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SHANNON REILLY

Cover art by Layne Takahashi
Editor's Introduction

While last year’s volume of Prized Writing presented a collection of essays written when classes were entirely remote, this year’s anthology is a bit different. Over the course of the 2021-2022 academic year, students fluctuated between in-person and remote learning depending on their classes, their instructors, and the number of COVID cases plaguing our community at the time. Although many of us would contend that operating under a constant state of are-we-learning-remotely-or-are-we-learning-in-person isn’t ideal, the outstanding quality of essays we received this year is—once again—a testament to the resilience and talent of UC Davis students.

Impressive too is the diversity of submissions we had this year, allowing us to build an anthology that features a variety of genres and topics. Prized Writing has always been an interdisciplinary collection of documents, but it feels especially true with this volume. Those selected for publication this year make up texts written for eleven different course subjects and range from research essays to environmental autobiographies to literature reviews to policy briefs, just to name a few.

Of course this excellence in quality and diversity wouldn’t be possible without Prized Writing’s student authors and faculty community. I appreciate every submission and every UC Davis community member—student, friend, advisor, instructor, or staff member—that shares information about our collection of undergraduate student writing. Our faculty judges, Amy Goodman-Bide, Cassie Hemstrom, Erika I-Tremblay, Sophia Jin, Greg Miller, and Agnes Stark, volunteered to read and offer their expertise on a considerable number of essays during the judging process, to which I am very grateful.

As always, Prized Writing remains indebted to the support of a variety of faculty and staff, especially from the University Writing Program (UWP). Within the UWP, John Marx (Interim Director), Dana Farris (Associate Director), Elliott Pollard, Anita Rodriguez, Darla Tafoya, Jasvir Mann, Kevin Bryant, Melissa Lovejoy, and Vicki Higby Sweeney have continued to offer invaluable assistance.
and advice. We’re fortunate to have the continued institutional support of Gary May (Chancellor), Mary Croughan (Provost and Executive Vice Chancellor), Cynthia Carter Ching (Vice Provost and Dean for Undergraduate Education), and Estella Atekwana (Dean of the College of Letters and Sciences). I’d also like to express gratitude for the advice and assistance I received from Bridgit Noss Patrick with ReproGraphics and Morgan Liu with the UC Davis Bookstore.

I’ve also had the pleasure to work with two stellar Assistant Editors this year, Gabriel Bellue and Kal Agdie. Both played vital roles in the successes Prized Writing saw this year and made my job as editor significantly more manageable. Their ingenuity, creativity, and adaptability cannot be stated enough.

Finally, a big thank you to Layne Takahashi for designing such a remarkably exquisite piece for us to feature on the cover of volume 33. Beautiful in color and texture, Layne’s work perfectly compliments the excellent writing that this anthology offers.

—Jillian Azevedo,
Continuing Lecturer, University Writing Program
Editors of Prized Writing: 1989–2022


Editors of Prized Writing

Vol. 27 (2015–2016): Amy Clarke
Prized Writing 2021–2022

Vol. 31 (2019–2020): Gregory Miller


Vol. 33 (2021-2022): Jillian Azevedo
Honorable Mention

Maya Schulz, “How Recent Fossil Finds are Shaping Our Image of the Eocene in Antarctica Under New Stratigraphy Interpretations of the La Messeta Formation”

Mikayla Rosario, “What A Rock Can Tell You”

Mina Bedogne, “Urban Runoff in Los Angeles: Restoring the Allure of the Golden Coast”

Benjamin Freed, “Feminism and Faculty-Student Relationships”

Hannah Dolan, “From Prop 13 to LCFF”

Kelly Crouch, “Benefits of a Prehabilitation Policy for Patients Undergoing a Total Knee Arthroplasty”

Sean Chen, “Ovarian Torsion Case Study”

Wyatt Northcut, “The Rare Story of the Common Bean”

Ashleigh Hartz, “Non-Traditional Enrichment Methods to Reduce Pacing in Captive Cats: A Review”
Beautiful Scar: Learning to Live with Tethered Cord Syndrome

Prachi Sood

Writer’s Comment: Before taking UWP 104F, my interactions with writing were minimal—mostly confined to the pages of my journal. I never considered that genres such as narrative medicine existed in which I would be able to combine my passion for health and research with storytelling. As an aspiring physician, I appreciate that case studies allow doctors to take rare disease encounters and reflect on aspects of patient care and policy that can be improved—and even changed—by writing about their experiences. In this piece, I chose to write about one of my close friends. I admire her strength in dealing with the physical and mental aspects of having a temporary disability, especially in a society that remains largely unwelcome to people with disabilities. Through my case study, I hope to shed light on different interventions the clinician’s role can implement to improve patient outcomes. I also hope to leave the audience thinking of ways to improve the experience of disabled people in society.

Instructor’s Comment: For this UWP 104F: Writing in the Health Professions lay audience case study, students gather both primary - by interviewing a patient - and secondary source (from medical reference resources and professional journals) research information. In her piece about Tethered Cord Syndrome, we can see Prachi’s thoughtful and purposeful research - she gives her patient a voice with carefully selected quotations and paraphrase, while her medical research writing gives us deeper insights into meaningful themes emerging from the patient’s experience. Thus, not only do we learn about a lifelong condition of the spine that begins in early childhood, we also learn about how children are often marginalized in medicine, in society, and in families and
cultures. This case study invites meaningful lessons and dialogue for medical providers, parents, educators, and community members - we should all examine how we treat each other, especially about health.

—Agnes Stark, University Writing Program

"I would have severe pain in the back of my legs and lower back. Compared to other kids on the playground, it was more difficult for me to climb on the play structure and move around normally”, Maya explains as she makes herself more comfortable in her chair, a far-off look in her eyes. The spinal cord is a structure that runs through the center of the spine from the brainstem to the lower back. It serves its role as a part of the central nervous system and carries messages from the brain to the body. Under normal circumstances, the spinal cord moves freely, however, in some rare cases a neurological condition in which the spinal cord is attached to the surrounding tissues of the spine develops and the spinal cord cannot keep up with the lengthening of the spine as it grows (“Tethered Cord Syndrome”). The result of this may be nerve damage and severe pain (“Tethered Cord Syndrome”). This condition is known as tethered cord syndrome (TCS).

TCS manifests itself in a variety of symptoms including back pain, numbness in the legs or feet, walking on toes, chronic constipation, and deformities such as hammertoes. (“Tethered Cord Syndrome”). At five years old, presenting with back pain and numbness in the legs, Maya was diagnosed with tethered cord syndrome. At six years old, surgeons operated on her back. At nineteen years old, although the severe pain has come to pass, Maya still gets annual spine checkups at the hospital, walks with a limp if she gets too tired, and has a scar on her back where the incision was made as a reminder of her surgery all those years ago.

“Getting a diagnosis was the most difficult part of the process,
because how can a child explain their pain in a way adults can understand it, you know? I didn't have the language to describe what I was going through, I just knew it hurt a lot”, Maya explains. Not only was it difficult being a child trying to navigate the intense pain, but it took several doctor visits and persistence from Maya’s parents for the correct diagnosis to be made. Usually, TCS is detected and diagnosed quickly in young children with two or three of the aforementioned symptoms occurring at once (“Tethered Cord Syndrome”). In Maya’s case, however, the condition was not easily diagnosed. Most doctors performed a physical exam, admitted that they were stumped, and made a reference to another provider. Others made an incorrect diagnosis of scoliosis and sent Maya on her way. This is significant because scoliosis doesn’t require surgery whereas TCS requires surgery as treatment.

Making a diagnosis is one of the most difficult but important parts of a primary care provider’s job (Singh). They must balance missing a serious illness with potentially making costly referrals (Singh). Concern about patients’ health as a result of diagnostic errors has recently risen in the medical community. In their study analyzing 18 databases, Panesar et al found that in primary care, diagnostic and prescribing errors “are the most likely to result in avoidable harm”. Singh proposes eight potential interventions to reduce the global burden of diagnostic errors. Three of the most intriguing interventions Singh mentions are: encouraging government policies that support primary care, improving access to diagnostic tests, and providing systematic feedback to clinicians about their diagnosis.

Another situation Maya commonly faced at the doctor’s office post-surgery was the doctor debriefing with Maya’s parents rather than her about the status and updates of her condition. “It made me feel like I was cast away to the side, and that I wasn’t a person, but rather my condition. I was in the same room, and yet, I wasn’t being acknowledged although the conversation was about me.” According to Strivers, a professor of sociology at UCLA, children’s lack of responsiveness to physicians’ questions is predictable. It thus
can be improved by implementing three strategies: asking children social questions early in the visit, phrasing questions as yes or no questions, and directing their gaze at children during each question (Strivers). This will help physicians secure more information about the child’s health and also socialize the children to be more proactive patients (Strivers). In this way, the effects of including children in their check-ups helps assert a child’s autonomy and establish a sense of responsibility for their health early on, encouraging them to continue to care in the future.

Once the diagnosis was made, Maya waited for several months before her surgery took place. Under the bright lights of the surgery room, the surgeons made an incision into Maya’s lower back. Metal clamps kept the target area open and accessible. Needles were inserted into her lower body to monitor nerve function even while she was asleep under anesthesia (“Tethered Spinal Cord”). The surgeon carefully lifted the bone over the tethered area of the spinal cord and cut the lesion, releasing it from the spinal cord (“Tethered Spinal Cord”). This is called a laminoplasty (“Tethered Spinal Cord”). Complications as a result of this surgery are rare. After three hours in the operating room and seventy-two hours of strict bed rest, Maya’s spinal cord was allowed to freely move and her body could continue to grow with her spinal cord. However, this was not the end of her journey with the condition.

“Many people seem to think, especially with a physically disabling condition, that once you undergo surgery, you are cured and everything will be how it was before, if not better. This is far from the truth,” Maya asserts, trying to wiggle her toes (something she is unable to do to this day) to prove her point to me. Besides the small seen remnants of her disabilities, Maya was also dealing with a hidden battle—a mental one.

According to Dr. Ring, a graduate of Dell Medical School of UT Austin, nociception is the pathophysiologic response to actual or potential tissue damage. Pathopsychology is a branch of psychology that studies the mechanisms of mental activity that deviate from the norm (Nikolaeva). As such, it follows that a pathophysiologic
response is a mental response that deviates from the norm (Nikolaeva). Pain, on the other hand, is the “unpleasant thoughts, emotions, and behaviors that can accompany nociception” (Ring). Of course, Maya was in a lot of physical pain following surgery and went to physical therapy to help bring back her normal range of movement, but there was also pain caused by society.

Ring asserts that people experience more pain when they “have more symptoms of depression…[and]...anxiety”. If Maya wore a certain type of shirt to school, her stitches were easily visible for people to see. It wasn’t the curious looks her peers gave her that bothered her, however. It was the parents of those kids and her teachers shutting down her peers’ questions about her condition that was damaging. If we want to minimize the stigma behind being sick, going to the hospital, or having a disability, “we need to talk about it”, Maya says.

Whereas Maya’s advice addresses society, Dr. Ring suggests that there is also something clinicians can do to help the mental health of patients post-surgery and injury. Clinicians can guide people to return to their normal routine as quickly as possible, focusing on meaningful activity as a way to put pain in the background (Ring). Meaningful activities can include reading a book, spending time with friends, crocheting, and taking a walk outside. Addressing the mental and social health aspects of recovery would help patients feel validated and also serve as a preventative measure if symptoms of compromised mental health occur anytime during recovery.

During her recovery, Maya also faced societal ignorance within the community she belonged to. In the South Asian community, there is a popular mentality “log kya sochenge”\(^2\) that keeps people from doing ‘scandalous’ or ‘shameful’ things. Due to this mentality, with issues of mental health, sickness, and disabilities, the community is quick to want to find an explanation or source of blame. Although Maya’s parents tried to hide the aunties’ intrusive

\(^2\) Hindi phrase which translates to “what will people think”
questions from her, she could hear whispers that what happened to her was her parent’s fault because it was genetic (tethered cord syndrome is not genetic, these were merely speculations people had). In turn, these speculations made Maya place the blame on herself for her condition.

“What I want for people to understand,” Maya says, a solemn expression on her face, “is that I don’t mind questions, in fact, I encourage them. But false assumptions were damaging to my journey to coming to terms with what I had gone through. Also, when symptoms would return, I would lose confidence in my abilities causing me to isolate myself. People expect you to be healed mentally once you are physically healed. They expect it to be a linear growth as well. I would consider these ableist views.”

