally abundant in island grasslands today, partly due to the lack of endemic herbivores (gophers, deer, etc.) that control their populations in mainland habitats. Relatively abundant carbonized blue dick corms have also been identified in numerous Channel Island archaeological sites spanning at least 11,500 years (Gill 2015; Gill et al. 2021; Erlandson et al. 2019; Reddy and Erlandson 2012) [2,3,6]. Another edible food abundant on the islands is a diverse array of seaweeds, the economic importance of which has been largely ignored because they rarely preserve in archaeological sites and a single ethnographic account that said they were not eaten by the Chumash (see Ainis et al. 2019) [7]. It now appears that Indigenous Channel Islanders had access to a diverse array of marine and terrestrial resources and were generally coping with abundance rather than food shortages. Here we add to the growing list of useful native plants available on California's Channel Islands by summarizing what is known about the abundance, nutritional content, and medicinal properties of prickly pear cacti (*Opuntia* spp., especially *O. littoralis* and *O. oricola*), which are abundant on the islands but whose potential value has been underestimated by archaeologists and anthropologists. We review historical and ethnographic sources to gauge the range of potential uses for *Opuntia* in the past, present available nutritional data to understand the food and moisture value of the pads and fruits, and summarize the medicinal properties of the prickly pear cacti.

Prickly Pear Cacti as a Potential Source of Food, Medicine, and Water

Prickly Pear cacti (*Opuntia* spp.) are endemic to the American Southwest and Mexico, although domesticated varieties are now cultivated in arid regions around much of the world. They are widely grown for food (the fleshy pads and fruits), medicinal purposes, as ornamentals, and other purposes. Prickly pear cacti are succulents that thrive in arid regions because they have leathery skins, spines and spicules that comb moisture from the air, and they utilize a nocturnal photosynthetic pathway known as crassulacean acid metabolism (CAM) that make them remarkably efficient in water capture and storage.

The coastal prickly pear (*O. littoralis*) is native to and abundant on all California's Channel Islands, parts of the adjacent mainland, and many of the islands of Baja California

(Junak et al. 1995; Smith 2007:206-207) [9, 10]. These islands range from arid to hyper-arid and the high water content (~87-94%) of prickly pear pads and fruit could have been an important source of moisture in areas with limited freshwater sources, especially during dry seasons and droughts. For Santa Cruz (Limuw) Island, Junak et al. (1995:145) [9] described *O. littoralis* as growing in patches ~1-1.5 m high that are widely distributed on rocky south-facing slopes, ridgetops, grassy hillsides, and coastal bluffs in chapparal, coastal scrub, and grassland habitats, at elevations ranging from 3 to >600 meters. *O. littoralis* generally flowers between April and June (Baker et al. 2019) [11] with fruits forming in summer and early fall that can remain on the plant for months. A somewhat larger prickly pear, *O. oricola*, often hybridizes with *O. littoralis* and is listed as common on all the Channel Islands, as well as the Islas Coronados, Todos Santos, and Islas Cedros off the Pacific Coast of Baja California (Junak et al. 1995; Smith 2007:207) [9,10].

After visiting several Channel Islands in AD 1873, 1874 and 1897, Gustavus Eisen (1904) [12] claimed that as much as one-half of the islands were covered with prickly pear cactus and considered their fruits to be a potential major food source for the Island Chumash. His claim that half the islands were covered in cactus seems unlikely, but their abundance may have increased after the Island Chumash were removed to the mainland in the early 1820s and their regular burning of island landscapes ceased (Timbrook et al. 1982) [13]. *Opuntia littoralis* is susceptible to fire, but also recovers well after low-to-moderate intensity fires (Baker et al. 2019) [11]. After sheep and other livestock were introduced to many of the islands in the mid-1800s, however, it seems likely that the abundance of prickly pear also would have declined. On Santa Cruz Island (Limuw) and undoubtedly other areas, exotic insects were introduced historically to reduce the extent of prickly pear (Smith 2007:207) [10].

The recovery of carbonized Opuntia seeds from Channel Island archaeobotanical samples demonstrates that prickly pear cactus were consumed by the Island Chumash for millennia (Gill 2015; Thakar 2014) [3,14]. Found that prickly pear remains were identified in 7 of 12 (58.3%) archaeobotanical assemblages analyzed from Limuw, ranking them in a tie for sixth among plant foods in terms of ubiquity. Measures of ubiquity and abundance may not fully reflect the dietary significance of prickly pear cactus on the islands, however, as the pads would leave no macrobotanical evidence of their consumption and most of the seeds—if prepared separately from the fruits—may have been ground into a meal to make them digestible.

