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THE CALIFORNIA GEOGRAPHER

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Founded in 1946 as the California Society of Teachers of Geography, the California Geographical Society (CGS) is the oldest statewide organization devoted to enhancing the understanding of geography. During the 1950s the organization became affiliated with the National Council for Geographic Education and changed its name to the California Council for Geographic Education. It acquired its present name during the 1980s as it sought, successfully, to become inclusive of all individuals interested in geography—academic and applied geographers, students, laypersons, and educators at every level. The CGS promotes interaction among its diverse members and holds an annual meeting in the spring at different venues around the state. Meetings include field trips and paper, poster, and map presentations, with cash awards for outstanding student presentations, and scholarships for graduate and undergraduate students. Teaching excellence and professional service are recognized with awards.

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The California Geographer



Volume 56, 2017



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CALIFORNIA GEOGRAPHICAL SOCIETY

Edited by
MATTHEW DERRICK
AND
ROSEMARY SHERRIFF

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The California Geographer

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For information on submitting a manuscript, see "Instructions to Contributors" on website, <http://www.csun.edu/~calgeosoc/>. Direct all manuscript inquiries to either Matthew Derrick, Department of Geography, Humboldt State University (mad632@humboldt.edu); or Rosemary Sherriff, Department of Geography, Humboldt State University (sherriff@humboldt.edu).

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From the New Editors of the *California Geographer*

THIS ISSUE OF *California Geographer* marks our debut as co-editors of the peer-reviewed journal that publishes articles on all aspects of California geography and beyond. Both professors in the Department of Geography at Humboldt State University, we hope our sub-disciplinary specializations—Matthew is a human geographer, Rosemary a physical geographer—provide a complementariness that reflects the breadth and dynamism of the field.

We envision a new format for the *California Geographer* that, evolving year to year, includes not only geographic scholarship, geographic education, and book reviews, but also welcomes non-scholarly essays, photo essays, and geo-visualizations. We also encourage geographic chronicles that may include reflective essays, general geographical interest stories, notes from the field, and notices relevant to California geographers.

We are accepting submissions for the next volume (2018) of the *California Geographer* until February 1, 2018. We also welcome questions on your interests for submissions. Please send your submissions (MS Word) and figures (JPEG or TIFF) via an email attachment to either of the co-editors: Matthew Derrick (mad632@humboldt.edu) and Rosemary Sherriff (sherriff@humboldt.edu).

In presenting this current issue, we wish to thank Kathryn Davis, who had edited the journal since 2011, for her graciousness in helping ensure a smooth transition. We hope to maintain the high standards established by Davis and previous editors of the journal.

Matthew Derrick
Rosemary Sherriff

Hidden in Plain Sight: Cannabis Cultivation in the Emerald Triangle

Joshua Meisel
Humboldt State University

In the checkout line at my local grocery store, a man unloads twelve boxes of turkey oven-roasting bags.

“Looks like you’re gonna have one helluva Thanksgiving!” I joke.

He turns to me, smiles, and leaves the store. It is October and cannabis harvest is in full swing. The clerk looks at me wide-eyed and asks, “You do know what those are really for...don’t you?”

Turkey bags are one of the many subcultural signs that mark the presence of the cannabis industry in Humboldt County, California. Since the 1996 passage of Proposition 215 and the pseudo-legalization of medical cannabis, Humboldt’s leading agricultural product has occupied a legal and cultural gray area. The medical cannabis industry, state and county officials, and law enforcement agencies maintain a fragile peace. Historically, the federal government disrupted this truce when, flexing its authority, it raided local medical cannabis dispensaries (Chapkis 2008) and seized medical cannabis grower records (Mozingo 2013), among other actions. Until California voters first considered legalizing recreational cannabis in 2010, the stigma and legal ambiguity of cannabis prevented fully open conversations and planning between users, growers, public officials, and businesses that participated in and benefited from the industry. In the intervening years leading up to the 2016 passage of Proposition 64, variously positioned players constructed a coded system of signs that now have meaning to even those not directly involved in the industry.

Since the 1970s, work in the cannabis industry gradually replaced the loss of local timber and fishing jobs (Raphael 1985; Anders 1990). Like many communities across the United States struggling with deindustrialization and the outsourcing of blue-collar employment (Reding 2010), my community capitalized on America’s growing appetite for “ganja” and developed an international reputation for quality cannabis.

Using law enforcement seizure quantities as a proxy measure of cannabis production, the United Nations Office on Drugs and Crime (2016, 43) reported that most cannabis in the world is produced in North America and Mexico. The majority of global cannabis seizures in 2014 occurred in North America (thirty-seven percent) and South America (twenty-four percent). Moreover, California produced most of the cannabis seized during Drug Enforcement Agency (DEA) raids: sixty-two percent of all cannabis seized by DEA agents in 2015 was grown in California (Drug Enforcement Agency 2017). Humboldt County is one of the largest U.S. cannabis-producing areas in the country and a cultural epicenter for the industry (Brady 2013; Corva 2014; Raphael 1985). Humboldt, Mendocino, and Trinity Counties are collectively known as the “Emerald Triangle.”¹

Cannabis cultivation in the Emerald Triangle was first initiated by an exodus of “back-to-the-landers”² fleeing broken promises of late 1960s social movements (Raphael 1985; Anders 1990; Anderson 1990), a migration pattern that somewhat ironically was sparked by U.S. government cannabis interdiction efforts in Mexico and Columbia (Lee 2013).³ However, the scale and density of indoor and outdoor cannabis cultivation in the Emerald Triangle increased substantially following the 1996 passage of the first medicinal cannabis law in the US (Brady 2013). One study estimates that one of every four dollars circulating in Humboldt County is tied to the cannabis industry (Budwig 2011) and the area retail rates for pot are some of the least expensive in the nation. One study found that the further one travels from Humboldt County, the higher the retail price of cannabis (Zook, Graham, and Stephens 2011).⁴

Beginning in 1983, law enforcement raids became more frequent (Corva 2014). A joint alliance of federal and state law enforcement agencies launched heavily armed drug agents from military helicopters onto remote parts of the county. Each year, these paramilitary raids netted increasing quantities of confiscated cannabis. Asset forfeiture and federal drug task-force grants subsidized budgets of local law enforcement agencies (Alexander 2012).

This local “war on drugs” fostered a culture of secrecy and distrust (Brady 2013). In heavy grow areas, neighbors do not ask what one does for a living. During harvest season, school teachers do not question extended student absences. And at the same time, the community has organized to resist attacks on civil liberties from federal and state law enforcement (Lee 2013).

In an era now past, cannabis cultivation was the “green elephant” in the community: Few were willing to debate its presence. In the decades following legalization of medical cannabis in California, Humboldt County

residents, like those in other parts of the Emerald Triangle, developed an ambivalent relationship with the industry. Cannabis became recognized as the economic lifeblood, as well as demonized for its linkages with lawlessness and environmental harm (Hudson-Cossar 2014).

Forest and river ecosystems, still recovering from historic over-logging and -fishing, confront new environmental threats associated with illegal marijuana cultivation in the region. Water diversion, soil erosion, diesel spills, and the excessive use of fertilizers are just some of the byproducts of unregulated cannabis cultivation conspiring to destroy area waterways and vulnerable fish habitats (Bauer et al. 2015). Other environmental dangers include substantial energy use powering industrial-scale indoor cannabis grow operations (Mills 2012), as well as the excessive application of pesticides and herbicides (Gabriel et al. 2015). For example, anticoagulant rodenticides have been widely dispersed around young cannabis plants and observed along miles of irrigation lines following law enforcement raids (Gabriel et al. 2012). The human health and ecosystem impacts from the use of such rodenticides are understudied.

Yet cannabis cash has helped build local environmental organizations. Today these groups are working with land-management agencies to selectively fight “bad growers” (Donahue 2014) who damage rivers and forests with irresponsible cultivation practices. For example, with funding from California Department of Fish and Wildlife, Sanctuary Forest in southern Humboldt developed a technology transfer initiative to purchase and install “over one million gallons of water storage in the Mattole River watershed, resulting in a measurable increase in stream flows within their project area” (Schremmer 2014, 81).

Coded signs of this illicit, not-so-underground economy are woven into everyday life. Whether one is looking at a colorfully decorated local bus or picking up a loaf of bread at the market, images and artifacts remind residents of the Emerald Triangle where they live. The images in this article appeared between 2011 and 2014 in the everyday life of residents in Humboldt County. They are part of my larger research project studying historical shifts in cannabis perceptions, policies, and practices in a heavy cannabis-producing region. Some photos I captured myself while going about my daily routine of walking downtown, shopping for dinner, and picking up light bulbs at the local hardware store. Most were culled from the 2012 to 2014 pages of a Humboldt County newspaper known for publishing cannabis industry advertisements.

In a region well-known for cannabis cultivation, the word “bud” has dual meaning. It references both the well-known national beer as well as the prized flower of the female cannabis plant. In 2011 a billboard appeared along a highway in Humboldt County aligning the cannabis bud with an all-American beer (Figure 1). The tag line “Grab some Buds” in a Hum-



Figure 1. Billboard appearing along major highway in Humboldt County. (personal photograph)

boldt County context linked cannabis consumption with the mainstream pastime of drinking a beer. According to Anheuser-Busch, the original six Clydesdale horses were a 1933 gift from Busch sons to father to celebrate the repeal of Prohibition. The horses, along with the slogan “Great times are Coming,” anticipated a new era of post-prohibition. The following year, Colorado and Washington were the first states to legalize recreational use of cannabis. While some might suggest the dual meaning is coincidence, other, more-explicit advertising suggests the association is intentional and targeted.

The linkage between beer and cannabis advertising was reinforced in a banner displayed in a local bar on April 18, 2013 (Figure 2), two days before “4/20.” The term “4/20” references the date cannabis aficionados celebrate the plant and publicly challenge federal cannabis prohibition. In an annual ritualized act of civil disobedience, they communally “light up” at 4:20 p.m. on the 20th of April (Halnon 2011). The image also depicts hops, the female flowers of the hop plant, which provide flavoring in beer. As with cannabis grown for its use as a drug, male plants are removed to prevent pollination. The advertisement also incorporates a red, yellow, and green border, drawing

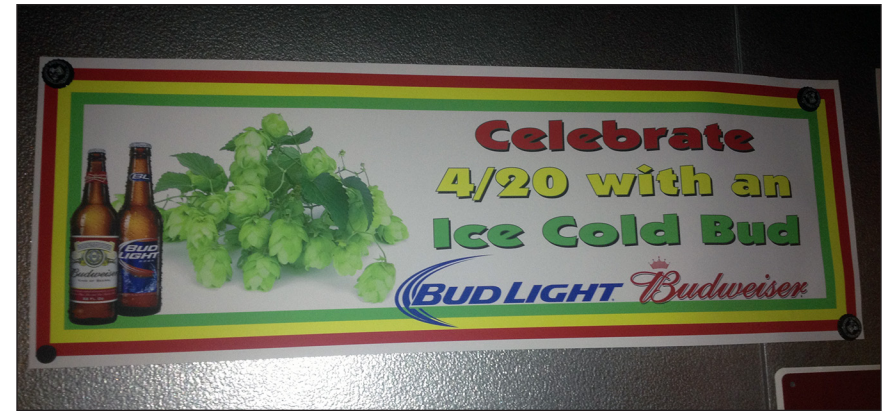


Figure 2. Beer advertisement displayed in Humboldt County bar. (personal photograph)

a symbolic connection to the Rastafari movement and its spiritual use of cannabis. Cultural appropriation of all things “Rasta” is part of the larger, lucrative mass-marketing of the cannabis counterculture.

The proliferation of local horticulture-supply businesses represents another indicator of an illicit cannabis industry. “A Fertile World” is a local horticulture supply shop. In 2014 the shop’s advertisement was featured on a bus operated by the Redwood Transit System (Figures 3 and 4). The regional bus moved that message through the streets and highways of Humboldt County. At first glance, the heavy use of earth tones and symbols, such as the planet Earth and redwood trees that extend the full height of the bus, suggest this is perhaps an ad for a local environmental organization. Yet prominent on the side of the bus is an image roughly resembling a cannabis plant with magnified roots reaching deep into the soil. The ad at once calls the viewer to understand the environmental richness of the area, as well as the strong and deep ties that cannabis has to the region. “Growshops” like Fertile World are highly concentrated in this area and represent the range of businesses that participate in—and prosper from—a cannabis-fueled economy. There are approximately ten times as many grow shops per capita in Humboldt County as there are five hours south, in the San Francisco Bay Area.⁵

The “green rush” of cannabis capitalism, like the other waves of resource extraction that have rolled through this region, has left the community scrambling to reconcile short-term profits with long-term damage to the natural environment and community cohesion. “Strike It Rich” (Figure 5) is an advertisement for another horticultural supply business and was



Figure 3. City bus adorned with advertisement for horticulture supply business. (personal photograph)



Figure 4. Horticulture business advertisement on city bus makes euphemistic reference to “Humboldt County Farming.” (personal photograph)

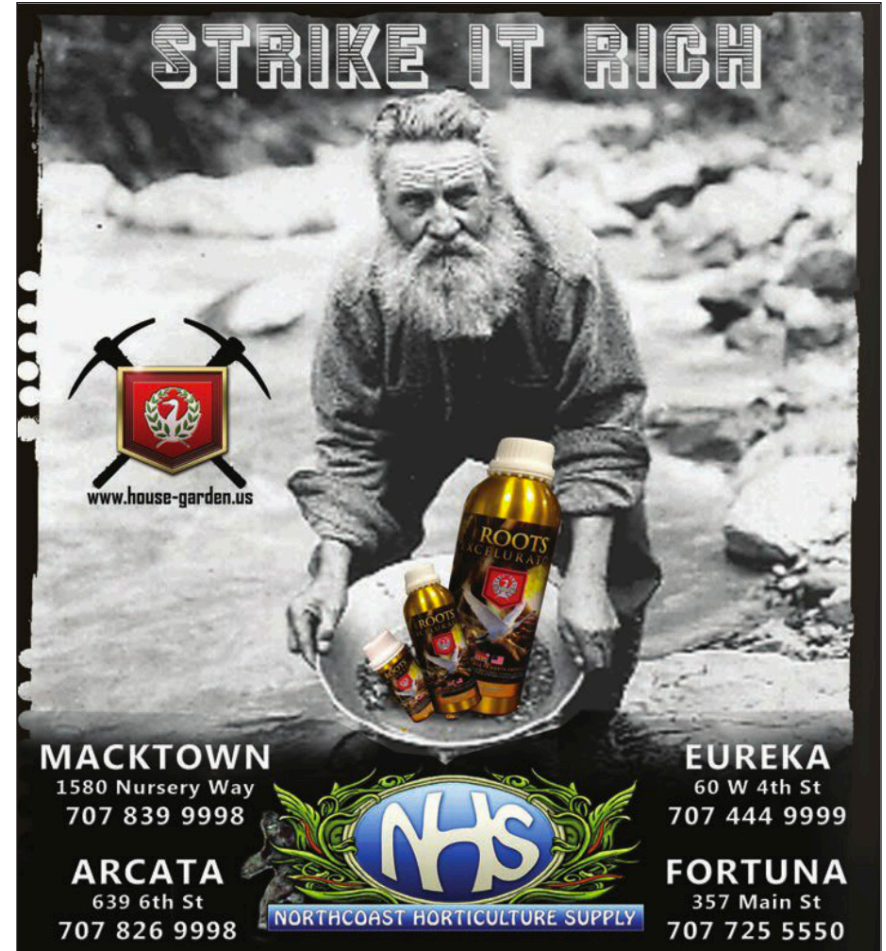


Figure 5. Advertisement for root stimulator sold by local horticulture supply business. (North Coast Journal, March 28, 2013)

featured in a spring 2013 issue of the *North Coast Journal*, a popular Humboldt-based weekly newspaper. The ad draws on an image of the California Gold Rush and the age-old rags-to-riches story. A miner holds a pan filled with bottles of “Roots,” a root stimulator popular among growers. This representation of grower as prospector provides a symbolic link to those who introduced cannabis cultivation to the region in the late 1960s. This first wave of “back-to-the-land” growers are now romanticized for their idealism and strong community ties, while newcomers to the area are viewed with suspicion and contempt. “Green rushers” or “cannabis capitalists” were often represented in the media as having foreign ties, often to Mexican drug cartels (Trujillo 2011). It is

important to note, however, that the influence of Mexican drug cartels in California cannabis cultivation were exaggerated (Kilmer, Caulkins, Bond, and Reuter 2010).

Beyond green rushers drawn to the area by the promise of cannabis profits, the cannabis industry also draws in students attending the local university. This local horticulture shop “Back to School Sale” ad (Figure 6) was featured prominently in a fall 2013 issue of the *North Coast Journal* as students were returning for a new term at the local university. In the advertisement, a student is carrying a backpack past the wall that marks a main university entrance. A closer look at her backpack reveals that it is not loaded with



Figure 6. Advertisement for various horticulture supplies targeting returning college students. (*North Coast Journal*, September 19, 2013)

books and binders; rather, it is overflowing with pruning shears, grow lights, liquid fertilizers, and turkey oven-roasting bags. Like students across the U.S., students at the local university are experiencing greater costs and fewer resources to finance their college education. Students arrive on campus with increased financial needs and encounter a cannabis industry with pervasive mechanisms for recruiting its workforce. One study found that almost one in five local university students surveyed were employed in the cannabis industry (Eschker, Meisel, and Grabinski 2014).

When students return to campus in the fall, a local hardware store features prominent displays (Figures 7 and 8) of some of the necessary supplies needed to build one’s own indoor cannabis grow operation. Displays include grow-light systems and Mylar polyester film, as well as boxes of turkey bags and latex gloves for use during cannabis harvest season. The cannabis industry involves not just those directly involved in the cultivation, processing, and distribution of cannabis; it also includes other peripheral business sectors that have an economic interest in cannabis cultivation. Beyond garden supply shops and hardware stores, these other businesses include builders and suppliers, irrigation system designers and suppliers, Realtors, and security equipment vendors and installers.



Figure 7. Grow light supplies on display at local hardware store. (personal photograph)



Figure 8. Turkey oven roasting bag, latex gloves and contractor bags on display at local hardware store. (personal photograph)

One prominent industry catering to cannabis farmers is the manufacturers of turkey oven roasting bags. In 2010, a “Turkey Oven Bags” billboard (Figure 9) appeared on the main Highway 101 corridor running through Humboldt County. For tourists passing through the region, this billboard must have looked bizarre. For many locals, however, turkey oven-roasting bags are a metaphor for the cannabis economy. Growers package cannabis in these plastic bags because of their durability and odor-blocking properties. As each bag is typically used to transport one pound of processed cannabis, turkey bag sales are a proxy for the scale of the local cannabis industry. When a regional news source reported that “Over 100 Turkey Bags Full of Pot Fail to Make Their Thanksgiving Destination” (Kemp 2012), locals understood both the humor, as well as the lost revenue from the confiscated cannabis. In this bust, the seller most likely lost about \$150,000 in sales.