The US Census 2019 revealed that there are approximately 1.4 million Asian Americans with disabilities in the United States. According to Dhanda, an activist and disability specialist, misinformed ideas of disability persist in South Asian communities due to a “lack of education and understanding of the issue itself”. Dhanda also cites the lack of terminology for disability, impairments, and conditions in South Asian languages (because they don’t exist) as another significant barrier to progress. In this way, changing the South Asian community’s perception of disabilities would simply require an open-minded audience that wants to learn the facts about disabilities, rather than continue to rely on false assumptions.

Maya adopted feelings of shame and loneliness for a long time but was glad to have the support of her family throughout her journey. Now when she looks in the mirror, picking an outfit to wear for the day, she doesn’t try to hide her scar but rather embraces it as a part of her identity and as a part of herself.
Works Cited


Ilsaw Bauer

**Cut Off**

**Writer’s Comment:** I had written a fair amount of research papers but had never before taken a stab at a personal narrative until UWP 101. The task for this piece was to write about a firsthand experience that commented on some greater social or political issue. I struggled at first to come up with a subject to fit the brief as I am a white girl and haven’t faced much adversity. I realized that my essay could be about a lighter moment in time instead of an ongoing inequity or pain. I settled on writing about cutting my hair short. Meant to be a fun, casual read, “Cut Off” is a two-for-one special. You can chuckle at the struggle of a high schooler and gain a little insight into a topic you may have never considered.

**Editor’s Comment:** At the end of the fourth paragraph in “Cut Off,” Ilsaw Bauer recalls the moment when she realized that a short haircut can be damn stylish: “Proud of my revelation, I set out to achieve it.” Next paragraph: “My hopes were promptly butchered by Lily, a hairdresser recommended by my grandma who had cut hair for decades.” This sharp turn may be my favorite moment of the essay (I’d gladly read a sequel about Lily the Butcher).

Read “Cut Off” and you’ll likely have a different favorite, for Ilsaw’s insightful and exquisitely humorous prose offers a series of highlights, from “The utilitarian ponytail was my go-to” to phrases such as “Annie Lennox’s orange buzzed badassery.” Note too Ilsaw’s ear for rhythm and sentence variety, including the well-placed one-word sentence: “Great.” “Cut Off” would be a deep pleasure even if it were merely anecdotal, but this autobiographical essay—a “Bildungsessay,” if I may—has a lot
to say about absurd and potentially harmful social norms, particularly where gender is concerned.

—Greg Miller, University Writing Program

Since childhood, my hair has been a source of fascination – for others. Petting my thick mane, stylists remarked how lucky I was to have “so much beautiful hair.” They marveled at my “natural highlights,” chunks of sunned locks, or as my mother called them, “amber waves of grain.” Their sentimentality for long hair was lost on me. I skipped all the poetry, and rarely wore my “glorious” hair down. The utilitarian ponytail was my go-to. The type of ponytail, high or low, did not matter. As long as it was tight and got my hair out of my face, I was content. However, the ponytail was not my best look. My face looked like an egg when viewed head-on. I might as well have been bald – which is why I was shocked to meet resistance when I expressed the desire for the big chop.

It was high time that I harnessed hair’s inherent power of self-expression. It communicates even if you’re stuck in frumpy school uniforms or bland office clothes. Unlike clothing, hair is a part of you. It can be cut, dyed, styled, or removed entirely – none of which I had explored. I was going into high school, so I wanted to leave my hair in the past with the ill-fitting emo band tees, faded skinny jeans, and tackily patterned Vans of middle school. The only foreseeable way to start fresh was to build from the scalp out.

I told my mom and grandma that I wanted a buzz cut. That one sentence put my grandmother one step closer to six feet under. With panic in her eyes, my mom hurled a flurry of reasons why I couldn’t. “It won’t grow out right. You don’t have the face for it. You’ll look like a hedgehog…You’ll look like a boy.” She made it sound like no woman had ever willingly forgone hair, forgetting the Grace Jones, Sinead O’Connors, and Annie Lennox-es of the world. Buzz cuts are a form of rebellion, they’re punk, they’re powerful. If buzz cuts are a boy’s club, did that mean I couldn’t
embody those traits? Mad Max: Fury Road had just come out and Charlize Theron’s kick-ass buzz was burned into my mind. Why couldn’t this suburban teen embrace her post-apocalyptic Imperator? I could hardly be “metal” sporting the cascading spiral locks of a blonde pre-raphaelite woman. I ultimately conceded and left the buzz to military recruits and delinquents all while picturing Annie Lennox’s orange buzzed badassery.

It would be a couple of years until I got the haircut itch again. I took time to reflect and realized that my hype for a buzz cut had been a case of the teen extremes. I had wanted to transform as fast and radically as possible to fill the need for change. Knowledge of Britney Spears’ psychotic shave also made me rethink the buzz. Besides, a buzz simply wouldn’t do with my moon-pie face and volleyball head. The remedy to the itch was simple: a pixie cut. It would frame my face and counteract its roundness. Short hair didn’t have to mean “boy”. The pixie embodies the class and cutting-edge quality of icons like Audrey Hepburn, Twiggy, and Linda Evangelista – markedly more feminine than a desert-dwelling gladiatrix. Proud of my revelation, I set out to achieve it.

My hopes were promptly butchered by Lily, a hairdresser recommended by my grandma who had cut hair for decades. Misguidedly, I put my hair in her hands. I communicated that I wanted a pixie and told her to go as short as she could. She was only capable of chin-length before succumbing to a fit of hair hysteria saying, “No no! No shorter, hon. You need to keep some of this beautiful hair! You don’t want to look like a man!” Here I was thinking I was heading in a more feminine direction, yet I somehow arrived at the threshold of manhood. I shrugged and told her I didn’t mind, quietly urging her to finish the deed. She never did. Instead, she insisted that the short (but not short enough) cut she had achieved looked amazing. Being too cowardly to argue, I agreed.

Upon arrival to class the next morning, my unfortunate pageboy cut was met by my friends’ wide eyes. They likened me to Hillary Clinton immediately. Great. I had gone from a
promising young man to an old political lady. A friend told me, “That looks like my grandma’s haircut. Super cute though!”. Cute for a sixty-five-year-old maybe. It had never really dawned on me that the elderly and middle-aged make up the preponderance of short-haired women. I can only chalk this phenomenon up to the inherent youthfulness of the cut. Short hair signifies that these older women are hip and fresh like the young’uns. Women with these cuts wouldn’t be caught looking like craggy Appalachian witches with a gray braid trailing down their backs. I had a time paradox on my head. I was perceived as having “middle-aged hair” by my peers while the older folks thought I had a youthful cut. Despite the haircut’s shortcomings, I felt somewhat liberated. This was the shortest I had ever been up until that point, and it served as confirmation that short hair was the move. It did suit me, just not in its current form.

My Clinton impression was short-lived. After a quick and final chop from a non-Lily stylist, I finally had my pixie. It shouldn’t have worked as well as it did since my 5’10” body doesn’t correlate with the tiny woodland fairy moniker. Although it miscommunicated my stature, it did proclaim my spunky and slightly tomboyish personality. I was the most confident I had ever been. I thought I was expressing my most accurate self. That would’ve been true – if I was a lesbian.

Questions of my sexuality trickled in slowly in the weeks following the pixie. Questions from extended family changed markedly from, “So, do you have a boyfriend yet?” to “Have you been eyeing any guys...or girls?” My friends weren’t as subtle. “Hey, are you a lesbian?”, my friend of four years asked. I was baffled. These were people that I had gossiped about boys with and confided in about my male crushes, people that knew that, generally, I was too busy or apathetic to think about dating. This false perception could have sprung from a couple of notions: a) short hair equals butch lesbian or b) no guy would be attracted to short hair so I must be trying to appeal to women. Nothing else about my demeanor would’ve been an indicator of homosexuality.
The cut apparently said it all.

The pixie left my head lighter and my mind clearer. It hadn’t occurred to me that short hair had such vast connotations to the general public. My short hair could be seen as a signifier of old age, manliness, lesbianism, and even mental illness – all things I do not identify with. The only associations I had were cool women, no other qualifier. Cutting my hair, as relieving as it was, implicitly saddled me with stereotypes. I was shouting without verbally saying anything. I could now understand why so many girls cling to their hair. They are maintaining their perceived femininity, sanity, and “attractiveness” – none of which should be innately tied to hair. Hair is the mark of an individual and should be treated as such. People should feel free to experiment without being branded with a label that may or may not fit. Prying comments and generalized assumptions should be cut off. Acceptance should grow instead.
Environmental Autobiography

SARAH KABIR

Writer’s Comment: LDA 30 has been my favorite course taken in my first year here at UCD. The teaching style of Professor Elizabeth Boults struck a chord with me. She always gave us a writing option for our bi-monthly artistic projects— an option I quickly took advantage of when asked to portray a memorable landscape. As an adolescent, storytelling was a big passion of mine, but over the years it wasn’t nurtured enough to stay alive; partially due to myself, partially the education system. With this project, I actually felt excited to write. For the first time in years. The landscape I characterized was my father’s garden, how it evolved over the years and how I evolved with it. This assignment lit a fire in me; compelled me to deal with and commit to paper the complex emotions of the past. What has now fueled my passion again was the unforgettable, heartwarming response I received from my peers. I am honored (albeit slightly anxious) to now be able to share this piece with the readers of Prized Writing.

Instructor’s Comment: LDA 30: History of Environmental Design traces the roots of peoples’ relationships to their built and natural surroundings, and explores how peoples across the globe have shaped the landscape in response to their changing needs and desires over time. I begin the course with an “Environmental Autobiography” assignment which asks students to reflect on how an environment has shaped them—how their own experiences and memories of meaningful spaces have influenced their present values and attitudes toward the built landscape—recognizing that there is never a single frame of reference for history. To accommodate different learning styles, students have the option of presenting their “origin story” to the class in the form of an essay or an “artifact” that they fabricate. Sarah has a wonderful talent for crafting with words. Her essay beautifully captures the significance and role of her family’s garden in shaping her appreciation of nature’s abundance and its role in sustaining cultural community and family
ties. Her narrative evokes a sense of care and cultivation, for to garden is to believe in the future. Winter quarter 2022 began on Zoom, and when Sarah shared her story the chat feature exploded with praise and clapping hand emojis. We all have faith that this orchard will bear fruit once again.

—Elizabeth Boultz, Department of Human Ecology

Ever since I could remember, my dad spent hours upon hours in our backyard, building up the garden of his dreams. When I was a toddler we lived in an apartment where he sneakily grew plants of all kinds on our balcony, even though he wasn’t allowed to. When we moved to a small house, he was free to plant to his heart's content, albeit the space wasn’t all that large and our time there was temporary. We had to move in 2008, but every time we pass by our old house we can see the fruits of my father’s labor- quite literally. That year, my parents bought a house on a small hill in Antioch, California; a house with a beautiful view of the surrounding neighborhoods, the nearby rolling hills, and Mount Diablo itself. More importantly, it came with a backyard large enough to fit almost everything he has ever wanted. Almost.

And so began my dad’s back breaking work. He would come home exhausted from his 9 to 5 job, take a nap on the couch, and then get right to work on the garden while he still had a few hours of summer daylight left. Weekends were completely dedicated to the backyard, he’d wake up before everyone else and continue well past the sun setting into the horizon. I questioned him as a child standing at the sliding door, “Baba, you’re not tired? You don’t want to take a break?” He’d pause and lean against his shovel, using the sleeve of his white and blue flannel to wipe the sweat off his forehead before chuckling, “This is my break! I don’t feel tired when I garden.” I never really understood that when I was younger as the work seemed so hard. He’d always try to get me to help him, but the most I’d do was dig up worms to scare my mom with. Sometimes I’d plant seeds or pull a weed or two here and there, but that was it really.
Although it was clear to my parents I didn’t like working in the garden, I loved playing in it. As all kids do, I had an overactive imagination and a big, luscious garden was the perfect playground for me. Who needs swings and monkey bars when you have a cave of vines and stepping stones and an array of tools? Who needs tanbark and sand when you have as much mud and natural clay a child could wish for? The most memorable part of the garden for me was this wooden structure my dad built to grow bottle gourd, or lau as it’s called in Bangla. It’s a vegetable that grows on vines that need to be woven through a support structure. He made it three sided so you could walk into it like a room and pick all the hanging gourds when they were ready. The vines grew a beautiful, thick canopy of leaves that swallowed the wood, so naturally my cousin and I would spend all of our time in it. “I can’t believe we’re stuck on this island!” We’d exclaim dramatically, “When are we ever going to be rescued!” The viney box became the cave in which we had set up base camp. We would prepare mud stew, start fake fires to keep us warm, and lay down to gaze up at the lau stars. Being in the garden made me happy.