Food Uses, Preparation, and Nutrition

Although the presence of spines and tiny bristles (glochids) can be imposing to inexperienced persons (see Figure 1), *Opuntia* flowers, fruits, pads, and seeds are all edible. According to Timbrook (2007:133-134; [15] see also Smith 2007) [10] the fruits (tunas) were "relished" by the Chumash, and young leaf pads (nopales) were eaten but not considered an important food. Timbrook's sources are

primarily Chumash elders interviewed by anthropologists such as John Peabody Harrington in the early 1900s, nearly a century after the Chumash were removed from the Northern Channel Islands in the early 1820s. These rich ethnographic sources primarily describe mainland practices during the colonial Mission period and may not fully reflect the nature of Island Chumash resource uses prior to European contact (Gill 2015; Ainis et al. 2019) [3,7].

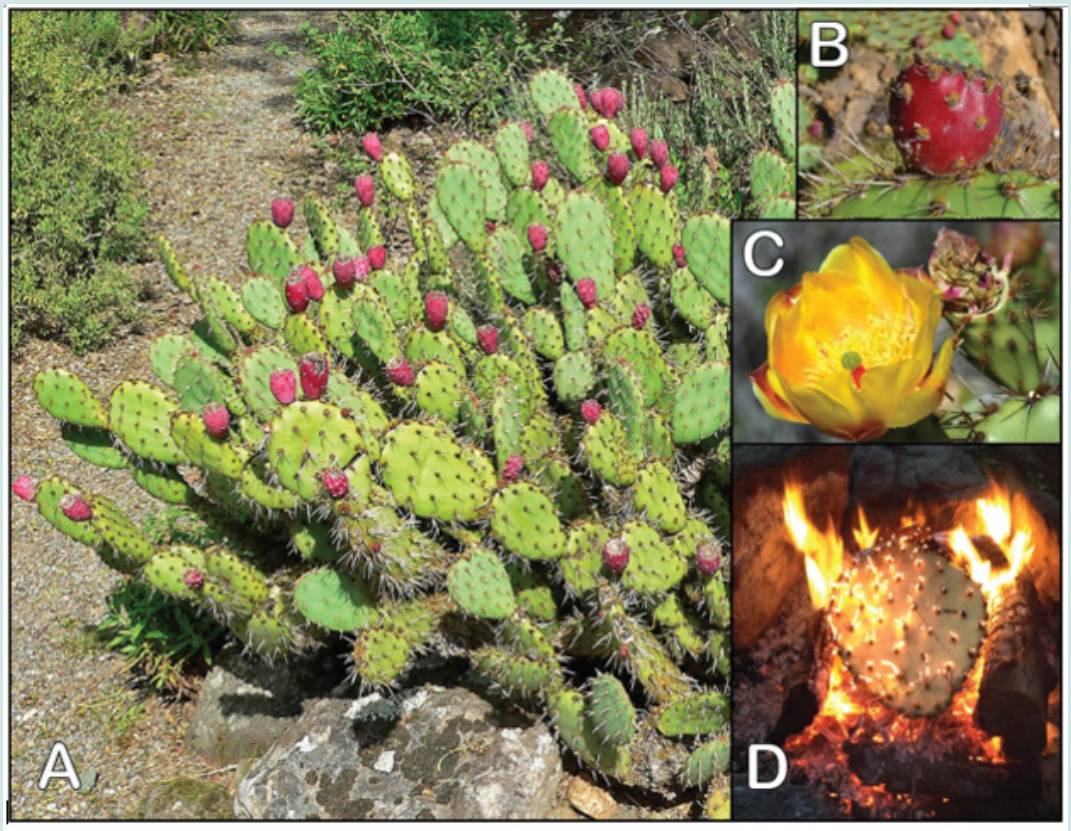

Figure 1: *A prickly pear cactus (Opuntia littoralis) thicket, showing pads (nopales) and fruits (tunas (a)), with inset closeups of pads and fruits (b), and flower (c) (background photo by Stanley Shebs 2007, closeups of flower by Nandaro 2014, pad and fruit by H. Zell 2016; images courtesy of Wikimedia Commons; and O. littoralis pad in fire to burn off spines (d), image by [22].*

Prickly pear fruit (~3.5-5 cm long, ~110 g) were harvested by the Chumash and other Indigenous Californians using bent sticks as tongs to remove them from the pads, with a broom-like brush, rolling them in the dirt, or burning used to remove the glochids (see Figure 1D). The fruit could be eaten raw by peeling back the skin or they could be dried for later consumption, leading to the name "Indian fig" in California Mission days (Smith 2007) [10]. Numerous relatively large (3-4.5 mm long) and hard seeds are found within the fruit and these could be consumed with the tunas, discarded, or saved for drying and grinding into a nutritious meal. The fleshy green pads, 19-25 cm long, could also be eaten raw or cooked after removal of the thorny spines via burning or peeling.