Figure 9. Billboard advertising turkey oven roasting bags appearing alongside state highway in county. (Kim Sallaway Photography)

Like turkeys raised for Thanksgiving, cannabis grown outdoors is harvested in the fall. “It’s Turkey Season - Again!” (Figure 10) was an advertisement for a garden supply shop that appeared in the *North Coast Journal* at the start of the 2013 cannabis harvest season. A turkey gazes at the threatening scissors in the foreground as a “gardener” sneaks up from behind, ready to



Figure 10. Advertisement for cannabis trimming supplies. (*North Coast Journal*, October 3, 2013)

bag the bird. The symbolic representation of the cannabis harvest as “turkey season” is understood by many locals in the Emerald Triangle. Likewise, the scissors, turkey oven bags, alcohol, and trim bins all displayed in the ad are not intended for processing turkeys. Instead they are used for manicuring the flowering female cannabis plant into an attractive bud for resale.

Some advertisements for turkey bags reflect the race, class, gender, and sexual orientation of those playing in the cannabis industry. “Discount Turkey Bags” (Figure 11) was another ad that appeared in the *North Coast Journal* during cannabis harvest season. The ad features a young white woman in high heels, long stockings, garter belt, and an apron, posing provocatively with



Figure 11. Advertisement for turkey oven-roast bags. (North Coast Journal, October 3, 2013)

her roasted turkey. The kitchen is marked by a restaurant-grade stove, as well as marble and tile surfaces. The image is constructed through a straight male gaze, associating the industry with the good life where both women and wealth are accessible. This particular construction also signals the gender inequality and sexism of licit economies mirrored in the cannabis industry. For example, Craigslist ads recruiting trimmers offered higher pay for “topless” trimmers (August 2012). Female trimmers reported earning about eighty percent of what males earn for the same work (Eschker, Meisel, and Grabinski 2014).

Some advertisements utilize sexually coded language referencing the propagation of female plants from existing plant stock. “Let’s Make Some Babies” was the slogan for two ad campaigns (Figures 12 and 13) launched by two different horticulture supply shops. Both appeared in the *North Coast Journal* and typify the comic use of sex to sell cannabis agriculture products. The first ad features the image of a bull mounting a cow in an open field. The second ad juxtaposes a white hippie complete with long beard and bandana against symbols of middle-class, feminized material comforts: a bubble bath, custom tilework, fresh-cut flowers, and burning candles. The ads target growers preparing to take cuttings and raise clones of female cannabis plants of a desired strain. Growers prefer this method of propagation, as it allows them to both continue producing a desired cannabis strain and prevent fertilization from male plants if they grew directly from seed. Paradoxically, the ad implies sexual reproduction in a process that is anything but sexual, as male plants are removed altogether from cannabis propagation.



Figure 12. Advertisement for cannabis cloning supplies. (North Coast Journal, February 7, 2013)



Figure 13. Advertisement for cannabis cloning supplies. (North Coast Journal)

Other advertisements build upon the desire of growers not just to propagate only female plants, but also to protect their plant stock from disease or infestation. “Clean up those Dirty Girls from Top to Bottom” (Figure 14) was an ad that ran in the *North Coast Journal* during late spring. The ad targeted growers concerned with different types of plant infestations. The photo depicts a crouching, hooded man as the active, almost predatory, agent juxtaposed against the more passive and unaware woman wearing heels and a dress. In the image, the woman is a proxy for the female plant being “fixed” for her dirtiness/infestation. The ad draws on a long history of misogyny targeting women’s bodies and subjecting them to broad and microscopic alterations (Matelski 2017), as well as the social marginalization of women

SALE!
 Atomizers \$219.95
 Sulfur Burners \$85.95
 Battery-Powered Sprayers \$145.95

CLEAN UP THOSE DIRTY GIRLS FROM TOP TO BOTTOM

Prices Valid Through June 1st
 Open Mon-Sat 10am - 6pm
 Sunday 10am - 5pm

707.826.7435

On Hwy. 101, in the Bracut Industrial Park

BAYSIDE GARDEN SUPPLY
 HYDRO • ORGANICS • SOILS

Figure 14. Advertisement for pest control supplies. (*North Coast Journal*, May 3, 2012)

with sexually transmitted diseases (Nack 2008). The ad reinforces this stigma of female plants infested with spider mites and other pests, by drawing on the broader sexist trope of dirty women in need of fixing.

“Football,” like “girls,” “babies,” and “turkeys,” are featured prominently in the symbolism communicating the local economic cannabis activity. “Keep your footballs fresh until next season!” (Figure 15) was an ad that ran in the *North Coast Journal* during harvest season. The football player on bended knee is carefully sealing footballs using the advertised industrial vacuum sealer. Again, a link is made to a popular American pastime to further solidify the legitimacy of cannabis cultivation in the local community.

Open Mon-Sat 10am-6pm
 Sun 10am-5pm

BAYSIDE GARDEN SUPPLY
 in between Eureka & Arcata
 On HWY 101 in the Bracut Industrial Park

SALE! HYDRO • ORGANICS • SOILS
 707.826.7435

\$459.95 Industrial Vacuum Sealer

\$59.95 15" x 18" 100 pre-cut bags

3 rolls 11" x 18" for \$18.95 ea.

Keep your footballs fresh until next season!

Figure 15. Advertisement for industrial vacuum sealer. (*North Coast Journal*, August 2, 2012)

Cannabis farmers face other threats to their crops. “Greenhouses Keep Piggies and other Critters out of the Garden” was an ad (Figure 16) that ran in the *North Coast Journal* during early summer 2012. Two young pigs gaze innocently at the reader as they stand in a freshly foraged row of young plantings. Greenhouses provide growers greater control over the cultivation process. Growers can moderate temperature, humidity, and even light to manipulate the flowering process. While greenhouses keep animals out of vulnerable gardens, they also conceal cannabis cultivation from potential theft and law enforcement surveillance. In this way, the “piggies” in the ad are also a derogatory reference to police, who pose the omnipresent threat of discovery.

Come by to discuss our many outdoor options

- Greenhouses
- Clear and Black Woven Poly
- Loose Soils
- Irrigation
- Water Storage

GREENHOUSES KEEP PIGGIES AND OTHER CRITTERS OUT OF THE GARDEN

Open Mon-Sat
10am - 6pm
Sunday • 10am - 5pm

707.826.7435

On Hwy. 101, between Eureka and Arcata, in the Bracut Industrial Park

BAYSIDE GARDEN SUPPLY

HYDRO • ORGANICS • SOILS

Figure 16. Advertisement for greenhouse kits. (*North Coast Journal*)

For some in the local community, the cannabis industry represents a public nuisance. A sign stating “Do Not Wash Your Growing Materials Here!! Not Allowed!!” (Figure 17) appeared in the window of a local laundromat. Flowering cannabis contains pungent terpenes. This sign warns growers that they are not allowed to use the laundromat facilities to wash their clothing smelling of cannabis.

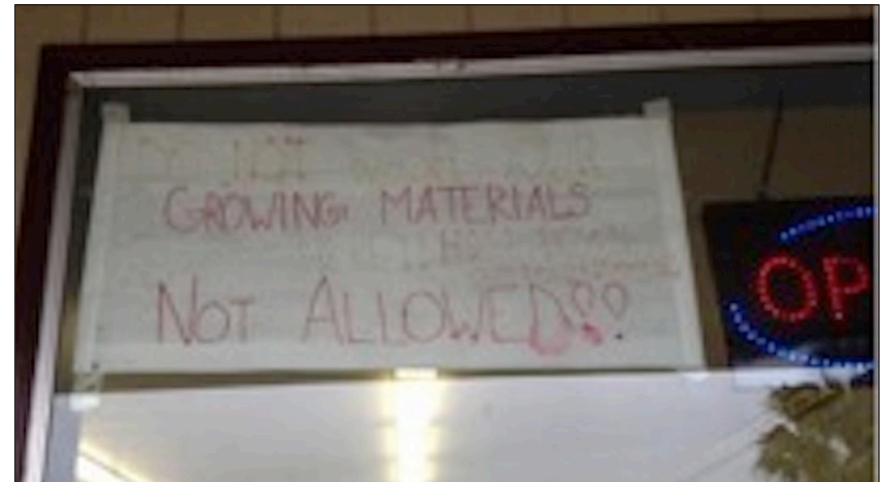


Figure 17. Sign posted in window of local laundromat. (personal photograph)

Advertisements also reflect local concerns with the environmental impacts of cannabis farming. “Don’t piss ‘em off. For a better community, get your water storage tanks now” (Figure 18) ran in the *North Coast Journal* in the spring of 2013 and marks a period of mounting news coverage and public discourse about the environmental effects and community impacts of irresponsible cannabis cultivation. The ad features the silhouette of a male figure urinating in a wild river. This series of advertisements reveal an industry well aware of community attitudes and weave that cultural knowledge into the construction of their narrative. Cannabis growers are blamed for diverting too much water from vulnerable fish habitats. Grow shops seize upon this critique to present themselves as playing a mediating role in the community.

Other nuisances targeted by horticulture supply advertisements include the noise and smell emanating from indoor growers. “Love thy neighbor!” ran in the *North Coast Journal* (Figure 19) during this same period of mounting backlash against growers. An angry elderly man shakes his fist at the reader. The ad references increasing community frustration with a proliferation of indoor cannabis growhouses in residential neighborhoods.⁶



Figure 18. Advertisement for water storage tanks. (North Coast Journal, April 11, 2013)

Local news coverage reported the concerns of neighbors with the smell of cannabis and noise from cooling fans. The ad also signals a generational split in which growers are represented as young, in addition to male and straight as depicted in other ads.

The strong smell of flowering cannabis is signaled in “Hide your smell ‘cuz not everyone is a fan” (Figure 20). This advertisement acknowledges community frustrations with residential cannabis production. A man lies on his back, playfully holding a skunk above his head, not bothered by the smell. Imagery is used to represent the skunk-like smell of particularly strong strains of cannabis. Their odor is undesirable for many, and the ad offers solutions. The representation also signals the growing rift between the problems created by the local cannabis industry and the broader community.

In this article, I analyzed common images and artifacts found in a region of the country known for cannabis production. I suggest the symbolic language of the pseudo-legal industry creates insider knowledge and the accompanying humor of sales and marketing efforts. Some of the images appropriate existing artifacts and give them benign new meanings (turkey bags, babies, footballs, and skunks). Others rely on sexist humor in an industry that early research suggests is reproducing gender inequalities found in legal industries in the United States.

Cannabis cultivation, like cannabis use, is experiencing a rapid process of redefinition. While only twelve percent of Americans supported cannabis legalization in 1969, the percentage increased to sixty percent by 2016 (Gal-



Figure 19. Advertisement for noise and smell abatement equipment. (North Coast Journal, February 7, 2013)

lop 2016). Moynihan (1993) called this “defining down” deviance, meaning that as cultural norms and values change, the boundaries of deviance designation change as well. The liberalization of state-level cannabis policies that began in 1996 ushered in a new era of greater openness in public discourse. Within the Emerald Triangle, there are signs that the deviance of cannabis cultivation is being further defined down. While ads for this study included coded systems signaling the hidden industry, many current ads abandon that coding, even while the possibility of a federal crackdown on state-level cannabis legalization remains (Fuller 2017). Future research should monitor the framing of industry images in advertising and marketing as a sign



Figure 20. Advertisement for fans and filters.

of the relationship to broader legal and political institutions, as well as the industry alignment or rejection of cultural norms and related inequalities.

Notes

1 This nickname was likely coined by law enforcement in the CAMP era of the 1980s and carries a symbolic connection to the Far East “Golden Triangle” of opium cultivation (Corva 2014). Some say it was not an accident that law enforcement chose a name with this connection that could conjure images of exotic warlords, lawlessness, and violence. While illicit drug markets are often associated with elevated rates of violence, passage of

state-level medical cannabis laws has been related to a reduction in violent crime rates (Morris et al. 2014).

2 During the late 1960s and early 1970s mostly white, middle class and well-educated “new settlers” (Corva 2014) returned to the idealized landscape of rural California to create a new life. Many of these back-to-landers had been involved in campus activism and were demonized by Governor Ronald Reagan and others for their association with counter-culture movements (Lee 2013).

3 In an effort to support cannabis eradication in Mexico, the United States in 1975 launched a program of spraying paraquat on cannabis and opium crops growing in the Sierra Madre. US government officials then issued public warnings about the health risks of consuming cannabis tainted with the herbicide (Anonymous 1978). These efforts created demand for domestic production (Lee 2013).

4 The price of weed varies greatly (Priceofweed.com 2017). The national average for an ounce of high quality weed is \$320.69. While folks looking for cannabis in California pay \$248.67, those in the nation’s capital pay \$599.10 per ounce.

5 This rate was computed by identifying the number of “grow stores” within a ten- mile radius of the Humboldt County seat, Eureka (13 businesses serving a population of 27,226 Eureka residences) and the Alameda County seat, Oakland (19 businesses serving 420,005 residents) using growstuff.com. A rate per 100,000 in the population was then computed from census data (United States Census 2017) for Eureka (48 per 100,000) and Oakland (5 per 100,000).

6 A “growhouse” is a residential dwelling partially or fully dedicated to indoor cannabis cultivation. Starting in 2008 there was substantial media attention to the “growhouse problem” as local officials repeated a dubious claim that there were 1,000 growhouses in Arcata, California (Reiterman and Bailey 2008).

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Mapping Marijuana Cultivation Sites and Water Storage in the Redwood Creek Watershed, Southern Humboldt County

Cristina I. Bauss
Humboldt State University

Abstract

Impending regulation of California's marijuana industry demands a quantifiable understanding of the extent of cultivation and adequacy of water storage on private lands long devoted to a dispersed, but commercial-scale, unregulated marijuana industry. Water storage is a critical factor, given both California's droughts and its climate: indoor plants are grown under lights year-round, and outdoor plants are grown during the dry months. This research aimed to quantify marijuana cultivation and water storage in the Redwood Creek watershed of southern Humboldt County, where major land use changes have taken place since the late 1960s. Using Google Earth imagery and geospatial analysis, an inspection of 369 assessor's parcels located within or partly within the watershed yielded 303 greenhouses, 100 outdoor cultivation scenes, 164 water tanks, and 51 installed ponds. Estimating the number of water-storage tanks was much more challenging than estimating the number of cultivation sites; it is virtually certain that numerous tanks are under the forest canopy and not visible. The only way to verify their number and holding capacity would be through either ground truthing or GIS analysis using point-cloud data. The latter is costly to collect and process; therefore, given that many landowners who have engaged in unregulated marijuana cultivation are loath to grant access to outside parties, at this juncture it may be difficult for academic researchers, state and county regulators, environmental inspectors, and other interested parties to measure some of the industry's existing environmental impacts.

Key terms: marijuana, marijuana legalization, Humboldt County, Redwood Creek, War on Drugs

Introduction

SINCE THE LATE 1960s, the "Emerald Triangle"—the area comprised of Humboldt, Mendocino, and Trinity counties, on the North Coast of California—has been one of the nation's hotbeds of unregulated marijuana cultivation. Begun by the counterculture and its "back-to-the-land" movement,¹ over

the last five decades what began as a secretive, black-market phenomenon has flowered into a billion-dollar industry. In 2007 the U.S. Department of Justice estimated that California produced between sixty and seventy percent of all the marijuana consumed in the United States (Carah et al. 2015, 1). In 2014 California accounted for an estimated \$1.3 billion in legal marijuana sales, or forty-nine percent of all legal sales in the country (ArcView Market Research 2015). That same year, the Drug Enforcement Administration's Domestic Cannabis Eradication Suppression Program eradicated 2.68 million plants in California (DEA 2015, 72); untold numbers remained, and the value of the illegal market has been virtually impossible to quantify. Marijuana is reputedly one of the state's top cash crops, but it is not listed in annual statistical reports released by the California Department of Food and Agriculture and the U.S. Department of Agriculture.

Marijuana's complex legal status and lack of regulatory oversight have ensured that until recently, its environmental impacts—like its financial impacts—have remained largely unquantified. However, as more states have legalized or decriminalized the consumption and/or sale of marijuana, academic researchers and journalists have taken an interest in assessing the environmental degradation attributable to unregulated marijuana cultivation. Trespass grows (or “guerrilla grows”) on public lands have become a nightmare for park rangers, law-enforcement officials, environmental managers, and members of the public who inadvertently stumble onto marijuana-cultivation sites. In 2013, trespass grows accounted for seventy-two percent of all outdoor plants seized in California (Harkinson, Brownell, and Lurie 2014). On private lands, marijuana has been cultivated on a commercial scale for decades without the oversight mandated for other agricultural products. On both public and private lands, environmental problems attributable to unregulated marijuana cultivation include—but are not limited to—dangers to wildlife exposed to numerous agricultural toxins (Gabriel et al. 2012, 12; Harkinson 2014; Peeples 2013); sediment delivery to streams from road construction, home construction, and grading for outdoor gardens (Short 2011, 110); and destruction of salmonid and other wildlife habitat due to stream diversions (Barringer 2013).

While many opportunists cultivate marijuana illicitly on public lands, this research does not address these abuses. Rather, with an eye toward the development of a fully regulated and environmentally sustainable marijuana economy, it focuses on private lands.

Impending regulation of California's marijuana industry demands a quantifiable understanding of the existing scope of marijuana cultivation, and the adequacy of water storage, on private lands that have long been devoted to commercial marijuana cultivation. Water storage is a critical factor, given both California's droughts and its climate: indoor plants are grown under lights year-round, and outdoor plants are grown during the dry months. Under a sustainable-agriculture model, regulated marijuana cultivation would not have adverse effects on local ecosystems, including river and riparian habitats.² One question to ask when measuring water-storage adequacy might be, “Can enough water be stored during the winter months to sustain agricultural and household needs through the dry months?”

This research has two objectives. The first is to review the historical context for the marijuana industry in California, with a focus on the Emerald Triangle. The second is to provide a case study of the Redwood Creek watershed, where critical changes have taken place in the last five decades, by attempting to quantify the extent of existing marijuana cultivation and water storage.³

The Redwood Creek watershed is one of the first areas where the back-to-the-land movement became entrenched, and is exemplary of numerous areas of the North Coast where ranching and timber extraction have largely given way to unregulated, commercial-scale marijuana cultivation. Redwood Creek is a tributary of the Eel River, which runs approximately 320 km (200 mi) southeast-to-northwest from Bald Mountain in the Mendocino National Forest to the Pacific Ocean west of Fortuna in Humboldt County. As seen in Figure 1, the 42 km² (26 mi²) watershed is situated west of Redway, in southern Humboldt County, with the unincorporated community of Briceland near its center. Quantification of existing marijuana cultivation and water storage in this area may be useful in at least two ways: (1) by contributing to guidelines for the local regulatory framework under which a legalized industry will operate, and (2) by helping to create a blueprint for other researchers and/or regulators to use when analyzing the “carrying capacity” of marijuana in similar areas.