And it made others happy too. It provided not only my family, but also family friends and neighbors with all sorts of fruits and vegetables. Different kinds of squash, tomatoes, apricots, plums, persimmon, guava, the list is honestly extensive. Exhaustingly extensive! I have distinct memories of giving my 5th grade teacher a basket of vegetables as a gift on multiple occasions, which he would always rave about. My paternal grandparents would love to sit outside and just bask in the sun while picking and eating whichever fruits they wanted, and I loved to be out there with them. It made me feel more grounded, it let me spend more time with my loved ones. My favorite part of spring and summer would be the days we spent as a family in the backyard. My dad would pick weeds or tend to wilting plants, my mom would pick spinach and fruit with my grandfather’s help, my dadu, while my grandma, my dadi, watched them. I would rotate between stuffing my face with plums, laying on the ground, or chasing my cat, Phantom,
around- and then of course him chasing me back. My extended family would plan barbeque nights where all my aunts, uncles, and cousins would come to my house in the morning, spend all day picking how much of whatever their hearts desired, and then end the day with bellies full of the product of my dad’s hard work and tandoori chicken. What I would give to go back in time and experience that again.

After my dadu passed away in 2012, the garden never felt the same, at least not for a very long time. My dad still maintained it and it still looked as beautiful as ever, but it didn’t make me as happy. It didn’t bring me the same joy or excitement. It only brought bittersweet memories of my dadu picking nearly ripe jujubees off the tree, wiping them on his shirt, and cutting off little pieces for me. “I know you like the ones that are more green,” he would say, giving me a smile-inducing toothless grin. The weather wasn’t the same either; the falls and springs became washed with clouds and rain, the summertime too unbearably hot to withstand more than 15 minutes outside. I stopped appreciating the garden as much, I stopped appreciating my dad’s hard work. Instead I groaned and griped about how much time and money he spent out there. Maybe I wanted him to spend more time with us, or maybe I didn’t want him to feel the pain of remembering his father like I did.

It was towards the end of high school that I regained my love for my dad’s passion. I got a new cat named Speedy, a few years after Phantom passed away, and she spends all her time in the garden. She loves to roll around in the dirt, hide in the spinach bed, and sleep in the damp-soiled corners during the sunnier days. Spending more time out there with her made that nostalgic feeling bubble up in my chest. I remember one day just stopping, standing up straight, closing my eyes and taking everything in. The beaming rays of sun draping over my back, the gentle breeze that caressed my cheeks, and the lingering smell of the blooming jasmine dancing into my nose. I realized how much I missed it all. From then on, I spent all my free time in the spring in the garden, either relaxing,
helping my father (surprises me too, I know!), or doing school work. It was my safe haven at the beginning of the pandemic, and I attended many Zoom lectures from my garden. Having moved out now, my old bedroom isn’t what I miss most about my parent’s house, that garden is. It looks extremely different now, my dad doesn’t have any more time or energy to tend to his “babies”, as he so lovingly likes to call them. He’s too busy trying to make extra money to put me through college. The overgrown, wild, mess of a garden in its current state is another reminder of my dad’s hard work- just as much as the pristine version of it was. “It’s okay,” he reassures me whenever I bring it up, “when you become a landscape architect, you can help me make it beautiful again.” Though I won’t be becoming a landscape architect as he once thought I would, I still plan on one day reinvigorating our backyard- together.
How Dolce & Gabbana Returned to the World of Fashion: A Global Perspective

Joelle Chan

Writer’s Comment: When tasked with writing a paper on either a public relations campaign or a crisis, I was immediately drawn to an incident involving Dolce and Gabanna in 2018. The incident in question involved a series of racially offensive videos released to promote their next fashion show. As someone who was born in Hawaii, grew up in Hong Kong, attended a British international school, and now lives in California, I often find myself struggling to connect with my Asian identity and heritage. Consequently, the crisis surrounding D&G piqued my interest, as I wanted to explore the reactions of people who identify in a similar way to myself. In turn, writing this paper allowed me to gain a better understanding of and deeper connection to my Asian identity and heritage. The subsequent paper analyzes this public relations crisis through the lens of communication theories along with a cross-cultural analysis to help the reader understand the practical implications of the crisis.

Instructor’s Comment: Joelle’s assignment from CMN 131 is a public relations case study examining a contemporary issue with the theories and concepts learned in class. For an introductory public relations course, this assignment can be challenging because students have to identify a worthwhile case and illustrate what we can learn from it through a theoretical analysis. Joelle’s paper is impressive because she applies multiple theoretical frameworks successfully to analyze the outcomes of this issue. Not only does she examine the crisis communication strategies of Dolce & Gabbana, but she also conducts a cross-cultural comparison. The global perspective that Joelle brings to
Introduction

In November of 2018, Italian luxury fashion house Dolce & Gabbana (D&G) was caught in a public relations crisis due to a series of racially offensive promotional videos that were released in anticipation of D&G’s largest fashion show in Shanghai, “The Great Show.” The company faced large amounts of criticism and backlash on social media networks such as Instagram, Twitter, and Weibo from users worldwide. The public reaction to this crisis resulted in the cancellation of The Great Show, and significant damage to D&G’s global reputation. Following this, D&G implemented various crisis management strategies in China and the West, which have generated different outcomes and reactions from key publics. The different crisis management strategies used by D&G can be examined using Situational Crisis Communication Theory (SCCT; Coombs, 2007), while the differences in tactics chosen and key public reactions in China and the West can be examined using Hofstede’s cultural dimensions (Hofstede, 1995).

Literary Review

A crisis is “a sudden and unexpected event which threatens to disrupt an organization’s operations and poses both a financial and a reputational threat” (Coombs, 2007, 164). Inspired by Attribution Theory (Weiner, 1985), Coombs (2007) developed SCCT to guide organizations in their crisis management based on stakeholder perception of responsibility. According to the scholar, stakeholders include any group which affect, or are affected by, the behavior of an organization and determine the level of organizational responsibility. SCCT argues that the more
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responsible an organization is deemed to be for a crisis, the more responsibility that organization needs to accept for the crisis in their management response.

To determine an organization’s level of responsibility for a crisis, Coombs (2007) categorizes crises into three types: victim crises, accidental crises, and intentional crises. The author explains that victim crises, such as natural disasters, attribute the least crisis responsibility to an organization; it is regarded as a victim in such situations. Accidental crises - those that arise from unintentional or uncontrollable incidents such as technical errors - attribute minimal, albeit slightly greater, crisis responsibility. Conversely, an intentional crisis has the greatest attribution of crisis responsibility. Coombs (2007) claims that such crises are often due to organizational misdeed or human error. Thus, they are preventable, so the organization is to blame. The scholar notes that an intensifying factor that increases the level of responsibility is an organization’s history of crises and prior reputation. Organizations with a favorable prior reputation will suffer less and rebound quickly from a crisis because they have more reputational capital to spend than an organization with an unfavorable or neutral prior reputation. Once the organization’s level of responsibility in a crisis has been determined, organizations can use the framework provided by SCCT to select an appropriate crisis response strategy.

SCCT has identified three categories of primary crisis response strategies: deny, diminish, and rebuild (Coombs, 2007). Coombs has identified three different deny strategies: attacking the accuser, denial, and scapegoating. These strategies attempt to establish a crisis frame and aim to remove any link between the organization and the crisis, thus eliminating any reputational harm to the organization. Diminish strategies aim to convince stakeholders that a crisis is less severe than it is thought to be, and that the organization lacks control over the crisis. These strategies include making excuses to minimize organizational responsibility and justification to minimize the perceived damage caused by the crisis. Diminish strategies are used to reduce the organization’s
connection to the crisis and are typically more effective in the case of an accidental crisis than an intentional crisis.

While deny and diminish strategies aim to reframe a crisis and reduce the level of responsibility attributed to an organization, rebuild strategies aim to improve the organization’s reputation and generate new reputational assets. To rebuild, organizations may offer compensation to those affected by the crisis or issue an apology to stakeholders and accept full responsibility. These strategies are positive reputational actions and are used when a crisis presents a serious reputational threat to an organization, such as in the case of intentional crises. When selecting a crisis management strategy, organizations must review the crisis type to predict stakeholder reactions and select the most appropriate strategy that protects the stakeholders.

Differences in culture mean that publics across the world react differently to crises and the resulting corrective actions. The Hofstede model distinguishes cultures according to five dimensions: power distance, uncertainty avoidance, masculinity/femininity, long/short term orientation, and individualism/collectivism (Hofstede, 1995 as cited in de Mooji & Hofstede, 2015). The model ranks countries on a scale from 0 to 100 for each dimension, and every country has a position on each scale relative to other countries (de Mooji & Hofstede, 2015).

Firstly, power distance is the extent to which the less powerful members of society accept and expect the unequal distribution of power (Hofstede, 2011). People in large power distance countries, such as East European, Asian, or African countries, believe that people have their rightful place in a social hierarchy (Hofstede, 2011; de Mooji & Hofstede, 2015). Hofstede (2011) explains that uncertainty avoidance is the extent to which people in a culture are comfortable with unstructured situations; high uncertainty avoiding cultures like East and Central European countries may have more strict behavioral codes than low uncertainty avoiding cultures to minimize such situations. China and the United States both score relatively low on the uncertainty avoidance scale (Barnum, 2011).
Additionally, the masculinity/femininity dimension places a large emphasis on role differentiation in cultures; feminine societies have small amounts of emotional and social role differentiation, while masculine societies have large amounts (de Mooji & Hofstede, 2015).

De Mooji and Hofstede (2015) further explain that long/short term orientation is the extent to which people in a society have a future-oriented perspective, rather than a perspective that is stuck in the past and present. This dimension is influenced by Confucian philosophy, which defines the relation of people within social hierarchies and places a large emphasis on hard work, patience, and perseverance in waiting for rewards (Barnum, 2011). The scholar finds that China is the highest scoring country for long/short term orientation, while the United States scores low on the scale. These dimensions act as a guide for public relations practitioners when dealing with global crises. However, the final cultural dimension of individualism/collectivism has the largest implications for public relations practitioners dealing with global crisis management.

Collectivism is the degree to which people in a culture value individual achievement compared to group welfare and affiliation (Barnum, 2011). Individualistic societies, like the United States, are “I”-conscious and value self-actualization, while collectivistic societies, like China, are “we”-conscious and value harmony and a sense of belonging (de Mooji & Hofstede, 2015). The authors mention that a collectivist’s identity is based on the social system to which they belong, and that saving face is a collectivistic norm that motivates individuals to act accordingly to their social position. The importance of saving face means that public apologies are rarely used as a crisis management tactic in China, as the admission of guilt leads to a loss of face in the public eye (Zhu et al., 2017). Additionally, Wang and Laufer (2020) found that developing a strong Guan Xi – a type of social capital developed between two parties through reciprocal exchange (Standifird, 2006) – with the Chinese government, avoiding public apologies, and diverting
attention from the crisis were successful crisis management tactics that have previously been used in China.

**Analysis**

The case of D&G’s 2018 crisis can be explored using the theories and frameworks discussed above. The racially offensive videos that were released to promote *The Great Show* involved a female Chinese model being told how to eat Italian food with chopsticks, utensils traditionally used to eat foods from Asia. The narrator then made sexually misleading remarks to the model. The video was swiftly removed from D&G’s social networks due to public backlash, but not before the videos were reposted onto a fashion watchdog Instagram account, @diet_prada, where many flocked to attack the brand and its behaviors. The next day, a series of direct messages between namesake designer Stefano Gabbana and a follower of @diet_prada surfaced on the watchdog Instagram account where Mr. Gabbana was exposed for making racist remarks about Chinese people and their country. The videos and the leaked messages contributed to the global crisis D&G soon found itself in. Under SCCT, this crisis was due to human error and organizational misdeed, and as such would likely be categorized as an intentional crisis. Moreover, had the company had thought about the implications of their advert, the crisis could easily have been prevented.

As such, D&G had to select appropriate crisis management strategies to deal with this incident. The company initially adopted a deny strategy. Following the backlash, D&G issued a statement on their Instagram account claiming that both the brands and Mr. Gabbana’s personal Instagram account had been hacked, arguably to avoid taking responsibility for the advert and Mr. Gabbana’s offensive remarks. In the same post, D&G apologized for “any distress caused by these unauthorized posts” rather than apologizing for the videos or racist remarks, claiming they “have nothing but respect for China and the people of China”. It appears that the brand
attempted to alleviate some of the responsibility attributed to them for the crisis through scapegoating and victimizing themselves. Unsurprisingly, the public did not respond well to D&G’s deny strategy, refusing to believe that hackers were to blame for the crisis.