Detailed nutritional data are available for *Opuntia* fruits and pads (Gilliland 1985; Kamble et al. 2017) [16,17]. Both are composed primarily of water (~88-94%) in their fresh state, which reduces their nutritional content compared to many other Native California plant foods. As a result, these raw products are relatively low in protein, fat, carbohydrate, and energy content (see Table 1), but good sources of vitamins (A, B, C, E, & K), as well as key elements such as calcium, iron, magnesium, potassium, zinc, copper, and selenium (Table 1). The low energy potential of prickly pear pads and fruits may suggest that they would be relatively low ranked among available island plant foods, but this may have been mitigated to some extent by their high moisture content on relatively arid islands, their abundance and ubiquity, and the lack of labor-intensive processing requirements. The pads are also available year-round and the fresh fruit are available for months in the fall/winter and they could be dried and stored for long periods of time. Finally, the seeds likely have higher fat, carbohydrate, and calorie contents, adding to the nutritional yields of harvesting and processing the fruit.

Table 1: Nutritional Data for Opuntia spp. (from Gilliland 1985; Kamble et al. 2017).

Contents (per 100g)	Fruit (tunas)	Pads (nopales)
Water (H2O)	85-90%	94.12%
Kcal	46	20
Protein	0.73	1.32
Fats	0.51	0.09
Carbohydrates	9.57	3.33
Fiber	3.6	2.2
Calcium (Ca)	56	164
Iron (Fe)	1.5	0.59
Magnesium (Mg)	85	52.0
Phosphorus(P)	--	24
Potassium (K)	220	257
Sodium (Na)	5	--
Zinc (Zn)	0.12	0.21
Copper (Cu)	0.08	0.052
Selenium (Se)	0.6	0.7
Vitamin A (IU)	43	457
B-Carotene	--	250
Vitamin B1 (Thiamine)	0.014	0.012
Vitamin B2 (Riboflavin)	0.06	0.041
Vitamin B3 (Niacin)	0.46	0.41
Vitamin B-6	0.06	--
Vitamin B9 (Folate)	6	--
Vitamin C (mg)	26	9.3
Vitamin E (mg)	527	--
Vitamin K (mg)	53.2	5.3

The Chumash reportedly also utilized Opuntia products for a variety of technological purposes. Timbrook (2007:133-134) [15] noted that the spines were used as needles in piercing and tattooing, as well as possible fishhook components; the juice of the fruits was used as pigments, and the mucilaginous gel from pads as a pigment binder, a congealing agent, and historically in waterproofing adobe bricks. The diced pads were also reportedly used as bait when fishing for sardines (ibid.).

The Chumash also reportedly used prickly pear cactus for medicinal purposes, at least historically. The juice from the pads had antibiotic wound-healing properties, for instance, and a tea from the flowers was used for heart conditions (Timbrook 2007) [15]. More generally, *Opuntia* products are used as folk medicines in many parts of the world today (Shirazinia et al. 2019) [18], and modern medical studies also support the efficacy of *Opuntia* products for treating a variety of chronic diseases, including diabetes. According to WebMD (2023) [19], cactus pads and fruits are both high in fiber and help lower blood sugar and cholesterol levels. Modern studies also suggest that prickly pear products have antibiotic, antioxidant, anti-inflammatory, and anti-tumor properties, as well as aiding digestion, nutrient absorption, and immune responses (Santos Diaz et al. 2017; Shirazinia et al. 2019, and references therein) [1,18].

Conclusions

As the marginality of islands off the Pacific Coast of Alta and Baja California continues to be reevaluated by archaeologists (e.g., Braje et al. 2021; Erlandson, Braje et al. 2024; Gill et al. 2019) [20,21,22], it is important that we reassess the former abundance and productivity of various plant resources on an island-by-island basis. It is also important that we not uncritically accept ethnographic and historic accounts from colonial times long after Indigenous islanders were forced to leave their island homes, and overgrazing and exotic plant introductions had devastated endemic island plant communities. Instead, it seems more prudent to utilize

archaeological data to evaluate the accuracy of such ethnographic accounts [23].

In this brief paper, we reexamined the economic potential—nutritional, technological, and medicinal—of coastal prickly pears (*Opuntia* spp.) for the Island Chumash and Tongva prior to European contact. Prickly pear cacti were abundant and widespread on the islands and their fruits, pads, flowers, and spines offered potentially important sources of water, nutrition, medicines, and technological products for Indigenous islanders. Even if prickly pear cacti were not among the highest ranked plant food resources on some or all these islands, they could have been a significant supplemental source of food and micronutrients during seasons when other resources were relatively scarce or unavailable, as well as a source of fresh water in dry seasons or areas with limited availability of other freshwater sources. With broad pharmacological properties, the consumption of prickly pear foods may also have improved the health, longevity, and reproductive potential of island peoples. Ultimately, the abundance and demonstrated utility of prickly pear cacti on the islands adds yet another resource to the food security, medicinal options, and technological needs of Indigenous Island peoples off the Pacific Coast of Alta and Baja California.

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