Increasing numbers of national media outlets are producing stories about marijuana and the environment, and more peer-reviewed studies are being published that detail different facets of marijuana-related environmental degradation. However, only one peer-reviewed study completed to date (Bauer et al. 2015) quantifies the extent of marijuana cultivation within a specific geographical area of California. The study used Google Earth imagery to extrapolate the number of plants grown in four watersheds in Humboldt



Figure 1. Location of the Redwood Creek watershed, in southern Humboldt County (detailed, upper right inset; within California, lower left inset). Sources: USGS Earth Explorer, County of Humboldt, California Department of Forestry and Fire Protection (CAL FIRE).

and Mendocino counties, and subsequently conducted hydrologic analyses based on water-demand estimates and streamflow reports. A key finding of the study was that in three of four watersheds examined, including Redwood Creek, “water demand for marijuana cultivation exceeds streamflow during the low-flow period” (Bauer et al. 2015, 1). These findings are particularly significant for salmon: in some parts of the North Coast, migration to fresh waters in order to spawn begins before the rains arrive, and adequate stream depth and temperature are critical for survival (“Coho Salmon Life History,” CDFW).

This study used the same framework as the Bauer et al. (2015) paper, which identified marijuana-cultivation sites in the Upper Redwood Creek, Salmon

Creek, and Redwood Creek South watersheds in Humboldt County and Outlet Creek watershed in Mendocino County. (The “Redwood Creek” of this paper is the “Redwood Creek South” in Bauer et al. 2015). However, there are three key differences between the two studies. First, Bauer et al. (2015) did not identify visible water-storage sites. In terms of establishing and improving regulatory frameworks, an estimate of the percentage of landowners who have already invested in water storage is important to adequately prepare and budget for regulatory frameworks where none have existed before. Second, this study does not conduct hydrologic analyses based on surface-water diversions. Third, this study uses county zoning classifications to estimate extent of cultivation and water-storage sites in each (e.g., “Agriculture Exclusive,” “Timberland Production,” etc.). A recently approved Humboldt County ordinance prohibits the establishment of new outdoor marijuana gardens in Timberland Production (TPZ) zones, which account for 25.7 percent of the total acreage in the Redwood Creek watershed. In short, the Bauer et al. (2015) study sought to quantify the number of plants cultivated, estimate the amount of water needed for cultivation, and calculate the impact of surface-water diversions during low-flow periods. This study sought to identify cultivation sites (greenhouses and outdoor gardens) and quantify number of plants; identify water-storage sites (tanks and ponds) and quantify capacity; and identify distribution of all sites according to county zoning classifications.

Historical Background

In the century and a half since European-Americans began permanently settling the North Coast, its landscape has been fundamentally changed. Historic drivers of change have included, but are not limited to, land privatization (i.e., commercial ranching and farming), commercial fishing, and commercial timber extraction. The latter has arguably been the most environmentally destructive, with only four percent of the old-growth redwood forest that once dominated the Pacific Coast from central California to southern Oregon remaining (National Park Service 2015).⁴ The devastation wrought on the land altered the region’s rivers as well. Sedimentation from grading, road development, and erosion has left many waterways unsuitable for salmon, one of the North Coast’s keystone species (McKee 2004, 13; Short 2011, 113).

In the wake of the post-World War II construction boom that saw the felling of numerous stands of virgin redwood and Douglas-fir (Easthouse 2002), a new threat emerged: unregulated marijuana cultivation. Environmental degradation associated with the local marijuana industry includes—but is

not limited to—stream sedimentation attributable to home construction and road development in new rural residential subdivisions (Carah et al. 2015, 3–4; Short 2011, 110); destruction of salmon, trout, and amphibian habitat because of increased stream sedimentation and water diversions (Bauer et al. 2015, 18; McKee 2004, 13; Short 2011, 113); poisoning of wildlife due to widespread use of agricultural toxins including fertilizers, rodenticides, pesticides, herbicides, and fungicides (Campaign Against Marijuana Planting 1985, 37; Gabriel et al. 2012, 12; Harkinson 2014; Peeples 2013); and noise pollution from generators used for indoor marijuana cultivation (Harkinson 2014).

The North Coast’s marijuana industry originated in the late 1960s with counterculture members eager to participate in the back-to-the-land movement (Bauer et al. 2015, 1; Scott-Goforth 2013; Short 2011, 110). Because many ranchlands and timberlands had been so degraded that they were no longer commercially viable, they were subdivided into smaller parcels that were sold at very low prices. In many parts of the future Emerald Triangle, such parcels were purchased by “back-to-the-landers” for whom marijuana cultivation became a chief source of income (Torgoff 2004, 281). As a group, they thought of themselves as responsible stewards of the land (Scott-Goforth 2013, Salmonid Restoration Federation 2013). Some went on to found organizations that actively fought—in some cases, successfully—for stronger regulatory oversight of timber companies and other industrial interests (Ostrow n.d., Associated Press 2008).

By the early 1980s, however, the 1960s ideals of the first generation of back-to-the-landers had begun to give way to “greed grows” that exacted a heavy toll on an already devastated landscape. In 1983, the Campaign Against Marijuana Planting (CAMP) was established, a multi-agency task force whose stated objectives included, but were not limited to, the reduction of marijuana availability in California through plant eradication; arrest and prosecution of marijuana cultivators and traffickers; seizure of assets derived from marijuana cultivation; reduction of marijuana-related environmental impact on public lands; and reduction of “associated criminal activity” in areas where cultivation occurred (CAMP 1983, 11). Comprised of eight federal and six state agencies, CAMP carried out its operations with the aid of local law-enforcement agencies, including sheriff’s and police departments.

In its early years CAMP’s chief targets were private landowners, and its helicopters became a feared and despised sight in North Coast communities where marijuana cultivation had become entrenched (Elinson 2011).⁵

However, raids on outdoor marijuana cultivation sites quickly led to an unanticipated development: many marijuana growers moved their operations indoors, to both greenhouses and permanent structures. Ironically, this enabled them to cultivate much more, and more potent, marijuana: as many as six crops can be grown indoors in a single year, and by controlling light, humidity, and temperature, an indoor cultivator can clone plants with higher levels of delta-9-tetrahydrocannabinol (THC), the physiologically active component in cannabis (Martyny et al. 2013, 622).

Many other marijuana growers continued to cultivate the plant outdoors, however. In addition, so-called “trespass growing” on public and tribal lands had already manifested by the early 1980s (CAMP 1983, 11). Trespass growers range from individuals who cultivate a few plants under tree cover, to multinational drug-trafficking organizations (DTOs) that establish veritable plantations on remote public and tribal lands. Trespass growing spiked sharply in the late 1990s, after California became the first state to legalize the use of medical marijuana through passage of Proposition 215, the Compassionate Use Act (Bauer et al. 2015, 1–2; Carah et al. 2015, 4). Seeking to cash in on an economic boom driven by legal marijuana sales, a new wave of migrants began pouring into the area, and unemployed local timber workers began cultivating marijuana as well (Barringer 2013; Harkinson 2014).

Industrial-scale marijuana farms—some with tens of thousands of plants—now dominate many parts of the Emerald Triangle, on public, tribal, and private lands (Barringer 2013). Paradoxically, the very land subdivisions that facilitated the back-to-the-land movement now facilitate another wave of environmental destruction. As Boston University professor Anne G. Short explains, “The slow but ongoing land use transition from timber and ranch lands to more rural residential and amenity-oriented development over the past four decades can be linked to an increased risk of sediment delivery to local streams and the continued degradation of habitat for salmonids” (2013, 122). Sedimentation is just the tip of the iceberg: local creeks are often sucked dry for marijuana cultivation, and the widespread use of agricultural toxins has adversely affected numerous species including the Pacific fisher (*Martes pennanti pacifica*), a member of the weasel family that inhabits forests from northern California to Washington (Gabriel et al. 2012, 1).

The complex legal status of marijuana poses unique challenges for researchers trying to quantify its environmental impacts, and for policymakers seeking to develop long-term solutions to industry-related problems (Carah et al.

2015, 4–5). On-the-ground scientific research has been largely confined to public lands, and marijuana’s federal classification as a Schedule I drug has often resulted in conflicts between federal and local laws. In a nationally publicized case, Mendocino County instituted a county code wherein medical-marijuana cultivators were allowed to grow up to ninety-nine plants, pay county fees, and be issued numbered zip ties by the sheriff’s office. Drafted to balance the needs of patients while providing funding to pursue criminal activity and mitigate harmful environmental impacts, the measure was hailed as groundbreaking (Aanestad 2012). However, the county was temporarily forced to suspend the program after the U.S. Department of Justice, under the aegis of federal law, issued a subpoena demanding information about program participants (Mozingo 2013). The code was revised, limiting the number of plants allowed per cultivator to twenty-five, but the county, state, and federal governments continue to spar over conflicting laws.

In 2010 California voters narrowly defeated Proposition 19, which sought to legalize, regulate, and tax a wider range of marijuana-related activities (Legislative Analyst’s Office 2009). Subsequently, advocacy groups representing different facets of the industry worked tirelessly to address the issues believed to have led to the failure of Prop 19. On 11 September 2015, they celebrated a major victory, when the California Legislature passed a series of bills establishing the Medical Marijuana Regulation and Safety Act—California’s first statewide regulatory system for medical-marijuana businesses (Marijuana Policy Project 2015). On 9 October 2015, Governor Jerry Brown signed the bills into law. On 8 November 2016, California voters chose to legalize the recreational use of marijuana (McGreevy 2016). Meanwhile, a slew of other states have also revised their marijuana laws. As of this writing, both medical and recreational marijuana use is legal in eight states—Alaska, California, Colorado, Maine, Massachusetts, Nevada, Oregon, and Washington—and medical marijuana use is legal in twenty states and the District of Columbia (Marijuana Policy Project 2017).

Unregulated Marijuana Cultivation and the Environment

In the past several years, numerous articles in mainstream media have addressed the environmental impacts of unregulated marijuana cultivation, and a number of peer-reviewed studies have examined some of these impacts in depth. To date, only one peer-reviewed study has attempted to quantify the extent of marijuana cultivation within specific watersheds (Bauer et al. 2015). For Redwood Creek, the results were alarming: according to Bauer et

al., “estimated water demand for marijuana cultivation is 36–173 percent of the annual seven-day low flow” (2015, 13). A review of several other studies provides an illuminating look at additional impacts associated with land use changes, sedimentation, and agricultural toxins—all germane to commercial agriculture, and by extension industrial-scale marijuana cultivation. Following is a summary of findings most relevant to this paper.

Land Use Changes

In a 2011 study focusing on private lands in Humboldt and Mendocino counties that have been subdivided as a result of the back-to-the-land movement, the researcher found that landowners who are engaged in timber and ranching are far more knowledgeable about best management practices (BMPs) than residential, vacation, and other landowners, who tend to be more-recent transplants to rural areas, and whose private properties are not as strictly regulated as commercial properties (Short 2011, 121).

Sedimentation

Sedimentation is one of the key problems associated with rural residential development, agricultural terracing, and road construction; not only does it degrade habitat for salmonids and amphibians, but it is also associated with habitat fragmentation and edge effects that in turn impact species composition—often favoring nonnative over native species (Short 2011, 109–113). A 2004 study by Sanctuary Forest, an environmental organization based in southern Humboldt County, found that sedimentation has increased and flows have decreased in the Mattole River watershed, an area where timber and grazing have largely given way to rural residential subdivisions and commercial-scale marijuana cultivation. The study recommends that water be stored “for use during the dry season [to] reduce water withdrawals during the critical months” (McKee 2004, 16).

Rodenticide Use

Another significant environmental concern associated with marijuana cultivation—indeed, with commercial agriculture and residential gardening as well—is the widespread use of second-generation anticoagulant rodenticides (ARs), which affect numerous predators in both rural and urban settings. In a study examining the use of ARs in agricultural settings in southern British Columbia, the authors concluded that “targeted rats provided the greatest potential pathway of second-generation rodenticides to wildlife predators” (Elliott, Hindmarch, and Albert et al. 2014, 904). Wildlife predators may be rural or urban: According to a sixteen-year study in southern California, urban bobcats have a high prevalence of notoedric mange as a result of high

exposure to ARs (Serieys, Armenta, and Moriarty et al. 2015, 844). The researchers also found that “single-family high-density residential area[s] [were] among the most frequent land use type to have positive associations with anticoagulant exposure” in the areas studied—even more so than areas zoned for agricultural use (855)—and that “residents who use ARs... reported continued use of the compounds although they were aware of the threat that the compounds posed to nontarget wildlife” (2015, 860). These findings parallel those made by Short, who concluded that commercial landowners were far more knowledgeable about BMPs than residential landowners.

While the two studies cited above provide generalized insight into the wide-ranging problems associated with ARs, a 2012 study examining the effects of ARs on the Pacific fisher specifically addresses trespass growing of marijuana. The researchers’ findings were disturbing: Of fifty-eight deceased fishers examined, four were killed by “lethal toxicosis, indicated by AR exposure” (Gabriel et al. 2012, 6); forty-six had been exposed to one or more compounds commonly found in anticoagulant rodenticides (5); and one kit—dead of starvation and dehydration at six weeks, following her mother’s death—“tested positive for AR exposure” (7), the first documented neonatal or milk transfer of an AR to a kit (1).

Case Study: Methods

Following both a review of existing literature and informal interviews with local environmental activists and law-enforcement officers, Redwood Creek was selected as a study area typical of North Coast watersheds where ranchlands and timberlands have been converted to rural subdivisions in which marijuana cultivation is now prevalent. Methodology applied to this study consisted of a GIS-based spatial analysis (in ArcGIS version 10.2.2, Esri, Redlands, California), following a visual search of the watershed using Google Earth imagery and acquisition of digital elevation models (DEMs; United States Geological Survey’s EarthExplorer website), Humboldt County administrative boundaries and assessor’s parcels (Humboldt GIS Portal), and the Calwater 2.2.1 Watershed Boundaries (CAL FIRE GIS data portal). All data were imported into ArcGIS, where the Redwood Creek watershed and parcels contained within or straddling the watershed were subsequently isolated. The resulting shapefiles were also saved as KML (Keyhole Markup Language) files for use in Google Earth. Watershed boundaries, parcel boundaries, and a UTM (Universal Transverse Mercator) reference grid were then imported into Google Earth for a visual analysis of the watershed.

For purposes of the study, sites identified were greenhouses, outdoor marijuana-cultivation gardens (commonly known as “grows”), water tanks, and installed ponds. Greenhouses were measured in Google Earth using the Ruler tool. Before recording each potential site, the historical-imagery tool was used to confirm that sites were indeed greenhouses, outdoor marijuana-cultivation gardens, water tanks, or installed ponds. Imagery used to conduct analysis was dated 28 May 2014, and historical imagery used for confirmation purposes was dated 23 August 2012. Sites outside the boundaries of the Redwood Creek watershed, but on parcels that straddle the watershed, were recorded due to the possibility that they draw water from Redwood Creek and its tributaries.

After data were collected, they were saved as KML files and imported into ArcGIS. Four point layers were generated from the KML files, one for each type of site. Each point layer was intersected with the newly created shapefile of Redwood Creek assessor’s parcels, in order to determine the concentration of cultivation and water-storage sites per zoning classification (Table 1) and land use designation. Simplified maps of zoning classifications (Figure 2), marijuana-cultivation sites (Figure 3), and water-storage sites (Figure 4) were subsequently created in ArcGIS.

It is important to note the difference between zoning classifications and land use designations. According to the Humboldt County website, “Land use designations are more general than zoning classifications. Typically, land use designations focus on allowed uses whereas zoning classifications provide specific standards related to building height and setbacks.” Most important for this study, under the county’s Medical Marijuana Land Use Ordinance, zoning classifications determine where, how, and how much marijuana can be cultivated. Land use designations are very useful, however, to differentiate between parcels that have been developed for residential use (e.g., “Rural Residential”) and parcels that are used for purely commercial or recreational purposes (e.g., “Open Space and Parks”).

Case Study: Results

Isolation of assessor’s parcels within or straddling the Redwood Creek watershed yielded 369 parcels, ranging in size from 0.02 ha (0.05 acres) to 306.34 ha (756.98 acres), with a total area of 8754.67 ha (21633.23 acres; Figure 2 and Table 1). No single zoning classification dominates the watershed, although it is notable that 155 parcels—accounting for 20.6 percent of the watershed—remain “Unclassified” by the county (Figure 2). Forty-three parcels classified as “Timberland Production” (TPZ) account for 25.7 percent

Table 1. Number of Marijuana-Cultivation and Water-Storage Sites, by Zoning Classification

Zoning	Hectares	% of Total	# Parcels	Greenhouses	% of Total	Outdoor	% of Total	Water Tanks	% of Total	Ponds	% of Total
AE	746.43	8.5%	13	16	5.3%	13	13.0%	12	7.3%	8	15.7%
AE+TPZ	1686.66	19.3%	25	8	2.6%	4	4.0%	5	3.0%	1	2.0%
AE+U	80.12	0.9%	2	6	2.0%	1	1.0%	0	0.0%	1	2.0%
AG	5.77	0.1%	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
AG+U	2.56	0.0%	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
C1	1.32	0.0%	1	1	0.3%	0	0.0%	6	3.7%	1	2.0%
FR	1585.22	18.1%	109	85	28.1%	37	37.0%	59	36.0%	25	49.0%
FR+TPZ	129.09	1.5%	3	1	0.3%	0	0.0%	0	0.0%	0	0.0%
FR+U	462.05	5.3%	11	25	8.3%	9	9.0%	2	1.2%	6	11.8%
RS+U	0.41	0.0%	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
TPZ	2248.45	25.7%	43	26	8.6%	10	10.0%	7	4.3%	4	7.8%
U	1806.59	20.6%	155	135	44.6%	26	26.0%	73	44.5%	5	9.8%
Totals	8754.67	100.0%	369	303	100.0%	100	100.0%	164	100.0%	51	100.0%

Key: AE = Agriculture Exclusive; AG = Agriculture General; C1 = Neighborhood Commercial; FR = Forestry Recreation; RS = Residential Suburban; TPZ = Timberland Production; U = Unclassified.

Source: County of Humboldt.