Soon thereafter, the brand released an apology video online. In the video, the two named designers discussed their love and respect for China and its culture, with both even apologizing in Mandarin Chinese. Despite this, netizens felt that the apology was ingenuine and continued to voice their outrage with their brand and attack the duo in the comments section. After releasing their apology video, D&G posted one final apology on Instagram, claiming that their “dream was to bring to Shanghai a tribute event dedicated to China which tells [D&G’s] history and vision” with The Great Show, claiming that the show was created with “love and passion for China and all the people around the world” who love D&G. This tactic – trying to boil the entire situation down to a mere misunderstanding – was part of D&G’s strategy aimed at diminishing the crisis and the organization’s connection to the crisis. However, it was ineffective; diminish strategies are typically unsuited to intentional crisis.

The tactics used by D&G to implement their deny and diminish strategies targeted publics in both the West and in China in similar ways. However, their rebuilding strategies differed. To rebuild their image in the West, D&G tried to stay under the radar online for nearly a year, after which they launched various philanthropic efforts to generate positive earned and shared media online. In 2020, the brand pledged a “significant”, albeit undisclosed, donation to the National Association for the Advancement of Colored People, and partnered with the Trevor Project, an LGBTQ+ suicide and crisis intervention organization. Additionally, the brand partnered with Humanitas University to fund COVID-19 research and launched their “Amore for Scientific Research” campaign with Sofia Vegara, where the brand donated a portion of proceeds from sales of its “Devotion” bag (McCall, 2021). D&G also tried to rebuild their image by shifting the spotlight off
the two named designers, and redirected attention to the artisans who help them bring their creations to life. In 2020, D&G’s runway presentations highlighted the skillset of the behind-the-scenes team and drew media attention to other important individuals within the company. These rebuilding tactics targeted consumers and the public, as the brand had to improve their image and social media presence. These strategies have proven to be effective, given that the brand slowly made a comeback in traditional media and social media; influencers and celebrities were seen wearing D&G garments on the red carpet and in daily life. Despite increases in “cancel culture” in recent years and the increased power netizens have over the reputations of large organizations, D&G’s presence in the fashion world has steadily increased in the years since the crisis.

The public reaction to the crisis in China was extreme compared to the West. The phrase “Boycott Dolce” had been used over 180,000 times on Weibo within a day of the ads being posted, and the social media platform was flooded with videos of users destroying D&G products. Chinese celebrities terminated their contracts with D&G and issued public statements disavowing the brand, which had a large impact on the public perception of D&G in China. Additionally, retailers in China were quick to remove D&G products from popular e-commerce sites such as Net-A-Porter, Alibaba, and JD.com (Nanda & O’Connor, 2021).

This adverse reaction led the company to employ more intense rebuilding strategies in China than the West. Due to China’s collectivistic society and the importance attributed to saving face, D&G could not continue to use apology as a suitable crisis management strategy. The strong government presence in China makes it a key public for D&G, especially since the government controls the media in the country. In attempts to remedy the situation, D&G tried to rebuild their Guan Xi with the Chinese government, a strategy that has proven to work previously in China. The company’s new Asia Pacific CEO, Carlo Gariglio, pioneered these efforts by ensuring D&G were present at the China Import
and Export Expo, a highly important event in Beijing attended by Xi Jinping, China's president, in 2019 and 2020. This strategy has proven to be successful in the context of this case; D&G began reappearing in Chinese fashion media such as Elle China and Vogue China and celebrities in Hong Kong were seen wearing D&G garments. This was a huge step forward for the brand; many news outlets had previously refused to accept paid partnerships with D&G due to the crisis. Crucially, this resulted in the brand gaining shared and earned media from surprised Weibo users reposting and discussing the ads.

It can be seen from the above that D&G has recovered its reputation with many publics. However, despite D&G’s efforts to manage their 2018 crisis, many critics feel that there is still a disconnect between the actions of the brand and its historic public presence (McCall, 2021). Aside from the initial apologies that were issued by the brand, there has been no further official statement regarding the entire crisis. The actions of D&G seem performative to many users on Weibo, and their actions have centered around shifting public perception of the brand in both the West and in China. While the brand targeted consumers as a key public in the West, their efforts in China were much more government focused. This key difference in D&G’s tactics can be attributed to the collectivist mindset and high power distance of China, in comparison to the individualist mindset and low power distance of many countries in the West. While the company has adopted all three strategies outlined in SCCT, no strategy seems to have been particularly effective in all jurisdictions. As such, this case highlights the importance of taking geopolitical factors and cultural dimensions into account when responding to a global crisis. The success of crisis management strategies will therefore depend on the ability of organizations to accurately identify these factors – and respond accordingly.
Works Cited


How Dolce & Gabbana Returned to the World of Fashion: A Global Perspective

Friends of Clearwater v. Probert Analysis

Katherine Cook

Writer’s Comment: Filed in 2021, Juliana v. United States piqued my interest in the use of civil suits to remedy environmental harms. I had the privilege of taking Professor Winsor’s Environmental Law class not six months after this suit was filed and became resolute in the idea of becoming an environmental lawyer. In addition, I have always loved the incredible beauty contained in the State and National Parks in the United States and I look for opportunities to advocate on their behalf. This piece is not only an explanation and analysis of the case The Friends of Clearwater v. Probert, but also a fraction of my passion for the environment and environmental law. My hope for students who pursue an Environmental Science and Policy degree is that they take after the Lorax and speak for the trees.

Editor’s Comment: In ESP161: Environmental Law, students work on a research paper about a current environmental law controversy throughout the quarter. In the paper, we ask that they introduce and explain the importance of the controversy they have selected, describe the parties involved, identify relevant laws, and evaluate the likely outcome and implications of the controversy.

Katherine’s paper on the Nez Perce-Clearwater National Forest litigation highlights her work ethic and commitment to conservation. From the drafting stages to the final paper, her analysis of the logging industry’s impact on federal forest lands demonstrated excellent reasoning and organization. In the classroom, Katherine was a positive presence and an active participant, collaborating with other students and regularly volunteering to answer questions posed to the class. Her
Instructor and TAs are proud to see her paper be published in Prized Writing.

—Juliet Vaughn and Tracy Winsor, Department of Environmental Science and Policy

Introduction

Earlier this year, the Friends of Clearwater, an environmental nonprofit based in Idaho, filed suit against Cheryl Probert, the supervisor of the Nez Perce-Clearwater National Forests and the United States Forest Service (USFS), alleging that they violated the National Environmental Policy Act (NEPA), the National Forest Management Act (NFMA), the Endangered Species Act (ESA), and the Administrative Procedure Act (APA) (Friends of Clearwater v. Probert, 1). The Plaintiff alleges that the USFS violated these policies in approving of two logging projects, the End of the World and the Hungry Ridge, in the Nez Perce-Clearwater National Forests without completing an environmental impact assessment, dismissing certain impacts of the plan, and refusing to acknowledge the impact on threatened and endangered species. The forests in the United States are an incredibly important and rapidly vanishing resource and with the USFS seemingly unrestrained approval of forestry projects, that trend will only continue. The two logging projects combined threaten more than 26,000 acres of land.

Parties

The Friends of Clearwater is an advocacy group for “public wildlands, wildlife, and waters in north-central Idaho” (Friends of Clearwater, 2018). This region of the country includes the Nez Perce-Clearwater National Forests. The Friends of Clearwater claim that their members regularly visit the Nez Perce-Clearwater and value the land for its aesthetic, recreational, and scientific contributions to the surrounding community. The Friends of
Clearwater claim to be injured by the USFS’s decision to approve the logging projects because they were not allowed to participate in the public review process and because of the loss they will suffer in lost time, energy, and money devoted to protecting the Nez Perce-Clearwater National Forests in this legal battle (Friends of Clearwater v. Probert, 6). The Friends of Clearwater ask the court for a declaration that the environmental assessment put forth by the USFS was insufficient and that a full environmental impact statement is required. They ask that both logging sites be set aside as protected lands and an injunction to bar the continuance of the logging projects.

The defendants, the US Forest Service and Cheryl Probert, are an agency with the authority to manage public lands and the Forest Supervisor of the Nez Perce-Clearwater National Forests, respectively (Friends of Clearwater v. Probert, 7). Ms. Probert is being sued because she approved of the two logging projects in the forest. The USFS and Ms. Prober would like the logging project to continue, as it was originally proposed, and without doing the paperwork that the Friends of Clearwater are asking for.

Issue

The policies at issue, as mentioned above are National Environmental Policy Act (NEPA), the National Forest Management Act (NFMA), the Endangered Species Act (ESA), and the Administrative Procedure Act (APA). The Friends of Clearwater claims that the USFS did not take the requisite “hard look” at the environmental impact of the logging projects as required by NEPA (Friends of Clearwater v. Probert, 7). The approval of the logging projects by a federal government agency triggers NEPA review which requires an environmental impact statement (EIS). The USFS only completed an environmental assessment (EA), which is only a sufficient replacement for an EIS if “no significant impact” on the environment is found in the EA (42 USC Sec. 4332). The Friends of Clearwater allege that the logging projects would obviously disrupt the surrounding environment and it is important for an EIS to be filled out.
In addition, the USFS continually refuses to acknowledge the projects’ impact on the resident endangered and threatened species (*Friends of Clearwater v. Probert*, 4), also in direct violation of NEPA.

The second issue is the alleged violation of the National Forest Management Act (NFMA) in regard to USFS’s violation of their forest plan. The NFMA requires the USFS to prepare a land and resource management plan for each “unit of the National Forest System” (i.e. each national forest) (16 USC Sec. 6). The USFS did create a forest plan for the Nez Perce National Forest detailing a management plan for logging, the protection of old growth forests, “water quality, fish, and wildlife” in the Nez Perce National Forest (*Friends of Clearwater v. Probert*, 9). The plaintiff alleges that the USFS violated its own forest plan in approving the logging projects because they would “increase water yields or sediment beyond acceptable limits” and they did not observe an “upward trend in carrying capacity” before any logging projects were allowed in the area (*Friends of Clearwater v. Probert*, 12). The USFS also failed to meet the forest plan’s management plan for fish habitat objectives (*Friends of Clearwater v. Probert*, 4).

The Friends of Clearwater also contest the USFS violated the Endangered Species Act (ESA), the statute that prohibits the illegal take of endangered animals and plants (16 USC 1531-1544). The plaintiffs claim that the projects would threaten grizzly bears, Snake River steelhead, and other at-risk species of fish (*Friends of Clearwater v. Probert*, 4). The ESA prohibits the take of any endangered or threatened species within the US or in the proprietary seas of the US (16 USC Sec. 9). A “take” in regard to the statute includes any harm or harassment of an endangered or threatened species or any disruption of their habitat that would harm or harass them (16 USC 1531-1544 Sec. 3). The Friends of Clearwater claims that the USFS refuses to acknowledge that the logging projects pose a threat to grizzly bears in the area. The fish in the waters near the proposed projects, notably the listed Snake River steelhead, will also be affected by the logging. Once again, the USFS “improperly dismissed” the impacts of the logging on
the fish habitats (Friends of Clearwater v. Probert, 4). The plaintiff alleges that each of these actions constitutes a prohibited “take” under the ESA.

Finally, the plaintiffs cite the Administrative Procedure Act (APA) because it allows private entities to bring action against governmental agencies if they feel their decisions are “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with the law” (5 USC Sec. 10). This document is the federal government consenting to be sued by a private entity, such as the Friends of Clearwater. The plaintiffs feel as though the approval of the two logging projects constitute an abuse of discretion by the USFS (Friends of Clearwater v. Probert, 15).

Relevant Laws

NEPA

The complaint focuses on three main environmental laws that the Friends of Clearwater believe have been violated. The first of these laws is NEPA, the statute that requires an environmental assessment (EA) or an environmental impact report (EIR) for any actions undertaken, funded, or approved by the federal government. In completing an EIR, the agency taking action must detail the environmental impact of the project, adverse environmental effects that the project has on its surroundings that cannot be avoided, alternatives and mitigation methods, short-term human use and long-term environmental productivity, and “any irreversible and irretrievable commitment of resources” (42 USC Sec. 4332). The responsible agency also has the duty of consulting any subject-matter experts that may have information on the impacts of their proposed project. The agency must make their report available for comment to all experts, relevant agencies, and the public. This law is relevant because the Friends of Clearwater allege that the USFS only completed an EA, because they needed to complete the more detailed EIR.
NEPA also created the Council on Environmental Quality (CEQ), which is charged with, among other things, reviewing and appraising “the various programs and activities of the Federal Government” to determine whether these agencies adhere to the statute (42 USC Sec. 4343). This means that the USFS, which is part of the Department of Agriculture (USDA), in addition to the CEQ will be involved in rewriting the EIR if necessitated by the court’s decision.

Much like the allegations against the USFS concerning their environmental assessment in this case, the US Court of Appeals for the Ninth District found that the environmental impact report in the case of South Fork Band Council of Western Shoshone of Nevada et al. v. United States Department of the Interior was not nearly detailed enough. The DOI missed key features of the document, such as the analysis of mitigation measures, intended to protect the environment. The project in that instance was not performed in a National Forest so one would think that the regulations surrounding federally owned lands would be much more strict than privately owned lands. As the Friends of Clearwater argue, a logging project of this size being performed on federally owned land should require more scrutiny than it is getting.

**NFMA**

The next relevant environmental law is the NFMA, the act that necessitates the publishing of a forest plan. The forest or land management plan includes the coordination of recreation, industrial, and sustainable wildlife interests. The NFMA also requires that the USFS come up with the suitable level of harvesting of forest products, like timber, fish, or wildlife (16 USC Sec. 472 Subsec. 6). Notably, in section 6, the Act requires that the responsible agency establish thresholds for the amount of sediment allowed in the water ways in each national forest as well as an approximation of the maximum wildlife population (carrying capacity) the forest can sustain. This is the part of the act that the
Friends of Clearwater claim that USFS has violated. The plaintiff claims that the logging project is in direct violation of the act because it assures that logging will only take place in a National Forest where the “protection is provided for [...] bodies of water from detrimental changes in deposits of sediment” (16 USC Sec. 472 Subsec. 6). The removal of trees from land uproots the soil and removes the roots that once bound together the soil. The dirt is then free to roll downhill and into a body of water, depositing sediment that is potentially detrimental to water chemistry or the wildlife that inhabits the waterway. The plaintiff alleges that the deposit of sediment in this case would be detrimental to the health of the stream.

The NFMA applies to the Department of Agriculture and even specifically mentions the duties of the Secretary of the USDA in certain sections. The US Forest Service, as the name suggests, is the chief agency in charge of completing and enforcing forest plans. The USFS seems to run into a lot of court cases alleging that they have violated NFMA. For example, a 2016 complaint filed by the Idaho Conservation League claims that the USFS violated the NFMA in approving a mine exploration project in Boise National Forest.

**ESA**

The final environmental law that is relevant to this case is the ESA. Section 7 of the ESA requires that a biological assessment be completed to ensure that a federal action is “not likely to jeopardize the continued existence of any endangered or threatened species” or the destruction of their habitat in a way that would negatively affect the species (16 USC 1531-1544 Sec. 7). The Nez Perce-Clearwater forests are home to several endangered and threatened species including the grizzly bear and the Snake River steelhead. The plaintiff claims that both these species will be harmed or harassed, either directly or via habitat destruction, by the logging projects. They also allege that USFS failed to comply with the
biological assessment aspect of the ESA in refusing to acknowledge the harm that the project poses to the grizzly bear and impact the Snake River steelhead’s habitat. The USFS also, allegedly, failed to complete the consultation process as delineated in Section 7 of the ESA. The formal consultation involves the Fish and Wildlife Service (FWS) and/or NOAA Fisheries depending on what species are implicated in the project (16 USC 1531-1544 Sec. 7). The action agency is to bring their biological assessment to the consultation so that a Biological Opinion may be formed by the consulted agency. The Biological Opinion includes measures that the action agency should take to protect any endangered or threatened species in the area. The plaintiffs allege that the USFS failed to even draw up the proper biological assessment to initiate the consultation process.

As mentioned above, the relevant agencies in this matter would be the USFS, the FWS, and/or NOAA Fisheries. The FWS, according to the ESA, is the agency that is in charge of gathering information on terrestrial and freshwater endangered and threatened species while NOAA Fisheries is in charge of marine species (16 USC 1531-1544 Sec. 8a). These two agencies prepare biological opinions on how federal actions will impact endangered and threatened species.

In 2015, the USFS was deemed in violation of Section 7 of the ESA when it failed to consult with the FWS concerning the critical habitat of the Canada Lynx on National Forest land (*Cottonwood Environmental Law Center v. U.S. Forest Service*). Another relevant case is *Defenders of Wildlife v. Bernal* which may help the plaintiff demonstrate what constitutes an illegal take. In that case, the Defenders of Wildlife contested the construction of a school on the grounds that it would harm or harass the resident pygmy owls. However, the US Court of Appeals for the Ninth Circuit found that because the building of the school would not occur on the critical habitat for the owls and that the birds could tolerate, and even benefit from, a high level of human activity, the construction would not constitute a take under ESA.
Evaluation

I believe that most of this case relies on the discovery portion of the trial process. The Friends of Clearwater must be able to prove that the USFS failed to comply with all of the relevant laws mentioned above. The Friends of Clearwater must come up with the documents- or the lack thereof- that prove that the USFS failed to complete an EIR when it should have. The plaintiff must also demonstrate why the agency needed to complete an EIR in the place of an EA. I think that given the massive impact the two logging projects seem to have on the surrounding environment, including sediment deposits in nearby bodies of water, habitat destruction, and the harassment of native species, the plaintiff has a good case for the requirement of an environmental impact report. In addition, given that trees are not immediately renewable, the USFS must include, in their EIR, whether the timber would be an “irretrievable commitment of resources” within a reasonable amount of time (42 USC Sec. 4332).

Based on my reading of the National Forest Management Act, it seems that a forest land management plan is for agency use so as to quantify each national forest based on its unused resources, and the wildlife that inhabits it. It is not a binding document and, therefore, a violation of the forest plan for the Nez Perce-Clearwater Forests would not entail a cause of action against the USFS.

The federal Endangered Species Act contains strict guidelines for the conservation of species listed as endangered or threatened. The Friends of Clearwater would have to produce evidence that the logging projects would result in the illegal take of the local grizzly bears and Snake River Trout. In order to do so, the plaintiffs must demonstrate that the aforementioned species occupy the land on which the projects are proposed and that the projects would harm or harass the animals under the ESA definitions in Section 3. As stated in the Defenders of Wildlife v. Bernal opinion, the plaintiff must show that there is a “factual basis to conclude” that the animals mentioned above use the planned project sites. I
would suggest they do this via trail camera footage and thermal photography to observe the grizzly bears and catch and release netting to observe the steelhead.

The plaintiff also needs to prove that the logging projects would be detrimental to the endangered and threatened species. The addition of sediment to the rivers inhabited by the steelhead must be predicted to impact some aspect of their lives significantly, the river is likely a spawning area for the fish and the addition of sediment would erode their spawning grounds. In addition, the act of removing timber from the forest must impact the grizzly bear, likely a destruction of their habitat.

It seems that the Friends of Clearwater are likely to win their case on the grounds of NEPA and ESA but not NFMA.

Conclusion

The Friends of Clearwater filed a complaint against Cheryl Probert, the Forest Supervisor of the Nez Perce-Clearwater National Forests and the USFS alleging that the agency violated NEPA, ESA, and NFMA. The plaintiff claims that it has the grounds to sue under the Administrative Procedures Act as they feel that the logging projects proposed by USFS in the Nez Perce-Clearwater Forests are “an abuse of discretion” (5 USC Sec. 10). The Friends of Clearwater believe that the USFS failed to complete an environmental impact report pursuant to NEPA. Although USFS completed an environmental assessment, it was allegedly not sufficient and lacked a thorough analysis of the environmental impact and mitigation methods.

The Friends of Clear water also claim that the USFS failed to consider the impact on endangered and threatened species that inhabit the Nez Perce-Clearwater National Forests and that the logging would constitute an illegal take.

Finally, the plaintiff alleges that the USFS violated the NFMA by failing to comply with the forest plan that they drew up for the Nez Perce-Clearwater National Forest.
The plaintiff is likely to show sufficient evidence under NEPA and ESA, but not under NFMA. This means that the defendant, USFS, would have to prepare a full environmental impact report and submit biological assessments to FWS or NOAA Fisheries to ensure that their project would not result in the illegal take of wildlife.
References


Administrative Procedures Act (1946). 5 U.S.C § 5


The Makah Whaling Chronicles: One Tribe's Modern-Day Battle for its Ancestral Cultural Identity

Mina Bedogne

Writer’s Comment: During my undergraduate career, I have become increasingly interested in the intersection of science and society. Through environmental-related classroom and internship experiences, I continue to learn the importance of engaging with diverse audiences to address natural resource management from a multidisciplinary perspective. In UWP 102G, Environmental Writing, Dr. Bender challenged me to expand my scientific communication skills and practice framing my writing for different contexts. For our feature article assignment, I wanted to integrate elements of environmental science and justice, ultimately deciding to expand on a policy memo I wrote for a marine policy course. Through my portrayal of the Makah People and their ancestral connection to the gray whale, I strived to highlight the disconnect between cultural rights and environmental law. While I extensively researched the Makah and their history, using primary resources written by the Makah themselves and trusted secondary accounts, I acknowledge I cannot fully capture the essence of a people and their culture without directly communicating with them. Moving forward, I hope to engage with the communities I advocate for in my writing.

Instructor’s Comment: In fall 2021, my environmental writing class spent a good amount of time discussing environmental justice and the history of racism within U.S. conservation movements. While these discussions energized the class as a whole, few students tackled this crucial concern as thoroughly and skillfully as Mina Bedogne does in
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this compelling lay audience article covering the Makah Indian Tribe’s struggles to maintain their cultural practices in the face of colonial incursions and environmental regulations. In these “chronicles”—as Mina aptly titles this piece—readers are taken on a journey that begins with Makah whaling practices that date back nearly 2000 years, illustrates the role that the North Paciﬁc grey whale has played in the development of Makah spiritual practices and community identity, and details the legal and political battles that have challenged Makah stewardship rights in more recent decades. Situated at the intersection of social justice and conservation efforts, the conﬂict central to Mina Bedogne’s article demonstrates how attentive we must be to the needs of all who have a stake in protecting the environment.

—Melissa Bender, University Writing Program

Welcome to Neah Bay

Cool waves crash against the rocky shoreline as a crisp maritime breeze and the call of seabirds emanate along Washington’s coast. Nestled at the northwestern tip of the state, secluded from the bustle of Port Angeles and Seattle, lays Neah Bay—the ancestral homeland of the Makah Indian Tribe. To the inquisitive traveler, trekking hours from the comforts of the nearest city, the Makah Reservation appears a remote, picture-perfect fishing village. With a membership of roughly 3,000, about half of whom reside around Neah Bay, the Makah form a tight-knit community with a rich history of shared traditions (Makah, 2019; IWC, n.d.).

For the Makah, Washington’s serene coast is more than a picturesque tourist destination. Much like their ancestors, a long line of expert mariners, a deep-rooted connection to the sea runs through the Tribe’s blood. Even today, the Makah turn to the ocean’s bounty for their subsistence, with 99% of households relying on halibut, salmon, and other local fish stocks for at least part of their diet (IWC, n.d.). In return, the Makah—translating
to those “generous with food” (IWC, n.d.)—serve as stewards of the sea, safeguarding marine resources.

Nowhere is the Tribe's maritime heritage more apparent than in the Makah Cultural and Research Center. Aptly located within view of the rugged shore, the museum's display of centuries-old fishing gear, basketry, and ocean-inspired artwork memorialize Makah fishing culture (AIANTA, n.d.). But among the carefully curated collection of over 55,000 artifacts, one exhibit in particular dominates the room: the massive, suspended skeleton of a North Pacific gray whale—a vivid portrayal of the Makah’s intimate relationship with this marine species above all others.

**Makah Ceremonial and Subsistence Whaling**

For nearly 2,000 years, the Makah owed their very persistence as a People to the gray whale. Before European contact, the large cetacean represented an abundant and reliable resource—one which the Makah regarded as sacred and thus managed sustainably (IWC, n.d.). At 90,000 pounds (NOAA, 2018), just one whale could provide enough meat, blubber, and oil to sustain the community for some time.

What began as a hunt for survival soon became deeply interwoven into Makah culture. The development of the Tribe's whaling practice drove the coevolution of their spiritual identity and formed the basis of the community’s social structure. Preparation for a hunt required rigorous physical training as well as numerous ceremonies, granting whalers their position at the top of the social hierarchy as protectors, providers, and spiritual leaders (IWC, n.d.). From the pursuit to consumption, all steps of the whaling process took on cultural significance, inspiring songs, dances, and designs that continue to define Makah tradition.
Whaling is so engrained in the Makah’s spiritual and social identity that under the 1855 Treaty of Neah Bay, the Tribe ceded much of their sacred land to the United States government while reserving the right to whale at their “usual and accustomed grounds” (Makah, 2019). With a homeland of just 50 square miles, a mere shadow of its previous extent, the Makah community relied on the gray whale more than ever for the physical, spiritual, and economic health of its members.