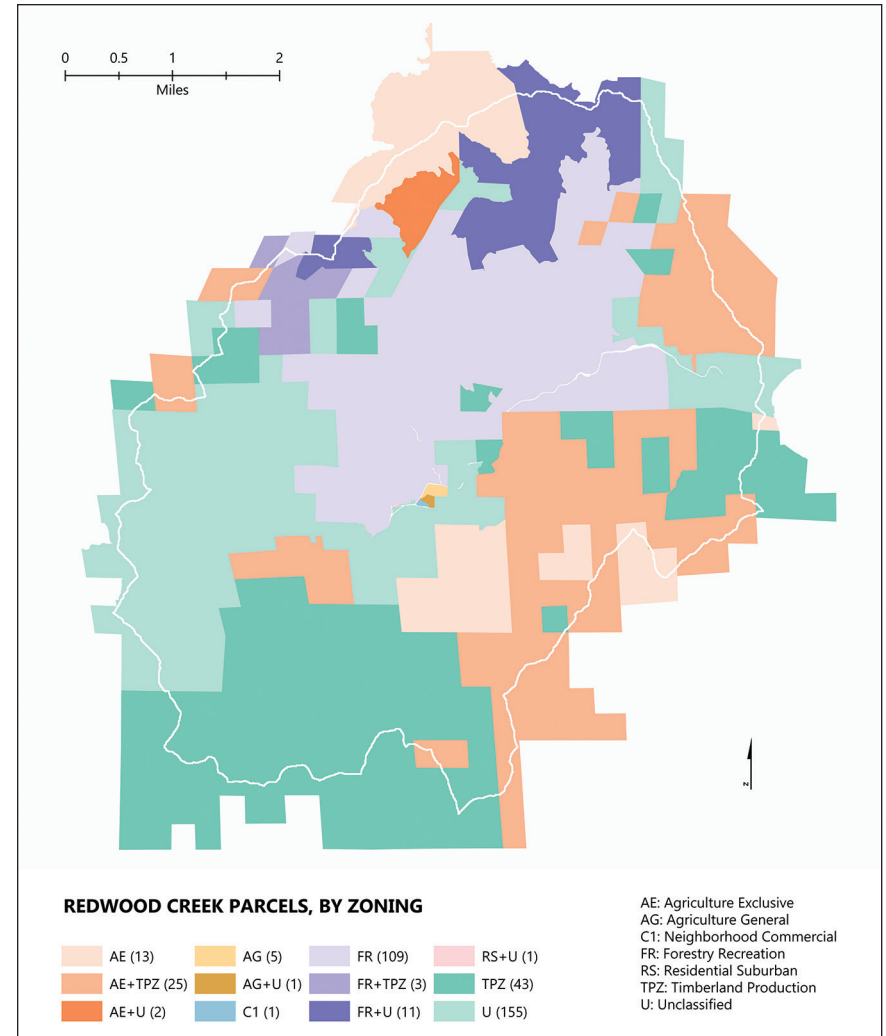


Figure 2. Parcels contained within or straddling the Redwood Creek watershed, by zoning classification. Sources: County of Humboldt, CAL FIRE.

of the watershed, 109 parcels classified as “Forestry and Recreation” (FR) account for 18.1 percent, and 25 parcels with dual “Agriculture Exclusive” (AE) and TPZ classifications account for 19.3 percent.

Visual search and analysis of the watershed yielded 303 greenhouses, 100 outdoor cultivation scenes, 164 water tanks, and 51 installed ponds. Relatively few sites were located in the far southern and southeastern portions of the watershed, which are dominated by timber and grazing lands (Figures 3

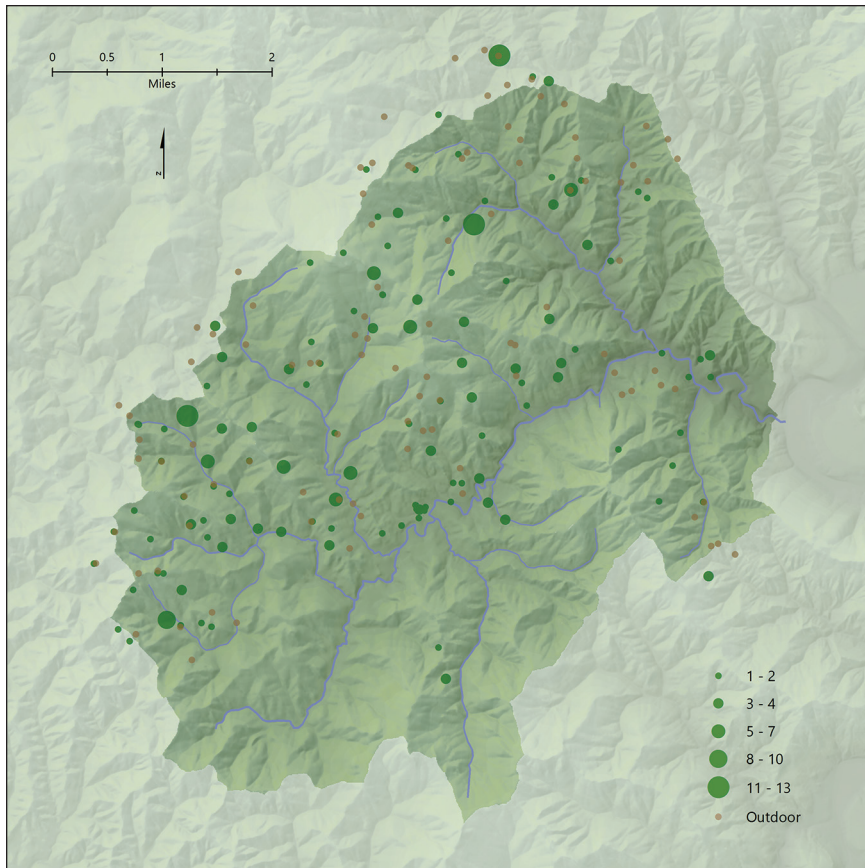


Figure 3. Simplified map of marijuana cultivation sites in the Redwood Creek watershed. Green circles represent clusters of greenhouses, by number; outdoor growing sites are mapped individually. Sites outside the boundaries of the watershed are on parcels that straddle two watersheds, and were recorded because they may draw water from Redwood Creek and/or its tributaries. Sources: USGS Earth Explorer, County of Humboldt, CAL FIRE.

and 4; Table 1). Outdoor cultivation scenes contained as few as 12 plants—so-called “mom-and-pop grows”—and as many as 170 plants.

Parcels zoned as “FR” account for only 18.1 percent of the land within or straddling the Redwood Creek watershed, but contain an estimated 28.1 percent of the greenhouses, 37 percent of the outdoor growing sites, 36 percent of the water tanks, and 49 percent of the installed ponds in the study area (Table 1). Similarly, parcels that remain “Unclassified” account for 20.6 percent of the acreage within or straddling the watershed, but contain an estimated 44.6 percent of the greenhouses, 26 percent of the outdoor growing

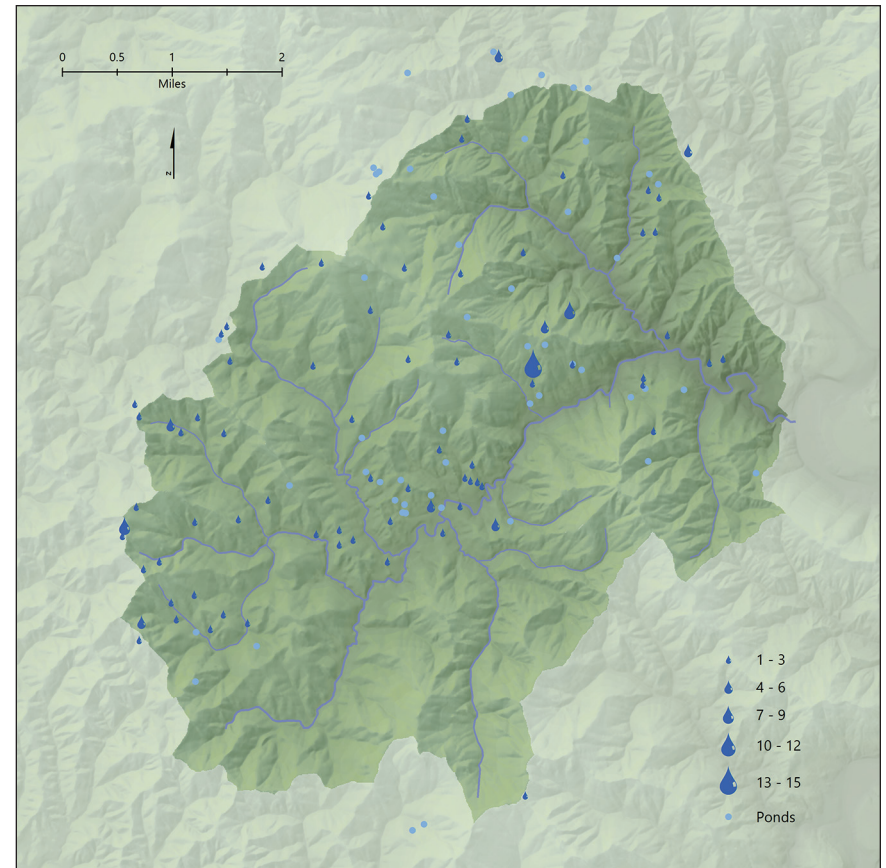


Figure 4. Simplified map of water-storage units in the Redwood Creek watershed. Water drops represent water tanks, by number; installed ponds are mapped individually. Sites outside the boundaries of the watershed are on parcels that straddle two watersheds, and were recorded because they may draw water from Redwood Creek and/or its tributaries. Sources: USGS Earth Explorer, County of Humboldt, CAL FIRE.

sites, and 44.5 percent of the water tanks. However, they account for only 9.8 percent of the installed ponds.

The study area contains 369 parcels, but greenhouses were identified on only 122 parcels. Outdoor cultivation sites were identified on 73 parcels, water tanks on 77, and installed ponds on 38.

Assessor’s parcels with land use designations of “Rural Residential” or “Rural Residential, Vacant” account for 47.8 percent of the parcel acreage within or straddling the Redwood Creek watershed, but contain an estimated 86.1

percent of the greenhouses, 84 percent of the outdoor growing sites, 91.5 percent of the water tanks, and 82.7 percent of the installed ponds in the study area.

Discussion

Research and Analysis Challenges

Because of challenges encountered during the visual search using Google Earth, these results likely represent a low estimate of the total number of water-storage and cultivation facilities in the Redwood Creek watershed. The greatest challenge was identifying water-storage facilities. A number of the tanks found are partly visible under the forest canopy, and it is reasonably certain that some tanks are extant but cannot be located using satellite imagery. Additionally, tanks vary in size and water-storage capacity is difficult to estimate; two tanks with the same diameter may differ greatly in height. Pond depth, likewise, cannot be determined in a two-dimensional analysis. The possibility of using LiDAR (point-cloud) data to resolve these issues was researched. However, the only LiDAR data collected in the Redwood Creek area date from 2007, and cover less than half the watershed.

Although it seems likely that the vast majority of greenhouses are used for marijuana cultivation, some are invariably used for other purposes. Conversely, it is also likely that many permanent structures—including former residential buildings—are used for marijuana cultivation. In 2014, data provided to Humboldt County by the Pacific Gas and Electric Company revealed that more than 3,000 households in unincorporated areas “had energy use exceeding 600 percent of average for at least one month in each of the last three years” (Mintz 2014), a very strong indicator of indoor marijuana cultivation. In addition, numerous property owners in unincorporated areas live “off the grid” (without relying on public utilities) and can maintain lights for indoor cultivation with propane generators.

Increase in Number of Sites Over Time

When comparing the Google Earth imagery dated 28 May 2014 and 23 August 2012, I noted that there were numerous locations where, over twenty-one months’ time, either (1) new cultivation sites had been established, (2) established cultivation sites had been expanded, and/or (3) water tanks had been installed where none had been extant before. These informal observations are consistent with the results of the study conducted by Bauer et al. (2015)—which used the 2012 imagery for analysis—and this study, which used the more recent imagery posted in 2014. According to the Bauer et al. (2015) study, in 2012 the estimated greenhouse capacity of the Redwood

Creek watershed was 16,777 plants (2015, 12). Using the same calculations as those used by Bauer, et al. (1.11484 m² per plant), according to this study in 2014 the greenhouse capacity in the Redwood Creek watershed was 20,570 plants. If both studies are reasonably accurate, this represents an eighteen percent increase in greenhouse capacity in less than two years’ time. These informal results are consistent with patterns of rapid land-use conversion seen in other parts of the Emerald Triangle since passage of the Compassionate Use Act. For example, in Hayfork, in neighboring Trinity County, between 2004 and 2009 the price of southwest-facing lots increased from approximately \$3,500 to as much as \$50,000, due to an influx of non-residents buying land for the sole purpose of cultivating marijuana (Semuels 2009).

TPZ Zoning Classification and Cultivation “Freeze”

On 22 January 2016, the Humboldt County Board of Supervisors unanimously adopted the Medical Marijuana Land Use Ordinance—which dictates, among a host of other things, what type of zoned property medical marijuana may be cultivated on and how much can be cultivated (Scott-Goforth 2016). The ordinance also prohibits the establishment of any new outdoor marijuana gardens on TPZ lands, a move that will merit future discussion as more counties move toward establishing frameworks for a regulated industry. As seen in Table 1, this study found that, in the Redwood Creek watershed, parcels zoned as TPZ represent 11.7 percent of all parcels (43), but accounted for only 8.6 percent of all greenhouses (26) and 10 percent of all outdoor gardens (10). It is notable, however, that TPZ parcels account for 25.7 percent of all the acreage in the watershed. Therefore, under current county regulations, nearly one-quarter of the watershed will be legally barred from new marijuana-cultivation operations.

Prevalence of Cultivation on Rural Residential Parcels

As summarized in the section titled “Unregulated Marijuana Cultivation and the Environment,” the academic literature reviewed prior to undertaking this study revealed that (1) commercial property owners (e.g., foresters and ranchers) were far more knowledgeable about best management practices (BMPs) than rural residential landowners; (2) sedimentation is one of the key problems associated with rural residential development; and (3) urban residents use second-generation anticoagulant rodenticides in higher concentrations than agricultural users, and continue using them even after learning of their deleterious effects on non-target wildlife. It is therefore notable that, in the Redwood Creek watershed, parcels designated by the Humboldt County Assessor as “Rural Residential” or “Rural Residential, Vacant” account for just 47.8 percent of the parcel acreage within or straddling

the watershed, but contain an estimated 86.1 percent of the greenhouses, 84 percent of outdoor growing sites, 91.5 percent of water tanks, and 82.7 percent of installed ponds. Much, if not most, of the development that has taken place on rural residential parcels has been unreported and undertaken without required permits—e.g., from county planning departments, the California Department of Food and Agriculture, and the North Coast Regional Water Quality Control Board. In short, the strict regulations governing commercial timber and grazing lands are currently absent from rural residential parcels that, in many cases, contain *de facto* commercial agricultural operations. Given Short's findings that "rural residential landowners have less knowledge of sediment control and report using fewer sediment-control techniques than landowners using their land for timber production or ranching" (2011, 108), education about BMPs will be key should these landowners continue to cultivate marijuana under the aegis of county regulations. This is vital, given that—in large part *because* of the lack of regulation to date—marijuana cultivation, unlike legally established forms of agriculture, is often irrigated by water diverted "directly from headwater streams and springs" (Carah et al 2015, 2).

Potential for Future Research

Future studies of both the short- and long-term changes that have taken place in the Redwood Creek watershed may contribute to a deeper understanding of land use changes in other rural areas of the North Coast. An extension of this study may involve comparing the locations of identified sites on the 28 May 2014 Google Earth imagery (the imagery used for analysis) and the 23 August 2012 imagery (used for site verification), and calculating changes over that time period in the number of greenhouses, outdoor marijuana-cultivation sites, water tanks, and installed ponds. Such an endeavor may shed light on current trends in other parts of the Emerald Triangle.

A much more detailed study might be undertaken by researchers studying both the extent of marijuana cultivation and the extent of road and other development over a much longer period of time—e.g., over the five decades since the back-to-the-land movement took root on the North Coast. If high-resolution, aerial photographs of the Redwood Creek watershed are extant from the late 1960s, a researcher may (1) use them to estimate the extent of marijuana cultivation in the early years of the local industry; (2) use both the historical imagery and present-day imagery to digitize roads, driveways, and areas terraced for residential or agricultural development; and (3) obtain historical information from the Assessor about parcel subdivision, and create shapefiles and digital datasets tracking the progression of

subdivision and road development. The resulting data could then be compared with historical streamflow data to better understand the cumulative impacts of development on the watershed.

Conclusion

A completely accurate assessment of the extent of marijuana cultivation and water-storage capacity in the Redwood Creek watershed is not possible at this time, absent researchers' capacity to perform ground truthing. However, with both medical and recreational marijuana use now legal in California, it is imperative to quantify the current extent of the industry and its environmental impacts in order to develop public policies that prevent more damaging impacts from occurring and allow for remediation of existing environmental degradation. According to at least two peer-reviewed studies, residential landowners are not as knowledgeable of BMPs as commercial landowners; given that fact, it is also imperative that rural-residential landowners—who comprise the vast majority of marijuana cultivators in the Redwood Creek watershed, and likely in other rural subdivisions in the Emerald Triangle—be educated about BMPs as the formerly underground marijuana economy transitions into a completely legal, state-regulated industry. Following this study, further research in the Redwood Creek watershed may take the form of both short- and long-term temporal studies, to better understand the environmental impacts of rural subdivision and commercial marijuana cultivation on the North Coast. The increased focus on academic research in this area—coupled with current technologies and increased dissemination of information on the subject—should facilitate the work of researchers delving into a long-neglected area of study.

Notes

1 The back-to-the-land movement was largely driven by liberal, college-educated youth seeking an alternative to what they viewed as a cynical and crassly materialistic society. As Emily Brady, author of *Humboldt: Life on America's Marijuana Frontier* explains, "with *Whole Earth Catalogs* and *Mother Earth News* magazines in hand, these idealist youth were leaving behind the 'American Dream' and its tarnished illusions of material wealth and success. They headed into the countryside of Northern California, upstate New York, Vermont, and elsewhere to grow their own food, live simply, and be self-sufficient" (http://www.salon.com/2013/06/30/how_humboldt_became_americas_marijuana_capital/, last accessed 15 November 2015).

2 For purposes of this paper, the definition of "sustainable agriculture" used is from the Agricultural Sustainability Institute of the University of California,

Davis: “[Meeting] society’s food and textile needs in the present without compromising the ability of future generations to meet their own needs.” The ASI further asserts, “The conversion of wild habitat to agricultural land reduces fish and wildlife through erosion and sedimentation, the effects of pesticides, removal of riparian plants, and the diversion of water. The plant diversity in and around both riparian and agricultural areas should be maintained in order to support a diversity of wildlife. This diversity will enhance natural ecosystems and could aid in agricultural pest management” (<http://asi.ucdavis.edu/programs/sarep/about/what-is-sustainable-agriculture>, last accessed 14 January 2017).

3 There is another Redwood Creek in Humboldt County, a considerably longer stream that runs for approximately 100 km (62 mi) from Board Camp Mountain, in the Coast Range, to the Pacific Ocean near Orick.

4 It should be noted that, while the North Coast is most famous for its iconic old-growth coastal redwoods, the study area is comprised of mostly mixed-forest ecosystems dominated by Douglas-fir.

5 CAMP was defunded by the DEA in 2012, when the federal agency shifted its enforcement priorities “due to state-approved marijuana measures”; the number of plants eradicated in California subsequently plummeted from 7.39 million in 2010 to 2.68 million in 2014 (<http://www.dea.gov/docs/2015%20NDTA%20Report.pdf>, last accessed 15 November 2015, 72).

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Central Valley Culinary Landscapes: Ethnic Foodways of Sikh Transnationals

Heather L. Benson
University of Nevada, Reno
and
Jennifer Helzer
California State University, Stanislaus

Abstract

This study explores the Americanization process of Sikhs in California's Central Valley based on the degree to which cuisine has evolved and consumptive patterns have changed since their arrival in the area. Drawing on insights from cultural geography and anthropology, this research examines the ethnic foodways of Sikh transnationals. The foods consumed by Central Valley Sikhs constitute fundamental components of ethno-cultural and geographical identity. This study contends that migrants experience foodway assimilation differently based on geographic location, age at arrival, and current age. The study employs multiple methods, including intensive field research, open-ended questionnaires, participant observation, and in-depth personal interviews. Because contact with American cultures has resulted in exposure to new types of foods, understanding which traditional foodways have resisted change will help clarify the process of acculturation. This study also reveals the role that spatial relationships play in maintaining a traditional diet.

Introduction

THIS STUDY EXPLORES the Americanization process among Sikh transnationals based on “cuisine evolution” and changes to food consumptive patterns since their arrival in California's Central Valley. “Cuisine evolution” refers to changes of ingredients and food preparation techniques in traditional Punjabi-Sikh dishes due to deliberate alteration of recipes to accommodate new consumer preferences and/or lack of availability of traditional foods and spices (Vu and Voeks 2013). Lack of availability may occur because the items are not sold or are difficult to grow in the United States, or because of the distance (drive time) required to obtain them from a market. This concept applies to immigrants who have lost interest in their traditional dishes or who have integrated new local foods and flavors into their cuisine—Americanizing or “watering down” their native dishes (Vu 2008, 6–7).

“Fusion cooking,” the combination of elements from two or more culinary traditions, can be used to measure assimilation into, and acceptance of, a dominant culture and can additionally reveal an emerging ethnic identity or foodway. Mannur (2005) argues that “the rhetorical strategies used to describe fusion as a form of culinary multiculturalism can be better understood by placing it in the context of the racial and ethnic debates about diversity, difference, and assimilation in the US without necessarily creating a homology between race on the one hand and culinary practices on the other” (74). Fusion cooking is popular in California, a state that has long served as a melting pot and home to people from all corners of the globe. Here, a culinary tourist can enjoy a fusion culture that takes inspiration from Italy, France, Mexico, and eastern Asia, and creates dishes from these cultures with non-traditional ingredients, such as Mexican pizza or the Korean taco. The Korean taco, a Korean-Mexican fusion dish, originated in California and quickly gained popularity in cities throughout North America (Amster-Burton 2009). The tacos use *bulgogi*, with all of its Asian seasonings, and the Mexican corn tortilla, fusing them into a single dish (Farivar 2009). This paper examines another example of a multicultural culinary fusion within the state of California: Sikh foods in the Central Valley.

In this article, we show how Sikh migrants experience foodway assimilation differently based on their age at arrival in the Central Valley, their current age, and where they live in relation to ethnic food suppliers. The reason this research focuses on the Central Valley Sikh transnational experience is because of the lack of academic literature written about them. While a great deal of literature looks at Sikhs in North America, the United Kingdom, and other parts of the world, very little addresses Sikhs in the Central Valley, despite their large presence within the region. This paper adds to the body of literature on Sikh transnationals, specifically California’s Central Valley population, through the lens of food geography.

Cultural Preservation, Acculturation, and Americanization

Cultural heritage is the legacy of religion, language, folk culture, history, place of origin, and cuisine of a group of people that is inherited from past generations, maintained in the present, and retained for the benefit of future generations. The deliberate act of maintaining cultural heritage for subsequent generations is known as “preservation.” Preservation of both tangible and intangible cultural features can all help in providing the basis of the sense of “we-ness” that underlies ethnic identity (Domosh, Neumann, Price, and Jordan-Bychkov 2010).

In contrast, “acculturation” refers to the changes that occur when disparate cultural groups come into close contact. As opposed to assimilation (total adoption of the “dominant” culture), the term *acculturation* is used to describe a process of extensive borrowing between cultures; representatives of the culture that is borrowing may voluntarily adopt elements from the dominant society’s culture in order to survive in their changed world. Religious change can sometimes be a consequence of acculturation, which can lead to a breakdown of social structures and spiritual demoralization (Ember and Ember 2002). Until recently, researchers studying culture change generally assumed that the differences between people of disparate cultures would become minimal. But over the past few decades, scholars have suggested that people affirm ethnic identities in a deliberate effort to introduce cultural difference (Ember and Ember 2002). In some ways, people reject assimilation and acculturation and, in the process, reassert place-based ethnic identities (Domosh, Neumann, Price, and Jordan-Bychkov 2010). “Americanization” refers to the action of making a person or thing (diet, for the purpose of this research) American in character or nationality.

Researchers are increasingly concerned with understanding a more sweeping culture change—the emergence of new cultural identities, or “ethnogenesis”—often in the aftermath of violent events such as depopulation, relocation, enslavement, and genocides (Ember and Ember 2002), such as the 1984 Sikh Massacre. Because the Central Valley region is home to both early and recent Sikh immigrants, the region provides an excellent setting to witness the process of ethnogenesis.

The Relevance of Foods and Foodways

The term “foodways” was coined to explain traditional behavior that includes more than simply preparing a certain recipe at a certain time, but rather encompasses behavior that reaches into many aspects of daily life. Foodways are “a whole interrelated system of food conceptualization and evaluation, procurement, distribution, preservation, preparation, consumption, and nutrition shared by all members of a particular society” (Shortridge and Gimla 1998, 121–122). They are the customary behaviors that vary by place and ethnic group. Foodways underline who we are and who we are not. In some cases, iconic foods become inseparable from the people who eat them. Some obvious, and perhaps stereotypical and even offensive, examples include the Irish being identified as “potato people” by the English, and Sicilians as “macaroni eaters” by northern Italians (Scholliers 2001).

What people choose to eat and drink constitutes a fundamental component of geographical identity (Vu and Voeks 2013). Some truth underlies the saying “you are what you eat.” The things we eat can say a great deal about us—who we are; where we came from; our current social, cultural, economic, and religious positions; and our ambitions (Shortridge and Gimla 1998). Historically, food has been place-based, dependent on local ingredients, and recipes have been passed down through generations. In recent times, food has served an important function for transnational communities. According to Brain (2014), “it serves as something familiar, emulates a sense of home, and functions as an act of tradition” (84–85). Foods play a crucial role in religious ceremonies, traditions, and customs, and serve as a material basis for rituals through which the stages of life are celebrated (Heine 2004). The present study follows in this tradition by investigating ethnic foodways among Sikhs in the Central Valley region of California.

Foods are pivotal to our sense of identity and spirituality (Fischer 1988) and often serve as the center point of religious and secular feasts, symbolizing culture-bound values and meanings (Murphy 1986). For example, Jewish dietary laws require matzo (unleavened bread) to be eaten during Passover. Matzo flatbread was created to represent the lack of time for leavening during the exodus from Egypt thousands of years ago (Apfelbaum 2001). In Islam, it is customary to sacrifice a sheep and share its meat with friends and relatives on Eid al-Adha (Festival of Sacrifice), in commemoration of Abraham’s willingness to sacrifice his son to God (Kittler and Sucher 2001). Among Brazil’s African diaspora, foods originating from their homeland—okra, black-eyed peas, sesame, and others—have attained sacred status for the followers of syncretic Afro-Brazilian religions. Some are sold on the streets to passersby as a form of offering to guardian deities (Voeks 2012). Many religions view certain foods as “unclean,” and members abstain from eating tabooed animals, such as pork among Muslims and cows among Hindus, beverages containing caffeine among Mormons, and dishes containing blood among Muslims and Jehovah’s Witnesses (Bell and Valentine 1997; Kittler and Sucher 2001; Heine 2004). In each of these cases, food and people are linked in complex interrelationships that reveal dominant ideas and prevailing practices within a culture.

In a globalized society, foods and foodways are often mobile, traveling and settling as they serve to renegotiate a sense of place for migrants, forced and voluntary, in their new homes (Vu and Voeks 2013). Food is also essential to maintaining connections to home and signifying ethnic identity among diasporic communities (Vallianatos and Raine 2008). Immigrants use different

foods not only to articulate cultural difference and distinctiveness, but also to make claims about the power and importance of ethnic food (Searles 2009). Historically, immigrants in the U.S. sought to maintain familiar foodways because food “initiated and maintained traditional relationships, expressed the extent of social distance between people, demonstrated status and prestige, rewarded and punished children’s behavior, and treated illness... [T]o abandon immigrant food traditions for the foods of Americans was to abandon community, family, and religion in the minds of many immigrants” (Gabaccia 2000, 51–54).

Today, more people are migrating than ever before; we live in the age of human migration. In 2015, around 244 million people migrated to international destinations, and the U.S. is home to more than 47 million of these transnationals (United Nations 2016). Because of this colossal movement of people around the globe, the significance of foodways as cultural markers and symbols of identity has never been stronger (Vu and Voeks 2013). Immigrants worldwide face scores of changes over which they had little control—where they will live, what kind of employment they will have, which language they will be required to learn and speak—but at least they have some control over their meals (Gabaccia 2000). The traditional foods of transnational migrants represent a connection to the past and assist in reducing negative effects of acculturation. So strong are connections with foods that they are often the only cultural element that is preserved after other ethnic traditions have faded away (Han 2008).

Transnationalism

A “transnational” is defined as a person who operates in, or belongs to, more than one country. Transnationalism involves a sense of home in the new territory, linking the country of origin with the country of settlement. A Central Valley Sikh transnational is defined here as a person of the Sikh faith who immigrated to the Central Valley but retains a significant connection with the Punjab homeland. Major transnational separatist movements, like the Sikhs, conduct their self-imagining in sites throughout the world where they have enough members to allow for the emergence of multiple nodes in a larger, diasporic public sphere (Appadurai 1997). Vu and Voeks (2013) argue that “nowhere is the attachment to homeland more evident than in the case of transnational foodways” (37).

Who Are the Sikhs?

A Sikh is a follower of Sikhism, a monotheistic religion (the youngest of the world’s major religions) that originated during the fifteenth century in the

Punjab region of South Asia. “Sikh” properly refers to adherents of Sikhism as a religion, not an ethnic group. However, because conversion is rare in Sikhism, most Sikhs share strong ethno-religious ties. The term “Sikh” has its origin in the Sanskrit word for “disciple” or “student.” A Sikh, according to the religion’s code of conduct, is any human being who faithfully believes in the One Immortal Being, the ten Gurus (from Guru Nanak to Guru Gobind Singh), the teachings of the ten Gurus, and the baptism bestowed by the tenth Guru (making the scripture, otherwise known as *Guru Granth Sahib*, the final Guru). Baptized Sikhs, also known as *Amritdhari* Sikhs, can be distinguished by wearing the “Five K’s”: *kesh* (uncut hair), *kangha* (a wooden comb), *kara* (a metal bracelet), *kashera* (cotton undergarments), and the *kirpan* (a small, curved sword). *Amritdhari* Sikhs are also responsible to live by the slogan “*Degh Tekh Fateh*” (“cauldron/kettle sword victory”), symbolizing the religious obligation to protect and feed the needy through *langar*—the free distribution of food to all people, regardless of religion, caste, or ethnicity (Mann, Numrich, and Williams 2008).

A Punjabi is any individual who is from the state of Punjab in India, but the term is usually interpreted as an individual belonging to the Sikh faith. This interpretation, however, is not entirely correct. Muslims from the region are called Punjabi Muslims, and Hindus from the region are called Punjabi Hindus. All three religious groups speak, or at least understand, most of the Punjabi language.

Geographic Setting: California’s Central Valley

California’s Central Valley comprises the large, flat valley that dominates the geographical center of California. It is forty to sixty miles wide and stretches approximately four-hundred-fifty miles from north to south (roughly from Redding to Bakersfield). “The Valley,” as it is called by its residents, is outlined by the Cascade, Sierra Nevada, and Tehachapi mountain ranges on the east, and the California Coast ranges and San Francisco Bay on the west. It runs parallel to the Pacific Ocean coastline and encompasses, fully or partially, nineteen California counties (see Figure 1). The Valley’s climate is predominantly Mediterranean; summer temperatures can reach 115°F (46°C), and winters are cool and damp, with temperatures rarely dropping below freezing.

One of the most productive agricultural areas in the world, the Valley is California’s breadbasket. It is known for producing mainly non-tropical crops such as tomatoes, grapes, cotton, apricots, and almonds. Early farming was concentrated close to the Sacramento-San Joaquin Delta, where water was

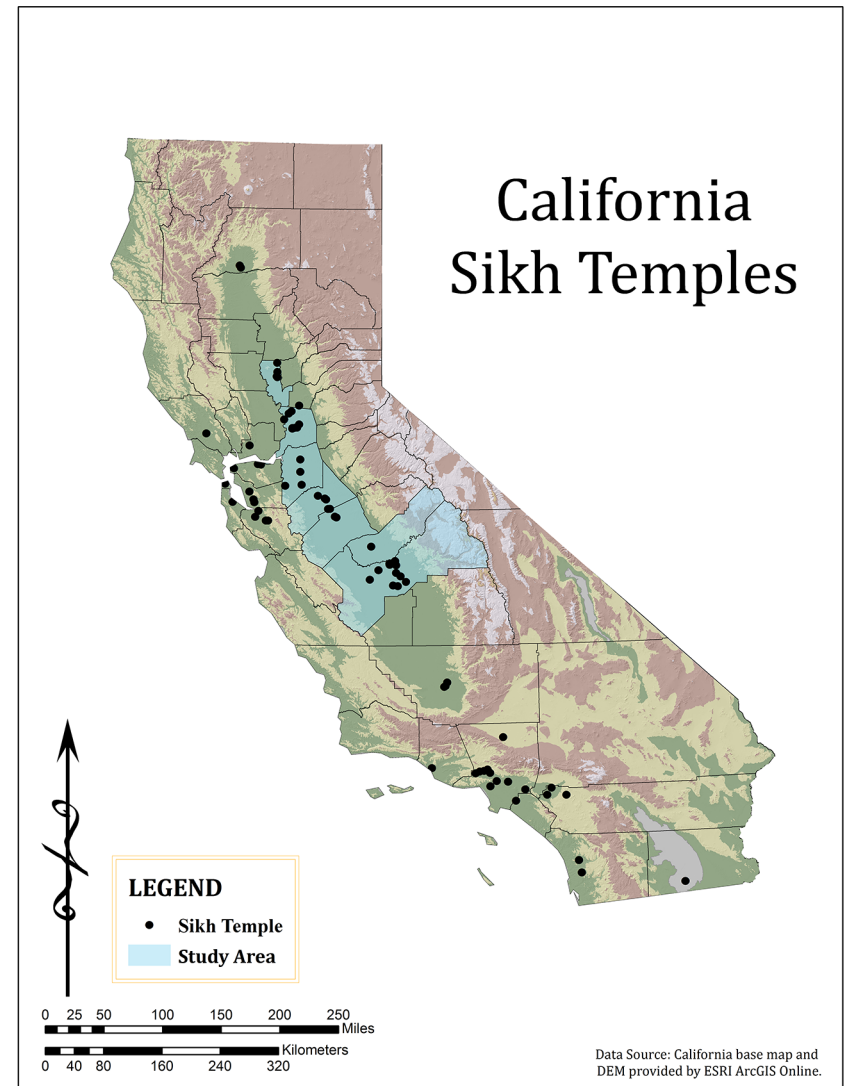


Figure 1. Map of California Sikh temples and study site. (H. Benson)

readily available, but later irrigation projects brought other parts of the Valley into production. The Central Valley is a culturally diverse region with an agrarian base; throughout California’s history, many immigrants, including Sikhs, have settled here to work in agricultural production.

Settlement Patterns and Cuisine

The early 1900s saw the peak of Sikh immigration to the U.S., with many migrants coming from British Columbia rather than directly from India.

Hostility and violence against Asian Indians drove Sikhs out of Canada, south to Washington and Oregon where they were met with more hostility, and finally further south to California (Takhar 2002). In California, they traveled along the farm belt, known worldwide for growing crops that Sikh farmers were familiar with in their native land, mainly orchards (peaches, plums, almonds, walnuts, and pistachios) and field crops (celery, beans, and potatoes) (Helzer 2015). Initial settlement destinations in California for Sikhs included the Imperial Valley to pick melons and cotton, Fresno to work in the fig and grape fields, and the orchards of northern California to pick stone fruit. In December and January, Sikhs pruned trees and grapevines; from March through May, they irrigated row crops and orchards and dug canals and ditches; and in the summer, they picked fruit and worked in the packing sheds (Takhar 2002). In particular, they settled in San Joaquin County and its county seat of Stockton. Stockton is home to the first U.S. Sikh temple, built in 1912 and still in operation today (see Figure 2). The first U.S. *gurdwara* (temple) was constructed at this site because Stockton was a central location for Valley Sikh farm workers and laborers on the Western Pacific Railroad. The Stockton *gurdwara* is no longer the hub of Central Valley Sikh activity, but it nonetheless retains historical significance.



Figure 2. Gurdwara Sahib, Stockton, CA. First Sikh temple established in the United States. (H. Benson)

The life of early Punjabi immigrant farm workers was harsh, their foodways reflecting their challenging situation. The workers' diet depended on religious ties and available food items. Sikhs ate mostly vegetables, fruit, milk, and *roti* (tortilla-like bread). Milk and butter were also consumed in large quantities. Butter (*ghee*) was viewed as a required ingredient. Each Sikh worker consumed as much as fifteen pounds of butter per month. Back in the Punjabi homeland, neither vegetable oil nor lard was commonly used for cooking. Sikhs enjoyed their food heavily spiced with curry, coriander, cumin, cayenne, and black pepper (Takhar 2002).

The population of Indian Americans, including Sikhs, grew considerably in the 1980s and nearly doubled in the year 2000 in response to the diaspora ("1984 Sikh Massacre" and aftermath), the establishment of the H1B visa program, and the American Competitiveness 21st Century Act, which increased the number of visas available for workers in specialty occupations such as math, science, and medicine. As a result, South Asian Indians became the third-largest group of Asian Americans, with increasing visibility in the Silicon Valley and other high-tech communities (Bayor 2011). With the expansion of the information technology economy, new locations have emerged as the latest destinations for Indian professionals; California led all U.S. states in 1990 and 2000, when the population had grown to include more than 350,000 South Asian Indians (Skop 2007).

The number and location of *gurdwaras* in California reflects this trend. More than fifty percent of all Sikh temples were constructed after the year 2000 (see Figure 3). As seen in the map of Sikh Temples (see Figure 1), *gurdwaras* are clustered in high-tech, urban communities such as the Bay Area and Southern California (forty-four percent), while others are scattered throughout the farm belt of the Central Valley. In contrast to urban

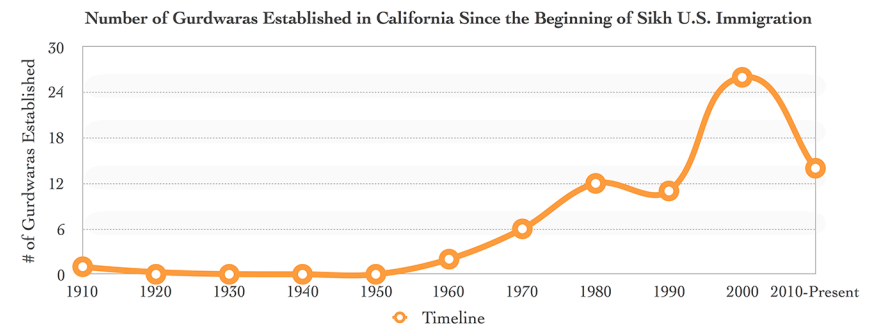


Figure 3. Number of *gurdwaras* established since the beginning of Sikh United States immigration. (H. Benson)

Bay Area and Southern California *gurdwaras*, Central Valley *gurdwaras* are commonly constructed on the outskirts of towns in large parcels of farmland or in low-income neighborhoods (see Figure 4).