And for nearly 70 years, the federal government more or less honored their agreement, permitting the Makah to whale freely. However, by the early 20th century, government neglect and ever-changing federal priorities rendered the Treaty of Neah Bay meaningless, setting the stage for future conflict between cultural rights and environmental concerns.
The Beginning of the End of Cultural Whaling

The Makah’s cultural and treaty whaling right has been in limbo ever since commercial whaling decimated gray whale populations in the 1920s (NOAA, 2021). Despite its treaty responsibilities, the U.S. did little to address overexploitation by fishermen looking for profit. Because the average gray whale reaches sexual maturity at eight years old and experiences a year-long gestation period, the species is especially vulnerable to extinction (NOAA, 2018). As gray whale sightings became few and far between, the steward-minded Makah voluntarily ceased their whaling activities. Unbeknownst to them, they would never be able to whale freely again.

Hurdles to the Makah’s whaling were institutionalized in 1970, when the gray whale was officially listed as endangered under a predecessor to the Endangered Species Act (ESA). During this time, Congress also passed the 1972 Marine Mammals Protection Act (MMPA), which imposes a moratorium on the taking—harassment, hunting, capture, or killing—of all marine mammals (NOAA, 2019). Such restrictions soon transformed Neah Bay from
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the Makah’s ancestral homeland into a socio-political battleground, pitting environmental justice against environmental law.

Although progressive environmental laws of the 1970s made great strides toward ecological rehabilitation and protection, they often failed to address the needs of relevant human stakeholders. For the Makah, the MMPA represented the criminalization of their cultural whaling. With the loss of whaling came a gradual loss of social cohesion within the tribal community as members struggled to maintain their cultural identity. According to the International Whaling Commission (IWC), an international body responsible for the conservation of whale stocks in collaboration with the communities that rely on them, “Makah elders and professional anthropologists trace the decline of the social and physical health of the Tribe to the elimination of the whale hunt and its associated ceremonial and social rigors.”

During the closing decades of the 20th century, poor economic conditions afflicted the remote reservation. The seasonal nature of fisheries and tourist attractions, combined with geographic isolation, left little opportunity for economic advancement, resulting in an average unemployment rate of 51% and an equally high proportion of household incomes below the federal poverty level (NPAIHB, n.d.). These conditions were, and continue to be, exacerbated by overfishing, habitat degradation, and other environmental pressures that threaten the reliability of alternative fish stocks. Yet, despite socio-economic hardships, the Makah refused to let go of one of the last remnants of their cultural identity, awaiting the day they could once again set out on the sea and pursue their spiritual and subsistence savior.
For a brief period in the 1990s, hopes for renewed whaling became all the more real when the federal government loosened protections for the gray whale. NOAA Fisheries, the agency responsible for marine mammal protection under both the ESA and MMPA, recognizes the North Pacific gray whale as two genetically distinct populations, or stocks: the western North Pacific (WNP) and the eastern North Pacific (ENP) (NOAA, 2018). By 1994, the ENP gray whale population had greatly recovered, prompting NOAA to delist this stock from the ESA while continuing to consider the substantially smaller WNP stock endangered (NOAA, 2021).

The following year, with a renewed sense of hope and purpose, the Makah appealed to NOAA to allow them to resume hunting the ENP gray whale, as consistent with the 1855 Treaty of Neah Bay, for ceremonial and subsistence purposes. After a period of
environmental assessment and with permission from the IWC, the U.S. government made good on its 19th-century agreement (NOAA, 2021).

On May 17, 1999, cheered on by a crowd of fellow Tribe members, an elated group of Makah whalers completed their ceremonial preparation and set out into the pristine waters of the Olympic Peninsula in traditional longboats. Bearing the tools and the bravery of their ancestors, the Makah successfully landed an ENP gray whale—their first landing in over half a century (NOAA, 2021). Today, it is the skeleton of this whale that hangs in the Makah Cultural and Research Center.

Alas, the memory of that triumphant spring day is all that remains of the Makah’s so-called whaling right. History tends to repeat itself in the most insidious of ways—by 2004, challenges under the MMPA once again brought a halt to the Tribe’s cultural practice. The museum skeleton remains a looming reminder of foregone promises and the back-and-forth legal battles between the Makah and federal environmental law that persist to this day.

**Tradition on Trial**

While the ENP gray whale was delisted from the ESA in 1994, bypassing the MMPA’s moratorium on the hunting of marine mammals requires navigating a series of legal hurdles and a long process of environmental analysis. Following a rapid succession of court rulings holding that the 1999 hunt was inconsistent with the MMPA’s goals and purposes, NOAA made clear that the Makah must seek its approval to waive restrictions and issue hunting regulations. Refusing to forget the broken promises of 1855 and abandon their spiritual connection to the gray whale, the ever-persistent Makah applied for a waiver in 2005, thus beginning their journey through the complex world of environmental law (NOAA, 2021).

The Makah’s request initiated an extensive review process under the National Environmental Protection Act, commonly referred to
as NEPA, which required NOAA to analyze the potential impact of hunting the ENP gray whale based on the best available science. Under the MMPA, NOAA’s decision must prioritize natural resource protection and conservation, ensuring that the ENP gray whale stock will remain a functioning component of its ecosystem. In addition to preparing a stock assessment report, which both examines the current range, abundance, and productivity of the stock and predicts future levels, NOAA must also factor in non-ecological considerations relevant to renewed whaling. These include existing international agreements governing the taking of whales, the development of other fishery resources, and the economic and technological feasibility of implementing guiding regulations (NOAA, 2019, p. 13605).

In 2019, after years of assessment, NOAA published its much-anticipated proposed rule to authorize limiting whaling privileges for the Makah over a 10-year-period. Based on federal biological reports, NOAA determined that an average annual removal of three ENP gray whales would not have a significant impact on population dynamics or larger ecosystem processes (2019, p. 13613). In its comprehensive proposed rule, NOAA further outlines a series of measures to protect the stock and interdependent marine species and resources, such as strict monitoring, strike limits, and alternating hunting seasons (2019, p. 13608).

Although the proposed rule represents significant progress, the Makah must continue to navigate carefully through the perilous legal waters ahead. Proposing to approve the Makah’s waiver request is a long way from granting the Tribe their whaling rights. Even if NOAA approves the waiver, the Makah will still need to obtain an MMPA permit, which involves additional opportunities for public comment and requires the Tribe to provide further evidence that an ENP gray whale taking is consistent with the purposes of the MMPA (NOAA, 2019, p. 13605).
Navigating Opposition and Scientific Uncertainty

Despite the Makah’s undoubtable frustration with the legal system, this long, arduous assessment process represents more than just bureaucratic red tape. As rapidly changing ocean conditions and anthropogenic influences threaten the health of marine resources, there is a very real need to protect whale stocks and the other species and ecosystem processes that depend on them.

Opponents of waiver approval emphasize legitimate scientific concerns over the effect of Makah whaling on non-target whale populations. Environmental and animal rights activist groups such as Sea Shepherd and the Animal Welfare Institute (AWI) argue that Makah whalers may accidentally land an individual from the endangered WNP gray whale stock or the Pacific Coast Feeding Group (PCFG) (Sea Shepherd, 2019; AWI, 2021). Because it resembles the ENP gray whale and follows the same migration route, renewed whaling activity in the Pacific puts the small WNP gray whale population of just 300 at an even greater risk of extinction. The PCFG, an even smaller population of 200 summer resident gray whales, is of particular concern because marine biologists know little about its range and habitat use (Lagerquist et al., 2019, p. 926).

Sea Shepherd and AWI also point to a recent increase in gray whale strandings as sufficient reason to deny the Makah’s waiver request. In 2019, in response to reports of gray whale mortalities all along the Pacific coast, NOAA declared an Unusual Mortality Event (UME), meaning that additional study is needed to determine the cause of these strandings and whether the ENP gray whale stock warrants further protection. While NOAA issued its proposed rule when the stock numbered 27,000 individuals, the population is now down to around 20,000 (Stewart & Weller, 2021). Together, scientific uncertainty and new threats to the gray whale bring into question NOAA’s earlier biological reports and the true health of interconnected ecosystem processes, posing the greatest barriers to Makah whaling.
The Makah Whaling Saga Continues

In light of legal hurdles and scientific uncertainty, the Makah remain optimistic for a future with whaling. In response to NOAA’s 2019 proposed rule, Makah Tribal Council chairman John Ides, Sr. spoke on behalf of his fellow Tribe members, stating, “We look forward to the next step in this process and hope it will soon allow our people to have consistent access to whale meat, oil, and other products to meet our subsistence and cultural needs” (Makah, 2019a). Toward that end, 2021 has proven an especially promising year. In January, NOAA released a technical memorandum on the abundance of ENP gray whales and projects the population to rebound based on similarities between the most recent UME and a past mortality event (Stewart & Weller, 2021). Most recently, this past September, an administrative law judge advanced the waiver approval process by issuing a 156-page recommendation to allow tribal hunts (AP, 2021).

While concerns over the health of the ENP gray whale stock and interconnected populations are justified, the survival of disadvantaged human communities is arguably just as important. Since the beginning of their history, the Makah have practiced great care with marine resources. This long-sustained stewardship ethic, combined with the strict regulations NOAA outlines in its proposed rule, will guide sustainable hunting practices. Furthermore, restoring the Makah’s whaling right, as consistent with the Treaty of Neah Bay, will set a precedent for addressing social justice and indigenous involvement in environmental law. Although a final decision likely won’t happen anytime soon, perhaps one day the Cultural Center’s lone whale skeleton will be joined by another.
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References


Iran's Nuclear Program: Analysis and Policy Recommendation for the United States

Maya Hsu

Writer’s Comment: As a student in UWP 102D, I was tasked with writing a policy paper about any current international relations issue. Although I was initially overwhelmed by the number of issues to choose from, I eventually decided on Iran’s nuclear program. I wanted to learn more about the Iran nuclear deal because it was hailed as a great success during the Obama administration but subsequently collapsed when former President Trump withdrew from the agreement. If another nuclear agreement is not created in the near future, it could have major implications for U.S.-Iranian relations and international stability. Moreover, this issue appealed to me because of its gravity and complexity. By gaining a deep understanding of the controversies and nuances associated with this issue, I was able to formulate a policy recommendation that the United States Department of State could pursue. This policy recommendation is based on extensive research on Iran’s nuclear program and seeks to advance both American national security interests and global security more broadly.

Instructor’s Comment: When I first read Maya Hsu’s policy paper draft in my Writing in International Relations course (UWP 102D), I was excited at how thorough and clear it was, but I was not surprised. Each assignment leading up to that first draft revealed that Maya cares about and works to achieve effective writing. She invests time in planning her work and then revising her drafts. She also cares deeply about politics, human rights, and international relations. For her policy paper, Maya tackled a very complex problem with a long history. Writing for an audience of foreign policy professionals, Maya
presented a focused, reasonable, informed analysis of the problem and a persuasive argument about the best policy for the U.S. to implement in its relations with Iran. I majored in International Relations here at UCD, and I want my course to give students the opportunity to research, analyze, and make an argument about a current real-world problem that also presents a pressing policy problem for at least one government. Maya’s policy paper epitomizes everything I hope the course makes possible.

—Lisa Klotz, University Writing Program

Executive Summary

Iran’s nuclear program presents a dire threat to United States national security interests and global peace more broadly. If Iran developed a nuclear weapon, it could directly attack the United States or one of its allies. Iran could also use a nuclear weapon to expand its influence in the Middle East or increase support for terrorist groups, which would further destabilize the region. The use of nuclear weapons in the twenty-first century would create a dangerous precedent for future conflicts while also encouraging other countries to develop nuclear arsenals (Bahgat, 2006). Moreover, Iran’s activities could lead to a new era of nuclear warfare that includes mass casualties and the erosion of international trust. The United States Department of State must act swiftly to prevent Iran from developing and deploying a weapon of mass destruction that could fundamentally change global security.

After the United States withdrew from the Joint Comprehensive Plan of Action (JCPOA), a historic international agreement that constrained Iran’s nuclear activities in exchange for sanctions relief, Iran stopped complying with the agreement (Katzman & Kerr, 2016a). Beginning in 2019, Iran “started exceeding agreed-upon limits to its stockpile of low-enriched uranium,” “began enriching uranium to higher concentrations,” and “began developing new centrifuges to accelerate uranium enrichment” (Robinson,
These activities have raised concerns among the international community that Iran is developing a nuclear weapon (Katzman et al., 2021). Given these recent developments, Iran’s breakout time, the “amount of time it would take Iran to produce a single nuclear bomb if it were to launch an all-out race to do so” (Lynch, 2022, para. 9), has shrunk from one year to one month.

Since former President Donald Trump pulled out of the JCPOA, the United States has issued heavy sanctions against Iran to address its nuclear program and other problematic aspects of its behavior (Katzman et al., 2021). However, despite increased sanctions, Iran has increased its nuclear activities (Robinson, 2020). The United States and Iran are currently engaged in negotiations about Iran’s nuclear program, but it is unclear whether these talks will lead to a mutual recommitment to the JCPOA (Hansler et al., 2022). During these negotiations, the United States should seek to re-enter the original JCPOA as quickly as possible to prevent Iran from developing a nuclear weapon; once Iran resumes compliance with the JCPOA, the United States should then pursue follow-on negotiations to strengthen the nuclear deal and address other problematic aspects of Iran’s behavior, such as its human rights abuses and its missile program.