Figure 4. Livingston Peach Street gurdwara located at the city limit on the outskirts of town. (H. Benson)

The Asian Indian population in the U.S. grew from 1,678,765 in 2000 (0.6 percent of the total U.S. population) to 2,843,391 in 2010 (0.9 percent of the U.S.), a growth rate of 69.37 percent, making them one of the fastest-growing ethnic groups in the nation (United States Census Bureau 2016). Today, hundreds of *gurdwaras* in the U.S. cater to the Sikh transnational population; seventy-three operate in California alone, forty-one of which are located in the Central Valley (see Figure 1). After the induction of immigration incentive programs, such as the H1B visa, most Sikhs were able to attain middle-class status immediately upon arrival, making them a “model minority.” Hence, rather than clustering in neighborhoods near other Punjabi Sikhs for social support during the assimilation process, they dispersed to middle-class neighborhoods and lived relatively independently of other Sikhs. This pattern is not only evident in California and the Central Valley, but is displayed in other parts of North America as well (Skop 2007).

Today, sites of Sikh cultural and religious activities are typically found at *gurdwaras*, which are spatially dispersed throughout the Central Valley, with Yuba City representing a northern California regional focal point. Yuba-Sutter is home to the largest population of Sikhs in the nation and outside the state of Punjab. This region hosts an annual Sikh parade on the first Sunday of November, a commemoration of the baptism bestowed on the Holy Scripture in 1708. Sikhs from across the U.S., Canada, the United Kingdom, India, and other parts of the world make the pilgrimage to Yuba City to attend the parade, which features floats and a procession of parade participants.

Methodology

The seven counties examined in this study were selected based on the prevalence of *gurdwaras* and a high number of Indian-Sikh grocery stores. There are seventy-three *gurdwaras* located in the state, with thirty-four located in the study area (see Figure 1). Participants included Sikh immigrants residing in the study area, men and women, who either have migrated from the Punjab or are the American-born offspring of Sikh immigrants.

Research activities were modeled after Vu and Voeks’ (2013) analysis of changing foodways of Vietnamese in Orange County, California. The current study employs a similar multi-method ethnographic approach, utilizing open-ended survey questionnaires, participant observation, and in-depth personal interviews. Researchers developed good working relations with a key informant and *gurdwaras* within the study region, which assisted in providing links into the Sikh community. At least one *gurdwara* in each of the study sites was visited (see Figures 1 and 5) to distribute questionnaires, perform interviews, and conduct cultural landscape analysis that included identifying Sikh symbols, Punjabi language, gathering spaces, and cultural festivals within the study area. Distance was calculated based on the drive-

STUDY SITE: GURDWARAS VISITED

Name:	Year Established:	Physical Address:	City:	Zip Code:	County:	Visit Date:
Sikh Association of Fresno	2013	4827 N Parkway Dr	Fresno	93722	Fresno	3/13/2016
Gurdwara Gurmat Parkash	2004	18456 Road 21	Madera	93637	Madera	3/13/2016
Sikh Temple, Livingston	1980	2765 Peach Ln	Livingston	95334	Merced	3/27/2016 Holla Moholla
Guru Nanak Sikh Temple, Livingston	1995	884 B St	Livingston	95334	Merced	3/27/2016 Holla Moholla
Gurdwara Sahib Guru Nanak Sat Sangat of California	1997	8132 Elsie Ave	Sacramento	95828	Sacramento	3/20/2016
Sikh Gurdwara Sahib, Stockton	1912	1930 S Grant St	Stockton	95206	San Joaquin	3/20/2016
Gurdwara Sahib, Turlock	2011	1391 5th St	Turlock	95380	Stanislaus	4/10/2016
Sikh Temple Gurdwara Sahib	1969	2468 Tierra Buena Rd	Yuba City	95993	Sutter	4/3/2016

Figure 5. List of gurdwaras visited. (H. Benson)

time required to get from place of origin (home) to destination (ethnic food supplier), similar to a study conducted by Wiseman (1975). This multi-method approach provided important opportunities to identify how foods are prepared and served, as well as whether alteration of traditional fare is taking place.

Ten questionnaires and food logs with an attached self-addressed/stamped envelope were distributed at each *gurdwara* within the study area (see Figures 1 and 5), totaling seventy in all. Eight responses were returned by mail (eleven percent return rate) from four men and four women, ages twenty-one to sixty-seven. Additionally, three personal interviews were conducted with two males and one female. Altogether, data were collected from eleven respondents in the following counties: Fresno (one), Madera (one), Merced (one), Stanislaus (three), San Joaquin (one), Sacramento (three), and Sutter (one).

Results and Analysis

To the Sikhs, food goes hand in hand with worship: The faithful cannot focus on God if they are hungry. A common meal, *langar*, an indivisible part of Sikh worship, is served at the end of *gurdwara* gatherings. *Langar* was established during Guru Arjan's time (1581–1606) and continues to this day; the charity of the communal meal is a religious duty. The *langar*, as it is open to everybody, also works as a medium for service and a marker of Sikh philanthropy. Participants sit and eat together without age, caste, gender, or status distinctions. *Langar* provides a way of expressing gratitude for the divine reward by sharing its fruit with others; offers the opportunity for service when participants help cook, serve, and clean up; and manifests Sikh solidarity and equality (Mann 2004).

Sikhs have few specific taboos regarding food, but meals served in the *gurdwaras* are always lacto-vegetarian (vegetarian dishes that include dairy products such as milk, cheese, yogurt, butter, *ghee*, cream, and kefir, but excludes eggs), although Sikhs are not bound to be meat-free. Once baptized, Sikhs are forbidden from eating ritually slaughtered meat, like Halal and Kosher meat. Seventeenth-century traditions report that meat was served at *langar*, but as a mark of respect for those who do not eat meat, food offered today is always vegetarian. Other dietary Sikh practices include what is known as an “all-iron lifestyle,” which consists of using only iron utensils and flatware and strictly eating only food prepared by members of the Sikh community (*The Sikh Review* 2005).

Data Analysis: Age

Respondent 2, the oldest respondent at sixty-seven years old, was born in Punjab and migrated to California in 1981. He speaks Punjabi fluently, English moderately well, and believes he has assimilated into American culture at a conservative pace. He was the only respondent who eats Indian dishes for every meal, no matter what day of the week, including savory Punjabi breakfast dishes (commonly *aloo paratha*, *puri*, and *chholey*). Respondent 2 often lunches on *chapati* with oats, veggies, and rice curd. Dinner for him is a repeat of the lunch meal, and he eats no snacks throughout the day. He predominantly eats at home, where his wife prepares all meals, and his favorite dish is *paratha* (fried, puffed bread) and duck curry. He dines at restaurants infrequently, but when he does, once in a while he indulges in food from Jack in the Box, Wendy's, and McDonald's.

Respondent 7, at twenty-one the youngest respondent, was born in the U.S. to immigrant parents. Her diet consists of only American foods, apart from Sunday when she attends service and *langar* at the *gurdwara*. She is fluent in English, speaks Punjabi moderately well (only at home), does not cook, and often dines at fast-food restaurants. For breakfast, she consumes items like garlic bread or Frosted Flakes cereal, or skips the meal altogether. Lunch for Respondent 7 generally consists of items from restaurants such as Subway and McDonald's. Her dinner continues this trend, as she reports eating popcorn chicken salad from Sonic, chicken burritos, or her favorite dish, Little Caesar's three-meat pizza. She enjoys several snacks throughout the day, such as Chee-tos chips and soda. Second-generation Punjabi Sikhs like Respondent 7 are faced with their parents' traditions and cultural heritage while simultaneously being confronted with American values. First-generation immigrants use the ABCD acronym (American-born confused desi) to convey a sense that American-born Punjabis are confused about who they are and where they belong.

All other respondents, median age forty-seven, reported roughly the same diet. They usually consumed an American-style breakfast but Indian/Punjabi for every other meal, occasionally partaking in international cuisine such as Chinese, Mexican, and Italian.

Data Analysis: Distance and Location

Respondent 7, the youngest respondent, resided in Merced County. An examination of the local phone book and Internet searches reveal that only one Indian ethnic grocer, India Bazaar, is in operation in Merced. There are, however, a couple of Southeast Asian stores and several Hispanic grocers

in the area. Respondent 7's Americanized food pattern could be attributed in part to her age and the fact that she is American-born, but the lack of traditional ingredient supplies in her region might also have an influence on her foodway pattern. However, Respondent 2, the oldest respondent, resides in Madera, where there is a similar ethnic grocer situation—only one Indian ethnic grocer and several other stores supplying Hispanic foods and spices—yet he had a less-Americanized foodway pattern. Neither Respondent 7 nor Respondent 2 specified in their questionnaires where the primary food preparer of the household purchased ingredients. This could be due to the fact that the person responsible for purchasing ingredients must travel a significant distance to buy traditional supplies, or because it is simply unnecessary for them to know where ingredients are bought. All other respondents were able to name at least two to three ethnic grocers within their region where they purchased supplies.

As mentioned earlier, women (wives and mothers) are typically responsible for purchasing ingredients for the household. Basic supplies (vegetables and grains) are purchased at American grocers, such as Winco Foods, Food 4 Less, Food Max, Save Mart, and Costco. Traditional Indian spices are purchased at ethnic grocers, including Sikandar Cash & Carry, Sher-E-Punjab, Jasber's Palace, Amar's Fashion & Grocery, the Golden Spice, and New India Sweets & Spices. On average, most traveled between 2 and 13 miles (3–21 kilometers), 9 to 30 minutes, one-way, to buy traditional spices at Indian grocers, and in some cases 48 to 63 miles (77–101 kilometers), 45 to 60 minutes, one-way, to revered ethnic grocers in the Bay Area.

American grocers, especially in culturally diverse areas like the Central Valley, are adapting their supplies to meet the needs of the local clientele. Most large American grocery stores have a section devoted to ethnic ingredients, most often catering to multiple ethnic groups. While large grocers may sell general ethnic foodstuffs (such as chili peppers, spices, sauces, and so on), specific traditional ingredients (for example, chickpea flour and milk solids) are harder to find. Costco, Food Max, Trader Joe's, Winco, Food 4 Less, and other American grocers sell ethnic items such as *tamales* and *naan* bread, but ethnic groups generally feel those items are whitewashed versions of ethnic foods, not authentic versions found in their home country. With U.S. supermarkets loaded with ethnic foods and gourmet foreign foods, advertising employs the words “authentic” and “real” to market mass-produced food products that have little or no relationship to the ethnic traditions upon which they are supposedly based (Lindenwold 2007). Several survey and interview respondents replied that they often have to shop at multiple stores,

both American and ethnic, in order to obtain all of ingredients necessary for their particular diet.

Another pattern revealed in this research is that many Sikhs in Sacramento had not emigrated from Punjab, nor had their ancestors immigrated directly from Punjab; rather, they emigrated from the Fiji Islands. Fiji was a British-controlled territory during the early years of Sikh emigration, and South Asian Indians were shipped to Fiji to meet labor demands of the British. Punjabi Sikh immigrants, however, arrived later as free settlers, in contrast to their counterparts, who were brought under the indentured labor system. From 1987 to 2005, the Fiji Islands have experienced a “brain drain” due to U.S. immigration incentives such as the H1B visa program, which stimulated the flow of immigrants out of Fiji and into the United States. Because Fiji is inhabited by people from across India, Fijian residents (including Sikhs) tend to speak Hindi rather than Punjabi. As reflected in questionnaire responses, Sacramento Sikhs generally speak Hindi at home but Punjabi at the temple. Chain migration brought Fijian Sikhs to Sacramento, where they are clustered here in a unique ethnic substrate. An “ethnic substrate” is defined as a semi-assimilated culture region that retains some distinctiveness, differing from the surrounding region in a variety of ways, whether they be local cuisine, dialect, or traditions (Domosh, Neumann, Price, and Jordan-Bychkov 2010).

Data derived from surveys and interviews indicate that Sikhs located in central and southern parts of the Valley (Fresno, Madera, Merced, and Stanislaus) tend to incorporate Mexican food into their diets more regularly than those in the northern parts of the Valley (San Joaquin, Sacramento, and Sutter). Sikhs in Fresno, Madera, Merced, and Stanislaus admit to experimenting with recipes such as Indian-spiced burritos and tacos, whereas those in the north tend to maintain a more traditional Punjabi-Indian diet. This could be a result of three factors: geography, history, and nodes of ethnic/cultural activities throughout the Central Valley.

Mexicans and Punjabis first came into contact with one another in the early 1900s in Southern California's Imperial Valley. The Imperial Valley was mostly uninhabited until 1901, when the Imperial Canal was opened and thousands of acres of desert were transformed into prime farmland. The culture of the area blended those of U.S. and Mexico due to its geographic location along the international border. Mexican immigrants began entering the U.S. during the 1910s, shortly after the Mexican Revolution, and many of these immigrants got their start by picking cotton in Imperial Valley

fields farmed by Punjabi men (Hart 2000). Inter-marriage between Punjabi men and Mexican women began in this area, where hundreds of bi-ethnic couples were clustered in the Imperial agricultural valley (Leonard 1994). The history and geography of this Southern California culture region could have an influence on the southern Central Valley Sikhs who claimed to incorporate Mexican foods into their diets more often than those in the north.

In addition to history and geography (distance from the U.S.-Mexico international border), another influencing factor could be that Sikhs in the northern parts of the Central Valley may have stronger Punjabi ethnic identities due to the presence of important nodes of ethnic/cultural activities. For example, San Joaquin County is home to the first *gurdwara* in the U.S.; Sacramento hosts an ethnic substrate of Fijian Sikhs; and Sutter has the largest population of Sikhs outside the Punjab. Such nodes of ethnic-cultural activities help to reinforce a sense of “we-ness” and “Punjabi-ness” within these communities, which could be reflected in the desire to maintain traditional foodways. It should also be noted that Central Valley Sikhs are fairly stable; they have anchored themselves in specific locations throughout the region, whereas other immigrant farm workers commonly uproot themselves to follow seasonal crops. Immigrant communities that are able to stay “in place” can engage in ethnic and cultural activities that solidify their community and reinforce a sense of “we-ness.”

Gender and the Preservation of Food Culture

Despite the many responsibilities associated with working outside the home, many Indian women follow traditional gender roles and are encouraged to be the torchbearers of family and culture as well. Hence, the least Americanized meals in the diet of Central Valley Sikhs are those prepared by women at home. Indeed, women in many ways are emblematic of what constitutes authentic “Indian-ness.” As cultural custodians, Indian women are primary transmitters of religious and cultural traditions within the household and in local associations (Skop 2007). Women tend to be responsible for food purchasing and preparation, and the meals they serve at home are often traditional Punjabi-Indian fare, like *roti* (tortilla-like bread), *daal* (spiced lentils), *basmati* rice, *chapati* (deep fried bread), *saag* (leaf-based puree), *chholey* (spicy chickpeas with onions, carrots, green chutney), and curries (meat or vegetable dishes prepares in a peppery spiced sauce).

In the Central Valley, the idea of women as “cultural custodians” is not only apparent in food traditions but in dress as well. During fieldwork, it was noted that many men at *gurdwaras* wear casual clothing, such as T-shirts

or button-downs, jeans or shorts, trimmed beards, short hair, and tennis shoes or sandals. Often, men do not wear the *dastar* (Punjabi turban), with the exception of the older generation, whereas nearly all women, old and young, wear the traditional *salwar kameez* (pantaloon and body shirt) and *dupatta* (head scarf).

The second-least Americanized meals are those served at *langar* in *gurdwaras*. Although Central Valley *gurdwaras* occasionally will host a pizza night, meals served are traditionally Punjabi-Indian dishes, such as *roti*, *daal*, *barfi* (condensed milk and sugar, cut into squares), *laddu* (minced flour dough and sugar, ball-shaped), and *pakora* (deep-fried vegetables dipped in batter) (see Figures 6a and 6b). Gender figures into the division



Figure 6a. Women making *roti* for *langar*, Fresno *gurdwara*. (H. Benson)



Figure 6b. Women making roti for langar, Madera gurdwara. (H. Benson)

of food preparation duties in *gurdwaras*: women usually make *roti* and other Indian fare, while men generally work the fryer and serving dishes. Both genders help clean up after *langar*, sometimes chanting religious hymns in the process (see Figure 7).

Acculturation and Americanization of Food Culture

In the Central Valley, Sikhs feel they must adapt to local customs, including fast food, changing time commitments regarding school schedules, and working outside the home. However, upon arriving home in the evenings, they commonly return to a house full of extended family, native language, and traditional fare. In both surveys and interviews, respondents admit to feeling Americanized when it comes to work and school, but Indian when it comes to family and home life.

The most Americanized meal in the Central Valley Sikh diet is the one eaten outside the home. In India, it is common to dine at street-side vendors or restaurants for several meals throughout the day, but traditional cuisine and eateries are less available in the Central Valley. As a result, Central Valley Sikhs very rarely dine at restaurants, but when they do, they tend to patronize fast-food restaurants such as Subway, McDonald's, Jack in the Box, and Mountain Mike's Pizza, or they dine at international cuisine restaurants



Figure 7. Men and women washing dishes after langar at a gurdwara in Turlock. (H. Benson)

such as Chinese or Italian. Remaining committed to a vegetarian diet in the U.S. poses an additional challenge for many respondents; most restaurants feature few vegetarian options and thereby often limit Sikhs to eating salads, which are not considered Indian fare nor eaten regularly in the home country. Respondents also complain that food in the U.S. tastes bland; one respondent attributes this to the mass production of food and industrial farming, stating that “even the bananas are flavorless” when compared to bananas in India.

Breakfast is the second-most Americanized meal among Central Valley Sikhs. Rather than eating a savory Punjabi breakfast, such as *aloo paratha* (*roti* stuffed with potatoes) or *chana masala* (spiced chickpeas), many opt for cereal, muffins, eggs and toast, or nothing at all. Seven out of eight questionnaire and food-log respondents ate an American-style breakfast every morning, and only one respondent regularly ate a traditional Punjabi-style breakfast.

Fusion-Cooking and Cuisine Evolution

After decades in the U.S., sharp intra-ethnic demarcations soften and some blending of food traditions—or “fusion cooking”—can occur. This style of

cooking is occasionally reflected in the diet of Central Valley Sikhs, usually at the request of the younger generation, with some admitting to experimenting with recipes such as curry pizza and Indian-spiced burritos or tacos. As described by Leonard (1994), California has already witnessed a blending of cultures among Punjabis and Mexicans during the early years of Sikh immigration:

Mexicans and Punjabis shared a rural way of life, with similar types of foods, furniture, and a similar material culture... Cuisine in the homes drew from both Mexican and Punjabi food cultures and the men taught their wives to cook chicken curry, roti, and various vegetable curries. As Moola Singh of Selma, California, (who has thirteen children from three marriages with Mexican women) says, "I never have to explain anything India to my Mexican family. Cooking the same...they make *roti* over there, sit on the floor—all customs India the same Mexico... Adobe houses in Mexico, they sit on the floor there, make *tortillas* (*roti*, you know). All kinds of food the same, eat from plates sometimes, some places tables and benches. India the same, used to eat on the floor, or two cutting boards, made benches" (311–316).