Context

Development of Iran’s Nuclear Program

Iran’s nuclear program began in the 1950s, and initially, the Iranian government demonstrated a commitment to a peaceful nuclear program (Bahgat, 2006). In 1970, Iran ratified the Treaty of the Non-Proliferation of Nuclear Weapons (NPT), which prohibits states without nuclear weapons from receiving or acquiring them (Treaty on the Non-Proliferation of Nuclear Weapons, 1968, art. II). However, in 2003, the International Atomic Energy Agency (IAEA) found that Iran was in non-compliance with the NPT, which raised concerns that Iran was building a nuclear weapon.
Although it is unclear when Iran first started seeking nuclear weapons, there are several explanations for why Iran would want such a weapon. First, instability and violence in the Middle East could have played a role (Fisher, 2015). During the Iran-Iraq War, Iraq’s use of chemical weapons killed or injured thousands of Iranians; the international community’s indifference reinforced that “Iran is fully justified to arm itself with nuclear weapons for defense and deterrence” (Bahgat, 2006, p. 314). The presence of United States troops in Iraq and Afghanistan could have also compelled Iran to develop nuclear weapons to protect itself from a potential United States invasion (Fisher, 2015). Additionally, “the right to develop nuclear power is a matter of national pride, where the population is largely united behind the regime” (Bahgat, 2006, p. 323). Some combination of these factors likely explains Iran’s desire for nuclear weapons (Fisher, 2015).

**Joint Comprehensive Plan of Action**

In 2015, Iran and the P5+1 (China, France, Germany, Russia, the United Kingdom, and the United States) signed the JCPOA, which places several restrictions on Iran’s nuclear program (Katzman & Kerr, 2016a. The goal of the JCPOA is “to ensure that Iran’s nuclear program can be used for purely peaceful purposes, in exchange for a broad lifting of U.S., European Union (EU), and United Nations (U.N.) sanctions on Iran” (Katzman & Kerr, 2016a, p. 8). More specifically, the JCPOA “includes a detailed set of physical limits on numbers and types of centrifuges, centrifuge research and development, centrifuge manufacturing, locations and levels of enrichment, and stocks of enriched uranium. The physical limits phase out over 10 to 15 years” (Samore et al., 2015, p. 23). The deal also enables the IAEA to monitor Iran’s nuclear activities (Katzman & Kerr, 2016a). In exchange, the United States ended major sanctions on Iran’s financial and energy sectors, rescinded banking sanctions, and lifted many secondary sanctions that discouraged firms from doing business in Iran (Samore et al.,
The JCPOA is a controversial agreement in the United States that has sparked intense debate. Proponents of the JCPOA argue that, without the deal, Iran could increase its nuclear activities and eventually produce a nuclear weapon (Samore et al., 2015). Additionally, the deal reduces the likelihood of military conflict between the United States and Iran (Samore et al., 2015). Critics of the JCPOA argue that restrictions on Iran’s nuclear program are not harsh enough and that the deal is not comprehensive; it does not address Iran’s support for terrorist groups, its human rights violations, or its ballistic missile program (Samore et al., 2015). Opponents also claim that, because many of the provisions expire after 10 to 15 years, “the nuclear deal only delays—rather than stops—Iran’s quest to develop nuclear weapons” (Kroenig, 2018, p. 95). Moreover, the JCPOA has benefits and shortcomings, and it continues to be a point of contention in American politics.

**Effectiveness of the JCPOA**

Although critics of the JCPOA claim that it is insufficient, the deal largely fulfilled its goal of limiting Iran’s nuclear activities. Before the United States withdrawal, “all official reports and statements from the United Nations, European Union, the IAEA, and the P5+1 indicate that Iran has complied with the JCPOA” (Katzman & Kerr, 2016b). While the JCPOA effectively limited Iran’s nuclear activities, it failed to change other aspects of its behavior. For example, there is evidence that Iran used the money it received from the United States and international sanctions relief to support terrorist groups in the region (Bergman & Mazzetti, 2019). Iran has also continued to develop its ballistic missile program (Katzman et al., 2021). However, the JCPOA was not created to change Iran’s behavior more broadly (Katzman & Kerr, 2016a). Moreover, the JCPOA is limited in scope, but it prevented
Iran from further developing its nuclear program.

**United States Withdrawal from the JCPOA**

On May 8, 2018, the Trump administration withdrew from the JCPOA and re-imposed sanctions on Iran as part of a maximum pressure campaign. The Trump administration claimed, “the JCPOA did not address the broad range of Iran’s objectionable behaviors and that JCPOA-mandated limitations on Iranian nuclear activities did not justify the sanctions relief provided” (Katzman et al., 2021, p. 2). Former U.S. Secretary of State Rex Tillerson criticized the JCPOA for failing “to achieve the objective of a non-nuclear Iran; it only delays their goal of becoming a nuclear state” (Katzman & Kerr, 2016b, p. 22). The Trump administration reimposed all sanctions lifted under the JCPOA and introduced new sanctions (Katzman et al., 2021). Former Secretary of State Mike Pompeo asserted that the United States would enter a new deal only if it included more severe restrictions on Iran’s nuclear activities, addressed Iran’s ballistic missile program, and prohibited Iran from sponsoring terrorist groups, among other demands (Katzman & Kerr, 2016b). Ultimately, the Trump administration engaged in this maximum pressure campaign to negotiate a stronger version of the JCPOA.

**Iran’s Current Nuclear Activities**

Since the United States withdrew from the JCPOA, Iran has increased its nuclear activities and violated several provisions of the agreement. Given these recent activities, Iran’s breakout time has shrunk from one year to one month (Lynch, 2022). The United States and Iran are currently engaged in indirect talks about rejoining the JCPOA. However, the window for reinstating the deal is quickly closing as Iran gains more intelligence about nuclear weapons (Hansler et al., 2022). At some point, Iran will have too much knowledge and infrastructure for the deal to be effective in preventing Iran from developing a nuclear weapon.
Thus, the United States Department of State must act swiftly to halt Iran’s nuclear activities.

Problems With the Existing Policy

The United States is using aggressive sanctions against Iran in an attempt to place more restrictions on the country’s nuclear program and address other aspects of Iran’s behavior (Katzman et al., 2021). On November 4, 2018, the United States re-imposed all sanctions on Iran that had been lifted under the JCPOA and issued new sanctions to place additional pressure on Iran (Katzman et al., 2021). The United States also designated Iran’s Central Bank and other financial institutions as terrorist organizations and implemented secondary sanctions (Katzman et al., 2021). As these sanctions damage the economy, Iran may be compelled to re-negotiate the JCPOA in exchange for sanctions relief. This maximum pressure campaign allows the United States to express its disapproval of other problematic aspects of Iran’s behavior, such as its human rights violations, its ballistic missile program, and its support for terrorist organizations. It also signals to Iran that the United States is committed to ensuring Iran’s nuclear program remains entirely peaceful. However, this strategy has emboldened Iran to expand its nuclear activities and is harming Iranian civilians.

After the United States withdrew from the JCPOA and re-imposed sanctions, Iran began violating the JCPOA (Katzman et al., 2021). This shift in behavior suggests that the current sanctions may be encouraging Iran to exceed agreed-upon limits on its nuclear activities. Additionally, sanctions are not deterring Iran from committing human rights abuses or advancing its missile program (O’Toole, 2021). The fact that neither the Trump nor the Biden administrations have successfully negotiated a stronger version of the JCPOA is another indicator that the current policy is failing.

United States sanctions are also likely harming Iranian
civilians, who are not involved in Iran’s nuclear program. An analysis of United States sanctions before 2015 revealed that “economic sanctions have adversely affected population health in Iran, by impairing [social determinants of health], health care delivery, and access to care” (Aloosh, 2019, p. 12). These sanctions were also associated with inflation, increased unemployment, and shortages of basic goods (Nichols & Charbonneau, 2012). Given that the Trump administration re-imposed all sanctions lifted under the JCPOA and implemented new ones, it is safe to assume that the Iranian people are suffering once again from United States sanctions. Thus, U.S sanctions are contributing to poor standards of living in Iran without eliciting changes in Iran’s behavior.

Policy Alternatives

Policy Option One: Continue with the Maximum Pressure Campaign

The State Department could recommend that the President continue with the maximum pressure campaign to negotiate a stronger nuclear agreement. This new deal would place more restrictions on Iran’s nuclear capabilities while also addressing “its support for terrorism; aggressive regional interventions; intimidation efforts through its armed drone, ballistic missile, and cruise missile attacks; and manifest human rights violations” (Brookes et al., 2020, p. 5). Until Iran agrees to a more robust agreement, the United States would continue with aggressive sanctions to bring Iran to the negotiating table (Brookes et al., 2020). This policy option is advantageous because it allows the United States to economically punish Iran for a wide range of its problematic behaviors. Additionally, aggressive United States sanctions led to the creation of the JCPOA, so constraining the Iranian economy could yield another nuclear agreement. A renegotiated nuclear deal could remedy many of the flaws with the original JCPOA by placing permanent limitations on Iran’s
nuclear program and addressing other problematic aspects of Iran’s behavior. If successful, this policy option could remove the threat of a nuclear Iran and increase stability in the Middle East more broadly.

Although a stronger version of the JCPOA could prevent Iran from obtaining a nuclear weapon, it seems unlikely that Iran or the United States would agree to such a deal. Iran’s current and former presidents have both signaled an unwillingness to compromise on its missile program and its regional influence, which highlights the challenges that the United States will face in creating a stronger nuclear agreement (Fassihi et al, 2021; Arouzi, 2020). Even if Iran did agree to renegotiate the JCPOA, the Iran Nuclear Agreement Review Act (INARA) allows the U.S. Congress to review “any agreement reached with Iran regarding its nuclear program” (Katzman et al., 2021); if lawmakers are unsatisfied with the agreement, they can issue a joint resolution of disapproval, effectively preventing the deal from taking effect (Katzman et al., 2021). Given the highly polarized nature of the U.S. Congress, lawmakers could block a new deal from taking effect. Moreover, this policy option is risky because both Iran and the United States could refuse to enter a new deal, which could lead to Iran continuing its nuclear program and eventually developing a nuclear weapon.

**Policy Option Two: Use Military Force to Destroy Iran’s Nuclear Infrastructure**

The State Department could recommend that the President and the Department of Defense launch airstrikes to destroy Iran’s nuclear infrastructure. This policy option would remove the immediate threat of a nuclear Iran; even if Iran wanted to develop its nuclear program after the attack, it would take years to rebuild its infrastructure. There is also evidence to suggest that Iran would not seek to rebuild its nuclear program after an attack; after Iraq’s and Syria’s nuclear infrastructure were destroyed, both countries were either unwilling or unable to restart their nuclear programs.
(Kroenig, 2012). The threat of another military attack could also deter Iran from pursuing nuclear weapons in the future and prevent nuclear proliferation in other countries (Kroenig, 2012). Even if Iran tries to rebuild its nuclear program, destroying key infrastructure will buy the United States time to develop more robust policies to prevent Iran from developing a weapon.

Using military force to destroy Iran’s nuclear facilities comes with many risks that ultimately make the policy too dangerous. First, United States military action could provoke war: Iran might retaliate against U.S. troops or allies, launching missiles at military installations or civilian populations in the Gulf or perhaps even Europe. It could activate its proxies abroad, stirring sectarian tensions in Iraq, disrupting the Arab Spring, and ordering terrorist attacks against Israel and the United States (Kroenig, 2012, p. 82).

Moreover, airstrikes could inadvertently threaten United States national security interests, further deteriorate U.S.-Iran relations, and lead to increased instability in the Middle East. Iran could also retaliate by closing the Strait of Hormuz, through which about 20 percent of the world’s oil supply travels; such an oil shock would have economic ramifications around the world (Kroenig, 2012). Additionally, unlike in Syria and Iraq, Iran’s nuclear program is a great source of national pride; thus, an attack could embolden Iran to rebuild its nuclear program and develop a nuclear weapon (Disvallar, 2022). Ultimately, this policy could delay a nuclear Iran but at the cost of provoking war, increasing Iran’s nuclear ambitions, and making U.S.-Iran relations more volatile.