Another example of this blending of cultures can be found in the Central Valley town of Kerman, which has grown by sixty percent over the past nineteen years, fueled in part by a wave of Punjabi immigrants whose cultural and political influence is reshaping a town that is largely Latino. Inside the Kerman Food Market (see Figures 8a and 8b), sacks of *basmati* rice and spice jars of turmeric are stacked across from the counter, where business owner Kulwant Brar sells hot tacos and burritos. Brar is one of several Punjabi merchants to run Mexican grocery stores in Kerman. In a 2012 interview with the *California Report*, Brar admitted that he never imagined selling cow-tongue tacos when he lived in India—where the cow is considered holy—but it is part of adapting to the largely Mexican clientele (Khokha 2012).

Cultural Landscape Analysis

Central Valley Sikh temples are fairly consistent in terms of cultural landscape elements. They feature the orange Sikh flag (*nishan sahib*), worship halls, Sikh architecture, the sound of spiritual hymns, and aromas from the *langar* halls. Modern U.S. Sikh architecture can be described as Indo-Persian in style. *Gurdwaras* are typically square or rectangular, with entrances on all four sides, and usually have domed sanctums (*gumbad*) in the middle. The *gumbad*, the crowning feature of the *gurdwara*, is customarily painted white or gold. *Langar* halls can be found adjacent to the *gurdwara*, and



Figure 8a. Kerman Food Market & Liquor, Kerman, California. Sign reads, "Kerman Food Market & Liquor, Mexican-Indian, groceries & fabrics." (H. Benson)



Figure 8b. Inside the Kerman Food Market & Liquor, Kerman, California. (H. Benson)

most halls offer the option to sit on the floor or at tables and chairs. Arched copings are used as exterior decorations, commonly painted in white, blue, or gold, and a tall Sikh pennant flag can be found on top of the building or in front of the *gurdwara*. Inside the worship hall, *Guru Granth Sahib* (the sacred text) rests under a canopy or in a canopied seat, usually on a platform higher than the floor where the devotees sit; men on one side, women on the other (see Figures 9 and 10).



Figure 9. Gumbad (domed sanctum) and Nishan sahib (pennant flag), Turlock gurdwara. (H. Benson)

In no way limited to the temple, the Sikh imprint on the cultural landscape throughout the Central Valley. The Punjabi language appears on signs in commercial centers, the word *khalsa* (“pure/nation of Sikhs”) embellishes the sides of semi-trucks (today, many Central Valley Sikhs are employed in the trucking business), and the *khanda* (emblem of the Sikh doctrine) is commonly pasted to signs and cars (see Figure 11).

Interviews In-Depth

The individual cases that follow offer an intensive illustration of how the foods consumed by Central Valley Sikhs constitute fundamental components of ethno-cultural and geographic identity. As immigrant lifestyles change, so do immigrant foodways. Upon arrival in the new territory, Sikh



Figure 10. Guru Granth Sahib and worship hall, Madera gurdwara. (H. Benson)



Figure 11. Khanda identified on a vehicle within the study site. (H. Benson)

transnationals have begun to modify recipes and meals to accommodate changing technology, ingredients, and time commitments. Distance and location have provided some challenges to preserving traditional day-to-day fare, but Central Valley Sikhs persevere; they track down grocers that supply desired spices and ingredients, and prepare dishes that suit their palate and make them feel at home. In each of the cases described below, food and people are linked in complex interrelationships that reveal dominant ideas and prevailing practices within the Central Valley Sikh culture.

Respondent A

Respondent A discussed his family's negotiation with "Americanness" as well as their experimentation with new recipes and food patterns. Respondent A is a twenty-nine-year-old male, a law student from Stanislaus County who is fluent in English but speaks Punjabi at home with his family. Suggesting a meeting at Denny's, he ordered a vanilla banana milkshake before commencing the interview. He and his parents are Sikh immigrants, although they did not all migrate at the same time. Born in India, outside of the Punjab, he eventually relocated with his parents to the state and spent a few years in the region. His father was the first to immigrate, followed by his mother, and then himself in 2008. His sister and brother still reside in the Punjab with extended family. "My mother had a hard time with the immigration process," he said. "In India, she lived in a house full of people, so when my father went to work she still had people to talk to. But in America, her and my father lived alone. So when he went to work, she was by herself at the house, bored and lonely."

Navigating the expectations of American societal norms for Respondent A continues to highlight cultural disparities. Living with his parents and consuming the traditional food his mother prepares makes for a situation that he says most of his American peers find "odd." "I get asked all the time, 'Don't you find it difficult to live with your parents? What about privacy and personal space?'" he said with a chuckle. He continued:

To me, it's normal. This is how we live in India. It would be harder for me to live alone and go to school, and work, and pay rent. This way, we all contribute to the same household. It's nice. When I wake up in the morning, my mother is there to make food or help with whatever I need. But Americans think it's strange to be an adult and still live with your parents. I'm American when it comes to work ethic, but Indian when it comes to family structure. I work hard and I do my work from home. But my mother has someone to talk to now.

Acquiring ingredients for traditional fare has proven to be one of the challenges that Central Valley Sikhs face, due to the location of ethnic grocers and restaurants and the travel required to reach them. As a result, fusion-cooking practices have found their place in Respondent A's family kitchen. His mother does the cooking for the household, and they all prefer Indian-Punjabi fare, such as curry, beans, rice, *roti*, *paratha*, yogurt, and Indian tea (*chai*), but both generations are open to integrating new foods into their diet. His mother often experiments with recipes, preparing, for instance, burritos with Indian spices. Occasionally, Respondent A will suggest that the family dine at well-known South Asian Indian restaurants in Dublin, and often encourages his father to eat healthier (his father, due to health reasons, follows a slightly different diet than the rest of the family). Respondent A and his mother regularly travel 3 to 14 miles (5–22 kilometers), or 9 to 30 minutes, one-way, to purchase ingredients and foodstuffs at ethnic grocers, and occasionally 35 to 48 miles (57–78 kilometers), or 36–60 minutes, one-way, to South Asian Indian restaurants and markets in Dublin.

In line with the majority of survey responses, Respondent A has difficulties maintaining a traditional diet when dining out and feels unsatisfied when consuming processed American foods. When asked what came to mind when he thought of Punjabi food, he replied, "Heavy foods. Vegetarian, no eggs. No liquor." When asked the same question about non-Punjabi foods, he answered, "Fast food, burritos, pizza." And when asked how living in the Central Valley has changed his eating habits, he said:

In India there are many restaurants to choose from, but there is only one Indian restaurant in my area and it's too expensive. Indian buffets here are expensive, and they're not that tasty. So when I go out to eat, it's not Indian food. My mother usually cooks for my father and I, but sometimes she goes back to visit Punjab for months at a time. When she is gone, my father and I eat fast food more often, so we eat less traditional food when she is away. Also, when I travel for events or classes, I am forced to eat fast food. There are few options for vegetarians, mostly just salad. I eat a lot of salad and processed food when I am away from home. Processed foods do not make me feel full and they don't taste good either. I enjoy eating at Subway though because the food there is not cooked or fried.

Respondent A provided an example of his family's utilization of transitory spaces and food to (re)create and maintain a sense of cultural cohesion and solidarity among Central Valley Sikhs. He and his father are very involved in the community, and they organize several Sikh awareness events throughout

the year. These events provide opportunities for Sikhs to socialize outside of the *gurdwaras*, as well as occasions to educate the local populace about Sikhism and promote acceptance. These events are catered by the one Indian restaurant in his area, and the food is free to all who attend.

Respondent B

Respondent B is a twenty-four-year-old male student from Stanislaus County who negotiates a similar American social-cultural matrix and reinforces his Sikh identity through familiar foodways. Born in the Punjab and migrating to California in 2006, he considers himself to be fifty percent Americanized, saying, “Compared to the average immigrant, I guess. I spend a lot of time at school, and all of my school interactions are American. But when I go home, I am Punjabi.” He lives with an extended family (father, mother, brother, and sister-in-law), speaking Punjabi and eating Indian-Punjabi food. His brother and sister-in-law enjoy dining at American restaurants more than the rest of the family, and his sister-in-law often suggests having a “taco night.” Everyone (brother and sister-in-law included) appreciates home-cooked Punjabi meals. Respondent B and his mother regularly travel 3 to 7 miles (5–11 kilometers), or 9 to 12 minutes, one-way, to local ethnic grocers, and occasionally, like Respondent A, 64 miles (102 kilometers), or 65 minutes, one-way, to South Asian Indian restaurants and markets in Dublin.

As with other immigrant groups in California, Sikh transnationals have incorporated new foods into their daily meals. Common foods of the immigrant generation, in some cases, have been reserved as ethnic treats for special events. Respondent B’s mother loves making Indian pizza (pizza with Indian spices), and he believes his family eats pizza more often in the Central Valley than it did in Punjab. “When I think of non-Punjabi food, I think of pizza,” he stated. “The temple serves pizza on Wednesday nights, and that’s the most non-Indian food served at the temple.” When thinking of Punjabi food, he conjures images of items like *shahi paneer* (Indian gravy with cheese). “*Shahi*” means ‘royal/fancy,’ so it is usually served at weddings.” When asked how his food habits have changed since arrival in the Central Valley, Respondent B stated:

Instead of Indian breakfast, we eat cereal. I’ve also been drinking *chai* a lot more. The Central Valley is similar to the Punjab; both are agricultural areas, so there are a lot of fresh fruits and vegetables available. Many Sikhs gain weight after they immigrate because of the American sedentary lifestyle. I try to eat more salads. I also drink more protein shakes for weight lifting. When I first moved here and found out everything wasn’t vegetarian that was difficult. Others don’t seem to understand

what vegetarians eat, finding vegetarian options is hard. Also, the food here seemed flavorless, the Indian food and even the bananas. There is something missing. I think that’s due to the mass production of food; bigger products, less flavor. Even carrots taste better in India, they are big and red and juicy.

In some ways, Sikhs reject assimilation and acculturation and are in the process of reasserting place-based ethnic identities. Respondent B illustrated this with a comment on the political battle waging between the younger generation and the older generation at a local *gurdwara*:

The older generation wants to become more modern—more American. They want to bring tables and chairs into the *langar* hall so they can attract more weddings and make more money. But the younger generation wants to keep things traditional, we want to get back to our roots and sit on the floor.

Respondent C

Respondent C, as with Respondents A and B, experiments with fusion-cooking and maintains her Sikh identity through purchasing and preparing traditional foods in her Central Valley home. Respondent C is a twenty-three-year-old female student from Stanislaus County. She is American-born to an immigrant father who was born in the Punjab and migrated to London and later New York, prior to settling in the Central Valley, and a mother born in California. She has visited family in Punjab on many occasions and for several months at a time. Respondent C lives in a household of five people (mother, father, brother, friend, and herself), where everyone speaks English and enjoys all types of vegetarian foods. She, also like Respondents A and B, encourages the older generation to maintain a healthier diet. She considers Punjabi food to be heavy, based on simple recipes, and views non-Punjabi food as “processed.” As the primary cook for the household, she buys ingredients at Food Max, Safeway, Costco, Trader Joe’s, Target, and Amar Fashion & Grocery. “I literally have to go to those six stores to obtain all of the necessary vegetarian ingredients that everyone eats,” she stated. She admits to experimenting with American-Punjabi recipes, like bean burritos with *masala*, spaghetti with Indian spices, and tacos with tofu and turmeric. Fusion-cooking recipes, such as the ones mentioned above, are examples of the unique cuisine evolution and ethnogenesis unfolding in the Central Valley.

First-generation immigrants in North America may be inclined to use the ABCD acronym to describe young, American-born Sikhs. However, that

acronym may not be applicable to Central Valley Sikh youth like Respondent C, especially with regard to cultural foodways. When asked about how the process of Americanization has impacted her, Respondent C said, “I try to have a balance between both Sikh and American cultures. America is a combination of so many cultures, so what is American anyway?” She shares a view similar to Respondent B’s in stating that the agricultural landscape of the Central Valley is akin to that of Punjab, in that both places offer access to fresh vegetables and dairy: “It’s almost like living in Punjab, except now we don’t wake up in the morning to milk the cows—we go to Costco to buy milk.” Respondent C observes that a plethora of Indian grocery stores have opened to cater to the Central Valley’s large Sikh population, contributing to continuity of a food culture amid long-distance migration: “It’s not difficult to retain traditional recipes.” Upon becoming a baptized Sikh three years ago, she committed herself to a lacto-vegetarian diet, stating that “it was hard not to eat eggs. Eggs are in everything, cookies, etc. When I go out to eat I often have to ask the waiters if there are eggs in the recipe. They usually say ‘no’ but I know how to cook, so I know that eggs are used in that sauce!” Respondent C regularly traveled between 5 and 7 miles (9–11 kilometers), or 9 to 13 minutes, one-way, to buy ethnic ingredients for the meals she prepared at home.

Like Respondent A, Respondent C provided an example of how she makes use of transitory spaces and food to reinforce her Sikh identity. Outside of the *gurdwara*, she gathers with other Sikhs at week-long *Siki* camps, which serve to educate youth about the history of Sikhism and Punjabi language. *Siki* camps often serve pizza, sandwiches, pasta, burritos, and Punjabi food for young attendees. She laughed, “The kids usually complain when they are served Punjabi food.”

Gathering Spaces

Central Valley Sikhs utilize a variety of strategies in their attempts to (re) create and maintain a sense of cultural cohesion and solidarity. One strategy involves the building of permanent spaces, like *gurdwaras*, as enduring sites for the demonstration and cultivation of Sikh ethnic heritage. Another strategy makes use of temporary spaces, such as community events and parades, as a more transitory way of bringing families together to celebrate cultural and religious traditions. In this place-making strategy, Punjabi Sikhs (both the foreign-born and their native-born children) invoke and transform traditionally ordinary spaces into social and communal spaces that they temporarily call their own. Unlike permanent sites of ethnic maintenance that endure as visibly identifiable and generic (Sikh) spaces, transitory sites

such as parades are nearly always inconspicuous in the urban landscape. They exist as (Sikh) places only briefly, to be returned to their customary purpose once events conclude (Skop 2007). Transitory Sikh spaces were made evident during field research: *Hola Mohalla* (see Figure 12) created a cultural space on the blocks between temples until the parade concluded; public spaces were made Sikh during community awareness events; athletic activities (such as volleyball) and weightlifting at the gym became cultural spaces; and *Siki* camps. All of these transitory spaces help reinforce a sense of “Punjabi-ness” among Sikhs in the Central Valley.



Figure 12. Parade procession following Livingston gurdwara float, *Hola Mohalla*, Livingston, California. (H. Benson)

Discussion and Conclusions

This study explores the Americanization process among Sikh transnationals based on cuisine evolution and changes to food consumptive patterns since their arrival in California's Central Valley. Central to this paper is the assertion that geographic location and age significantly influence the process of acculturation among Central Valley Sikhs: Sikh migrants experience foodway assimilation differently based on their age at arrival in the Central Valley, their current age, and where they live in relation to ethnic food suppliers.

The narratives provided in this paper show the nuances that exist between the participants' age and their rate and degree of Americanization. As in Vu and Voeks' (2013) research on Vietnamese diaspora in Orange County, the results of our study indicate that members of the first generation of the Central Valley Sikh population retain food culture more strongly than those of subsequent generations. The older generation of Central Valley Sikhs, those who arrived earliest, are the least Americanized and tend to preserve a traditional Indian-Punjabi diet; whereas the younger immigrant generation and native-born Central Valley Sikhs are the most Americanized and tend to incorporate more of the local, American cuisine into their diets. This aspect of the research reveals that youths who arrived in more-recent decades and those who are American-born straddle being Punjabi and being American, a dynamic that is reflected in their foodways. When cooking non-Punjabi food, they would add Indian flavors such as curry, turmeric, and masala to dishes that would not normally contain those ingredients. Contact with American cultures has resulted in exposure to new types of foods, and as a result we are witnessing an emerging Sikh foodway culture and ethnogenesis in the Central Valley.

A culturally diverse region with an agrarian base, the Central Valley hosts a number of ethnic grocers that supply traditional ingredients and basic components necessary to a Sikh vegetarian diet (for example, fresh vegetables and grains). However, ingredients and food items that figure into traditional Sikh cuisine are also amply available at American grocers. Furthermore, the Central Valley is within a reasonable distance (45–60 minutes by car) to revered ethnic markets in the Bay Area, which aids in providing access to customary ingredients. Field research shows that while Sikh food practices have changed significantly with regard to breakfast and dining at restaurants, foods prepared and consumed in the homes of Sikhs have largely remained traditional Indian-Punjabi fare. Additionally, due to geography, history, and nodes of ethno-cultural activities, Sikhs in the central and southern parts of the Valley differ from those in the northern region; those closer to

Southern California exhibit Mexican influences in their foodway patterns, whereas those in the north exhibit a more traditional Indian-Punjabi diet. Published literature does not reveal much in relation to foodway preservation and distance decay (Vu 2008); further research on this topic could provide additional data to strengthen the results of this study and provide additional details regarding access to traditional ingredients.

Additional findings revealed that Sikhs employ place-making strategies utilizing permanent and transitory spaces to bring people together to celebrate cultural and religious traditions. This place-making strategy, which often involves food, helps reinforce the sense of “we-ness” and “Punjabi-ness” within the new landscape and culture of the Central Valley. In this approach, Central Valley Sikhs (both foreign- and native-born) invoke and transform traditionally ordinary spaces into social and communal spaces that they temporarily call their own. The unique combination of these methods and interdisciplinary approach have provided a fresh perspective on ethnic foodways and transnational identities that isn't currently available in the literature, and it has added to our understanding of ethno-religious groups in the Central Valley. This study has further added to our understanding of the process of acculturation among young and old Sikh transnationals and has helped uncover the role that spatial relationships and processes play in maintaining traditional foodways.

What Punjabi-Indian food lacks in visual aesthetic, it makes up in flavors and aromas. In claiming the superiority of French over English food, lovers of French food, from the “great master” Jean-Anthelme Brillat-Savarin on, have argued that theirs is a cuisine of intermingling, while English food is the product of mixture. If we concede that to the French, then Punjabi-Indian food is the result of an even-deeper interpenetration, in which the original substance loses its distinctive identity, as in a stew (Ray 2004). In regard to the Central Valley, it is important to celebrate and preserve cultural and ethnic diversity, call it what you will—an intermingling, a mixture, an interpenetration, a fusion of recipes, a stew—but the variety of people and flavors create a unique buffet of international culture.

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Survey Questionnaire

(adapted from V. Vu 2008 and K. Ray 2004)

General Information:

1. Your Zip Code: _____
2. Gender: Male ___ Female ___
3. Year of Birth: _____
4. Occupation: _____
5. Were you born in the Punjab? (Circle one) Yes / No
6. If you were born in Punjab, what year did you migrate to the U.S.? _____
7. What year did you arrive in California? _____
8. Were your parents born in the Punjab? (Circle one)
Father: Yes / No Mother: Yes / No
9. If your parents were born outside the US, how old were they when they arrived in the U.S.? Father: _____
Mother: _____
10. What is the primary language spoken in your home? _____

Food Practices:

Please answer questions 11–14 based on the following scale:

1 = Least Often, 5 = Most Often

11. How often do you eat at home? (Circle one)
1 2 3 4 5
12. When you eat at home, how often are the dishes Punjabi/Indian? (Circle one)
1 2 3 4 5
13. How often do you go out to eat? (Circle one)
1 2 3 4 5
14. When you go out to eat, how often is the restaurant Punjabi/Indian? (Circle one)
1 2 3 4 5
15. Which member of your household is the primary food preparer?

16. Where do you, or the primary food preparer, typically buy ingredients? Please name grocery store, vendor, or market. _____

17. What type of food is primarily consumed in your home? (Punjabi/ Indian, American, Mexican, etc.) _____
18. What is your favorite dish to consume? Please include ingredients if possible.
Meal: _____
Ingredients: _____
19. Do you cook? If so, what are your favorite dishes to prepare? Please include ingredients if possible.
Meal: _____
Ingredients: _____
20. What dishes do you typically consume during special occasions? (Holidays, birthdays, weddings, etc.) Please specify special occasion and include ingredients if possible.
Meal & occasion: _____
Ingredients: _____
21. Do you dine at restaurants or fast foods? If so, where? Please provide name of eatery: _____

Perceived identity:

Please circle the best answer for each of the following questions (22–29).

22. How quickly did you assimilate to American Culture?
Very Quickly Quickly Moderately Slowly Very Slowly
23. How well do you speak the Punjabi language?
Very well Moderately well Very poorly I don't speak Punjabi
24. How well can you understand the Punjabi language?
Very well Moderately well Very poorly I don't understand Punjabi
25. How well do you speak the English language?
Very well Moderately well Very poorly I don't speak English
26. How well can you understand the English language?
Very well Moderately well Very poorly I don't speak English
27. How often do you speak Punjabi?
Always Often Sometimes Rarely Never

28. How often do you listen to Punjabi music or radio?
 Always Often Sometimes Rarely Never
29. How often do you watch Punjabi programs (television or online media)?
 Always Often Sometimes Rarely Never

Further research will be conducted regarding cooking practices and food consumption habits. If you would like to participate, please provide your *first name* and *phone number* or *e-mail address*:

Food Log

(adapted from V. Vu 2008 and K. Ray 2004)

The purpose of this survey is to observe daily food consumption habits of Punjabi Americans. These findings will be presented at academic conferences and in my Master's thesis. I would greatly appreciate your participation in this project. All you have to do is write down what you ate for 3 days. If you could be as specific as possible, that would be great! (i.e. A cheeseburger from McDonald's; *sarson da saag* made by my mother/myself/wife/husband; *basmati* rice and *roti* from Punjabi Dhaba; or a ham sandwich, jello, and juice that my mom packed for my lunch). You can even include drinks and desserts. If the meal was prepared in your home and you know what ingredients were used, including those will also be very helpful. Please include at least one weekend day in your food log. Your information will remain anonymous. Thank you for your assistance.

Thank you,

Heather L. Ream
 Geographer, MSIS
 California State University, Stanislaus

Please write down what you have eaten during a 3-day period:

Day 1 _____

Breakfast: _____

Lunch: _____

Dinner: _____

Other (Snacks, Beverages, Desserts): _____

Day 2 _____

Breakfast: _____

Lunch: _____

Dinner: _____

Other (Snacks, Beverages, Desserts): _____

Day 3 _____

Breakfast: _____

Lunch: _____

Dinner: _____

Other (Snacks, Beverages, Desserts): _____

Any Additional Information: _____

Follow-up Interview Guide

(adapted from V. Vu 2008 and K. Ray 2004)

How many people live in your house? Can you provide the age, gender, and how they are related to you?

What are the food preferences of each of these persons?

Do you feel pressured by the younger generation to integrate new foods into your diet?

When you think of Punjabi food, what comes to mind?

When you think of non-Punjabi foods, what comes to mind?

How Americanized do you think you are?

How has living in the Central Valley changed your food habits? (ex. food preparation, food consumption, integration of new ingredients, changing time commitments or gender roles)

According to your questionnaire, you typically buy ingredients (*insert name of food supplier*). Do they have adequate supplies of traditional foods and spices?

Do you blend American/Californian foods with Punjabi/Indian foods? (ex. curry pizza)

Are there Punjabi/Indian markets or restaurants in your area that I should be aware of? Please specify.

Aside from *gurdwaras*, where do you gather with other Sikhs/Punjabis? Is there food/eating involved at this/these location(s)?

Have you been to Punjab? If not, would you like to go? If yes, would you like to go back, if only for a visit?

IF FEEDING INTERVIEWER: Why was the particular meal served? How was it prepared?

Do you have any stories you would like to share about your experience assimilating in the U.S. related to food?

Description of Sikh Fare

basmati rice: aromatic, slender-grain rice from the subcontinent of India

roti or *chapati**: tortilla-like flat bread

daal or *dhal**: staple food; dried lentil, pea, or various types of bean which have been split and cooked into a thick stew

chana masala or *chholey*: popular street food/snack dish commonly eaten at breakfast; spiced chickpeas with a sour citrus note

jalebi: sweet; deep-fried wheat flour batter in pretzel or circular shapes, soaked in sugary syrup

*barfi**: sweet; condensed milk and sugar, cut into squares, originating from the Indian subcontinent

*laddu**: sweet often served at religious or festive occasions; flour, minced dough, and sugar, molded into a ball shape

paratha: unleavened flat bread, originating from northern India

aloo paratha: breakfast dish; unleavened flat bread, originating from northern India, stuffed with potatoes

paneer: non-melting curd cheese

sarson da saag: vegetable dish made from mustard leaves and spices, originating from the Punjab region of the Indian subcontinent

curry: dishes prepared with a complex sauce made from spices, herbs, and fresh or dried peppers/chilies

*pakora**: snack; deep-fried vegetables, fruit, or meat in a chickpea flour batter

samosa: fried or baked dish with a savory filling, such as potatoes, onions, peas, lentils, noodles, or meat

chai: Indian tea; black tea, milk, and a mixture of aromatic spices such as cardamom, cinnamon sticks, and ground cloves

*denotes fare found at all Central Valley *gurdwaras* during *langar*

Teaching California Climate and Vegetation Change Over Long Timescales: An NGSS-Aligned Unit Using CalFlora and the Neotoma Paleoecological Database

Katherine C. Glover
UCLA

Abstract

This paper introduces an inquiry-based classroom unit titled “California Climate and Vegetation Change,” a set of place-based exercises that utilize real data from California. NOAA climate data at four locations throughout the state are provided to create climatographs. Students then use Neotoma Explorer to find and evaluate past vegetation change from fossil pollen sites, and use CalFlora to research the environmental tolerances and distribution of plant taxa that seem most sensitive to climate change. Synthesis at the end of the classroom task includes writing a summary of what we can discern about California climate change over the past 10,000 years from vegetation records, and proposing and defending a new collection site for a palynological study. The unit is appropriate for high school and college coursework that cover topics such as climate, vegetation, range shifts, and the fossil record in physical geography and biogeography. Both databases employ graphical user interfaces that reinforce the spatial thinking central to geography. The unit is aligned with the Earth Sciences and Life Sciences content criteria of the Next Generation Science Standards, the latest set of scientific standards that stress active learning, use of technology, interpretation of real datasets, and connections across disciplines. While this approach to learning may put students into the uncomfortable territory of complex data sets and no simple “right answer,” there is potential for student practice and skill-building. These skills include data visualization, interpretation, synthesis, evaluation, and evidence-based proposal writing, all essential for real-life problem solving and finding solutions to environmental challenges in California.

1. Motivation

CALIFORNIA IS ON THE FRONT LINES of twenty-first century climate and ecosystem change. The effects of such change are already evident in recent warming and statewide drought,¹ longer wildfire seasons,² tree mortality

in alpine zones,³ and thermophilization (i.e., the northward migration of plants colonizing disturbed areas.⁴ Educating our state citizenry to meet the challenges that rapid climate and landscape change present to society is of utmost importance, and geospatial skills are a key component of this climate literacy.⁵ Retrospective studies are also crucial to understand the range of possible variation in moisture availability, rates of change, vegetation turnover, and past wildfire regime.

This paper briefly describes an educational unit I developed from California-based climate, vegetation, and pollen data. The urgent need for inquiry-based, local course content was apparent while I was teaching biogeography as a general education course at UCLA. Students struggled to connect with traditional teaching paradigms of ecosystem function, which often assume knowledge of landscape history and successional models in deciduous biomes (e.g., old-field succession, primary succession after ice sheet retreat). Palynology, one of the key techniques in biogeography for discerning vegetation change through time, also has its roots in the deciduous hardwood forests of Europe⁶ and the U.S. Northeast and Midwest⁷. Interactive online exercises that illustrate palynology offer excellent visualization of deposition, coring, and analyses (e.g.,⁸), but include a large proportion of arboreal taxa not native to the U.S. West. Deciduous forests, ice sheet glaciation, and the natural regrowth of forest on abandoned farmland remain abstract concepts to a large proportion of students in California's secondary and higher public-education systems. Pedagogical research has shown that student motivation tends to be higher when curricula and problems are derived from their community and region.⁹

The exercises presented here comprise a classroom task designed to supplement these teaching models. This task aims to explore the environmental and vegetation dynamics in California, starting with its winter-wet, summer-dry Mediterranean climate. Pollen data from California that span the past 10,000 years are explored, with a focus on how vegetation change can inform hydroclimatic change, rather than changes in the vegetation community as a whole. Students also gain familiarity with accessible public databases on California vegetation at CalFlora,¹⁰ and fossil pollen data archived at the Neotoma Paleocological Database.¹¹

2. Classroom Task Components and Skills Addressed

In this unit, students examine and graph climate data from four disparate regions of the state, explore and evaluate the available pollen records near these areas, then develop a working plant list of most-sensitive taxa that

yield information on past climate change. The following task components then ask students to summarize climate change over the past 10,000 years in California, and design and defend a new fossil pollen study. Worksheets and formatted tables for documenting notes and observations are available in the unit, allowing flexible adaptation for education level, and time available. Designed for three to five hours of class time, the unit is available at <http://serc.carleton.edu/dev/neotoma/activities/174249.html>, and formatted and aligned with Next Generation Science Standards (NGSS) at the high school level.¹² Table 1 shows a shorter summary of all task components, skills reinforced, and high school standards satisfied with this alignment.

Table 1. Summary of classroom task on California Climate and Vegetation Change, including skills and Next Generation Science Standards (NGSS) satisfied by each component. See classroom task for further detail on each NGSS.

Task Component	Skills	NGSS alignment
A. Compare monthly climate data from 2010 at four locations to 20-year averages	• comparison and evaluation of real data	
B. Plot climatographs for each location	• graphing and plotting, including setting appropriate scale	
C. Find and evaluate fossil pollen data that shows vegetation change over the past 10,000 years	• data evaluation and comparison • scientific observation • spatial thinking	HS-LS2-6 HS-LS4-C HS-LS4-3
D. Develop a list of most-sensitive plant taxa in California pollen studies	• evaluate plant characteristics and spatial distribution/range • consider taxonomic rank of plants	
E. Summarize the past 10,000 years of climate change in California	• consider and evaluate shortcomings of real datasets • synthesis in writing and/or oral presentation • effective communication of results	HS-ESS2.E HS-LS4-C
F. Propose a new pollen research project that addresses gaps in the fossil record	• persuasive writing and/or oral presentation • integrating supporting evidence	HS-LS2-6 HS-ESS2-7

3. Standards Alignment

NGSS are the latest K–12 content standards for science, with a focus on understanding the interconnectedness of Earth systems and actively practicing science and engineering methods.¹² Earth Science content standards underwent the most substantive changes when NGSS was developed, particularly in applying science and engineering methods to real problems and building connections to other disciplines via cross-cutting concepts.¹³ While I initially designed this lesson (i.e., classroom task) with my student population in mind, using these K–12 standards as the primary framework has broader appeal for the following reasons:

- NGSS emphasizes several of the components and skills in this task. These include integration of technology¹⁴ to access and analyze real datasets, examining the interconnectedness between modern plants and their fossil record, and effectively communicating these often-complex topics.
- NGSS alignment allows one to create a classroom task that is flexible across several courses (e.g., life sciences, earth sciences, environmental science, and geography) and grade levels.
- The NGSS emphasis upon cross-cutting connections allows space for geographical thought¹⁵ an inherently interdisciplinary subject.
- NGSS is the first set of science standards to explicitly include climate change.¹⁴

This task addresses four of the NGSS crosscutting concepts: **patterns, cause and effect, scale, and stability and change**. **Patterns** in nature lead to classification, a concept this exercise addresses through the use of plant taxonomy. Elucidating process from pattern, or vice versa, is also a key component in biogeography.¹⁶ One of the overarching objectives of this unit is asking students to examine **cause and effect**, e.g., how does climate change drive vegetation in California’s environment? Differences of **scale** are introduced as students move from monthly average climate data to examining records on longer timescales, with time steps on the order of decades, centuries, or millennia. Finally, students confront differences in landscape **stability and change** as they encounter pollen records that may show relative staticity in one area or vegetation group, compared to others that demonstrate significant change.

NGSS at the high-school level does not include explicit standards for the English Language and Mathematics skill-building incorporated into the unit (Table 1); these are satisfied through California’s Common Core State Standards.¹⁷ This task does include integrating information with different formats,

writing arguments with valid reasoning and citing supporting evidence to communicate complex ideas, writing a sensible and well-supported narrative on California’s past climate change, and representing and interpreting data.

One challenge to implementing this unit, and NGSS-aligned curricula in general, is shifting the focus and expectations of students toward more integrative concepts, practice, and the messiness often inherent with real datasets. Earth Science secondary-school curriculum has long focused on objective testing and categorization,¹⁵ with binary “right” and “wrong” answers. Suggestions at the beginning of the task address this somewhat, but instructors may need support and training to effectively guide and assess students in what will likely be a new mode of science education.^{18, 19}

4. Differentiation and Scaffolding

Worksheets and graphic organizers for tasks B–D are included as options for lesson structure and scaffolding. Higher-level synthetic tasks E–G can be assigned to groups or as oral presentations, or omitted altogether, depending on level and instructional time available. Advanced students can determine the format of their final assignment as appropriate, with the option of completing all work electronically, including use of graphing software.

More-advanced students in upper-division or masters-level university courses can work on the assignment independently, particularly if the goal is to acquire background knowledge for future research that involves familiarity with California’s plants, available pollen records, use of the CalFlora and Neotoma platforms, and/or original palynological research. Neotoma’s more-advanced features were not employed for this lesson, but offer opportunities for powerful integration and synthesis of large datasets with R packages that can quickly extract pollen data for analysis.²⁰

5. Summary

This paper describes components and rationale for a newly developed classroom task that employs California climate, vegetation, and paleoecologic data. The content spans geography, biogeography, earth science, ecology, and environmental science coursework. Available at <http://serc.carleton.edu/dev/neotoma/activities/174249.html>, the unit’s flexible format includes worksheets and templates that can be provided to match course goals and student level. It satisfies several standards in the NGSS-HS framework that focus on interdisciplinary connections of scale, pattern, cause and effect, and stability and change. The unit also focuses on evaluating, drawing connections between, and synthesizing real (and often incomplete) vegetation and

fossil pollen datasets. This satisfies core goals of NGSS, providing essential practice in problem-solving and inquiry necessary for an educated citizenry. Such skills are crucial to develop in the next generation as we consider solutions to climate change effects, including stress upon California's ecosystems, water and food supply, and infrastructure.

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Geographic Chronicles

2016 CGS Annual Conference Award Winners

JOE BEATON POSTER AWARDS

Undergraduate Posters

FIRST PLACE:

Maelynn Dixon and Kristy Morehead, CSU Fullerton
One Step Closer to Zero Waste: Evaluating and Enhancing Sustainability at California State University, Fullerton

SECOND PLACE:

Jared Lardie, Grossmont College
Rooftop Rainwater Collection: A financial exploration utilizing LIDAR for Commercial Sites in San Diego

THIRD PLACE:

Emily Webb, CSU Sacramento
Reconstructing Climate History in the Northern Sierra Nevada

Graduate Posters

FIRST PLACE:

Heather Ream, CSU Stanislaus
Preservation of Acculturation? Ethnic Floodways of Central Valley Sikhs

SECOND PLACE:

Amanda Lindgren, CSU Northridge
Determining Sustainable Quinoa Locations in Wyoming using Multi-Criteria Analysis

THIRD PLACE:

Elizabeth Higgins, CSU Fullerton
The Rise of the Non-Religious Population and the Movement Towards Secularism

DIGITAL MAP AWARDS

FIRST PLACE:

Steve Ganger, CSU Chico
Crime and Safety

SECOND PLACE:

Claire Sarraille, CSU Stanislaus
Drawing Conclusions about the Impact of Contaminated Drinking Water on California Public Schools: A Problem of Data Quality and Scale

PAPER MAP AWARDS

FIRST PLACE:

Joben Penuliar, Humboldt State University
Manila Bay

SECOND PLACE:

Elyse Warren, Humboldt State University
Hawaii

THIRD PLACE:

Greg Beringer, CSU Fullerton
Wartime Operations of the U.S.S. Sevier 1943 to 1945

TOM MCKNIGHT PAPER AWARDS

Undergraduate Papers

FIRST PLACE:

Nick Burdine, Humboldt State University
Spaces of Consumption: Homelessness and the Commodification of the Natural Beauty in the Arcata Community Forest

SECOND PLACE:

Cristina Bauss, Humboldt State University
Mapping Marijuana Cultivation Sites and Water Storage in the Redwood Creek and Watershed, Southern Humboldt County

THIRD PLACE:

Monica Moreno, Humboldt State University
Mediterranean Refugee Crisis: Italian Student Attitudes Towards Political Migrants

Graduate Papers

FIRST PLACE:

Cassie Hansen, University of Nevada, Reno
Diagnosing the Role of Atmospheric Rivers, Past and Present, in Snowfall Events on Mt. Shasta, CA using Numerical Simulations

SECOND PLACE:

Stacie Townsend, UC Davis
Narratives of California's Heartland: A Geographic Perspective on the Fictional Literature of the Central Valley

THIRD PLACE:

Sarah Harris, UC Santa Barbara
Backwards Trajectory Analysis of Southern California Atmospheric Rivers

GEOSYSTEMS AWARD

Katherine Glover, UCLA
Vegetation Changes in the San Bernardino Mountains from 60,000–15,000 yrs BP

DAVID LANTIS SCHOLARSHIPS

Undergraduate Award

No applications received

Graduate Award

Cameron Pallotta, CSU Stanislaus

FRIEND OF GEOGRAPHY AWARD

Kris Jones, multiple colleges in Southern California

DISTINGUISHED SERVICE AWARD

Kate Davis, CSU San Jose

OUTSTANDING EDUCATOR AWARD

Steve Graves, CSU Northridge

DISTINGUISHED TEACHING AWARD

William Henniger, Silver Creek High School, San Jose

STUDENT TRAVEL AWARD WINNERS

Cameron Pallotta, CSU Stanislaus

Hakela Davalos, CSU Stanislaus

Heather Ream, CSU Stanislaus

Kaylie Cates, CSU Stanislaus

Pablo Estrada, CSU Stanislaus

Alex Mclaughlin, CSU Northridge

Greg Beringer, CSU Fullerton

Carl Adler, Irvine Valley College

Jared Lardie, Grossmont College