**Policy Option Three: Rejoin the Original JCPOA and Pursue Follow-On Negotiations**

The State Department could recommend that the President rejoin the original JCPOA and then pursue follow-on negotiations to strengthen the deal (Katzman et al., 2021). This policy acknowledges that the original JCPOA on its own is insufficient. Some of its flaws include that it fails to address non-nuclear
activities, and many of the restrictions on Iran’s nuclear activities expire after 10 to 15 years; follow-on negotiations would work to address these shortcomings (Kroenig, 2018). Additionally, since the JCPOA allows the United States to continue sanctions not related to Iran’s nuclear activities, the United States could still place economic pressure on Iran until it agrees to follow-on negotiations to address Iran’s human rights violations and its support for terrorist organizations, among other issues. However, since Iran’s nuclear program is the most pressing threat, this policy will limit Iran’s nuclear activities as quickly as possible while avoiding military action. By emphasizing diplomatic negotiations, this policy also seeks to strengthen and repair the relationship between the United States and Iran.

Additionally, rejoining the original JCPOA may be more feasible than immediately creating a stronger version of the agreement. Although Iran has signaled its resistance to limit its missile program and its influence in the Middle East,

Iran’s Supreme Leader Ali Khamene’i, who is Iran’s paramount decision maker and whose views on major national security issues almost always prevail, stated on January 8, 2021, in reference to a possible U.S. resumption of JCPOA participation; ‘If they return to their commitments, we will return to ours’ (Katzman et al., 2021, p. 2).

Moreover, Iran has demonstrated a willingness to re-enter the original JCPOA. In the United States, Congress may not be able to prevent the President from resuming the JCPOA. Although the INARA is slightly ambiguous on this issue, if the United States simply rejoins the original JCPOA without making any changes to the agreement, Congress may not have the ability to review and reject the agreement (Katzman et al., 2021); if the President does not have to submit the JCPOA for congressional approval, the United States can rejoin the agreement more quickly, meaning that Iran would stop certain nuclear activities sooner.

Although this policy is the best option for the United States, it still has limitations. A likely possibility is that Iran rejoins the
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JCPOA but refuses to agree to follow-on negotiations. In this case, after key provisions of the JCPOA expire, Iran could advance its nuclear program and work towards developing a weapon. Even if Iran agrees to resume compliance with the JCPOA, it cannot reverse all activities that currently violate the agreement (JINSA, 2021). For example, Iran cannot “uninstall the invaluable learning experience its scientists have gained” (JINSA, 2021, p. 12) through developing its nuclear program. Moreover, some experts question whether the original JCPOA is still relevant considering how much Iran’s nuclear program has advanced in recent years (JINSA, 2021). Additionally, if the JCPOA is not amended to create consequences for parties that leave the deal, future U.S. administrations could withdraw from the JCPOA; such a decision would further diminish U.S. credibility and make another nuclear deal even more unlikely.

Despite its flaws, this policy is the most feasible way to prevent Iran from developing a nuclear weapon. Rejoining the JCPOA will still place meaningful restrictions on Iran’s nuclear program until follow-on negotiations occur, and the United States can use sanctions to bring Iran to the negotiating table. This more gradual approach promotes cooperation and diplomacy, which will hopefully improve U.S.-Iran relations and stability in the Middle East. Ultimately, the United States should seek to strengthen the JCPOA and limit other aspects of Iran’s behavior, but it should prioritize restricting Iran’s nuclear activities as quickly as possible; this policy option allows the United States to achieve both of these objectives.

Analysis

None of the policies described above can definitively eliminate the threat of a nuclear Iran, but rejoining the JCPOA and pursuing follow-on negotiations is the best available option. Military action is the least desirable option because it increases the risk of war and economic instability. Policy options one and three are similar because both have the JCPOA at their foundation. However, the
third policy option is better because it is the most practical. Given that the United States withdrew from the JCPOA despite Iranian compliance, Iran may be reluctant to rejoin a nuclear agreement, let alone one that places even more restrictions on its activities. Moreover, in recent months, Iran has demonstrated a willingness to re-enter the original JCPOA, and the United States should capitalize on this opportunity. The third policy recognizes that the JCPOA alone is insufficient to address Iran’s nuclear activities and its other problematic behaviors; at the same time, it recognizes the need to urgently address Iran’s nuclear program. Conversely, the first policy option takes an all-or-nothing approach that could result in a nuclear Iran. Thus, the United States should seek to re-enter the JCPOA as quickly as possible and then work to create follow-on agreements that protect U.S. national security interests and global stability more broadly.

**Conclusion**

The United States Department of State should seek to rejoin the JCPOA and pursue follow-on negotiations to prevent Iran from developing a nuclear weapon. This policy option is ideal because it allows the United States to quickly place restrictions on Iran’s nuclear program while also addressing other problematic aspects of Iran’s behavior, such as its human rights violations and its missile program. If diplomatic negotiations fail and the United States abandons the JCPOA, there is a greater risk of military conflict, global nuclear proliferation, and a new era of nuclear warfare. To prevent these consequences from occurring, the United States must rejoin the original JCPOA and engage in continued diplomatic negotiations with Iran to strengthen the nuclear agreement.
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Tierra y Libertad, Antes y Ahora

Kyle C. Elshoff

**Writer’s Comment:** For our final paper in HIS 165: Latin American Social Revolutions, our professor challenged us to synthesize what we had learned and write an original interpretation of a revolution we had studied through the lens of a topic such as gender, age, race, etc. Being interested in the natural world, I chose to investigate the relationship between environment and revolution. For example, how did the agrarian reforms undertaken during many revolutions impact the environment? Or, how do environmental histories create conditions favorable to revolution in the first place? In my paper, I focus on the indigenous revolutionary movement known as the EZLN and their relationship with the environment. The EZLN operates out of the Lacandón Rainforest in Mexico, an amazingly biodiverse ecosystem that is unfortunately fragmented and fragile after decades of human mistreatment. For this and other reasons, the EZLN provides an ideal case study to examine the links between revolutions and the environments in which they occur.

**Instructor’s Comment:** What is the environmental legacy of revolution? As an entomology major in an honors college course on Latin American social revolutions, Kyle consistently approached historical questions from a new angle. With this simple yet elusive question Kyle’s research explores the legacy of the Zapatista Army of National Liberation (EZLN), who took their name from the 1910 Mexican Revolution movement for Tierra y Libertad led by Emiliano Zapata in the state of Morelos. Despite being an acclaimed movement for indigenous autonomy and agrarian reform, the modern-day Zapatistas in Chiapas have been surprisingly quiet on questions of environmental stewardship.
In an ambitious three-part essay, Kyle considered multiple angles on the EZLN’s relationship to the environment and, as always, remained attentive to the silences within the documents. This creatively conceived and beautifully executed essay exemplifies his outside the box thinking.

—Marian Schlotterbeck, Department of History

Introduction

Over the past several decades, much has been written on the conflict in the Lacandón Rainforest in Chiapas, Mexico, which is one of the largest and most biodiverse in the country. According to a news report published in El País in 2019, it is home to a quarter of all mammal species and almost half of all bird species in Mexico. In addition, it is one of the last jaguar habitats in North America. The indigenous Lacandón Maya have also lived there for centuries, and more recently other groups have immigrated to the forest. Notably, the Lacandón is the central territory of the EZLN, an armed indigenous resistance movement who rebelled against the government in 1994. As Bill Weinberg notes in his 2003 NACLA Report, they have again come to the fore, this time in land and conservation conflicts, because many unauthorized communities living in the jungle are Zapatista. Now, the focus is on the EZLN’s ecological and environmental positions. This situation offers an opportunity to examine the environmental legacy of a revolution, a perspective that is not often explored. Both past and present, the EZLN’s complex relationship with the environment has been shaped predominately by the immediate needs of their communities. This relationship is crucial to understand because as a major regional organization, the EZLN

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plays an important role in determining the future of the Lacandón.

**Part One: Environmental Roots of the Rebellion**

The relationship between the EZLN and the environment begins with the environmental history of Chiapas. In many ways, the Zapatistas rebelled against the ecological marginalization of the Chiapanecan poor because addressing marginalization was one of their most pressing needs. According to Philip Howard in “The History of Ecological Marginalization in Chiapas,” an important cause of this marginalization is unequal land distribution, which began in colonial times. Spanish elites seized most of the good farmland and forced indigenas either into labor or into exile. This system of land ownership persisted throughout the 19th and 20th centuries; in 1910 large landowners or latifundistas (1% of the Chiapanecan population) owned 81% of the land, and even after the Mexican Revolution created ejidos and comunidades agrarias, most of the land remained in private hands. This forced many indigenas and campesinos onto poor agricultural land at the edge of the Lacandón. In the 20th century, migration to the region (often encouraged by the government) was high, leading to annual population growth rates of up to 4% in some communities. The marginal quality of the land on the frontier meant it became barren after a few harvests, so settlers steadily cut further into the jungle for more land. As James D. Nations writes in “The Ecology of the Zapatista Revolt,” this did not concern the government until they realized that these communities competed with logging companies for timber. So, in 1972 they gave ownership of the Lacandón Rainforest to the Lacandón Maya (who then signed an agreement with loggers) and forcibly removed many settlers.

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5 Ibid., 363-364.
A similar situation occurred in 1978, when the Montes Azules Biosphere Reserve was established to protect approximately 300,000 hectares of primary forest. According to Weinberg’s 2003 report, because this action turned established communities into illegal squatters overnight, the government again forced relocation. The reforms undertaken by the administration of Carlos Salinas de Gortari in the 1980s and 1990s also hurt the campesinos. Subcomandante Marcos, as quoted in “The History of Ecological Marginalization in Chiapas,” remarks that “what most radicalized our companions were the changes to Article 27,” referring to the reform of the Constitution that, among other things, essentially put ejido lands on the market. Altogether, the environmental and agricultural history of Chiapas directly and consistently harmed rural Chiapanecans. Addressing these issues was what the people needed; thus the Zapatistas took up arms.

Part Two: Zapatistas Speak on the Environment

Since 1994, the Zapatistas have generated an immense body of writing that covers many issues, including the environment. The environment is mentioned less frequently than other topics, primarily when the basic needs of the people are affected by environmental issues. For example, one of the first major EZLN documents, “La Declaración de la Selva Lacandona,” released on January 2, 1994, makes no mention of the environment other than highlighting that the poor people of Chiapas have no land. However, the “Ley Agraria Revolucionaria,” published earlier in the group’s internal newspaper in December 1993, addresses the environment somewhat more. It calls for the protection of the local ecology, but it does not contain concrete proposals: “se preservarán

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las zonas selváticas vírgenes y los bosques y se harán campañas de reforestación [...] [los recursos naturales] son propiedad colectiva del pueblo y se cuidarán.” This lack of specificity contrasts with their detailed proposals for agrarian reform in the same document. Finally, their January 27th communiqué “Chiapas: el Sureste en dos vientos, una tormenta y una profecía,” contains one of their most direct indictments of environmental exploitation. In it, the Zapatistas decry the environmental exploitation of the Lacandón by corporations. However, they justify logging of the forest by campesinos, noting that “el campesino tumba para vivir, la bestia [la corporación] tumba para saquear.” The document also praises the biodiversity of the region, but ultimately states that “la mayor riqueza de la entidad son los 3.5 millones de chiapanecos.” In other words, the people are the Zapatista’s highest priority. In addition, this states that alteration of a fragile environment like the Lacandón is permissible so long as the people who live there are the ones benefiting, not the exploitative corporations and government. In these documents, the environment is referenced primarily as a resource to support the people, not necessarily something to defend for its own sake. The EZLN recognizes the need to preserve their environment, but what that means is shaped by the immediate needs of their people.

Part Three: Zapatista Environmental Practice

In recent years, the EZLN and its supporters have come into conflict with environmentalists in the Montes Azules Biosphere Reserve. As noted in Bray and Klepeis’s article “Deforestation, Forest Transitions, and Institutions for Sustainability in Southeastern Mexico, 1900–2000,” the reserve was established in 1978 and has

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12 EZLN, “Dos vientos,” 52.
so far mostly succeeded in preserving habitat\textsuperscript{13}. However, it was created without the knowledge of the preexisting communities, making them illegal squatters overnight. The government evicted some communities, yet many remain due to the turmoil of 1994 and underpatrolling of the reserve, as reported in a 2002 article from \textit{The Miami Herald}\textsuperscript{4}.

According to Weinberg’s 2003 report, these Zapatista or Zapatista-allied communities have different perspectives on living in the forest. Some communities, like Nuevo San Gregorio, plan to sustainably use the land they have and clear no more. Others want to continue clearing trees as their communities expand, eventually transforming the jungle into a patchwork of settlements, agriculture, rangeland, and forest\textsuperscript{15}. As of 2003, the Mexican government threatened further relocation of these communities, and the EZLN voiced their staunch opposition. They hold that the threats conceal a hidden motive. As quoted in Weinberg’s report, the EZLN states that “environmental, bioprospecting, eco-tourism, and birth control (eventually, sterilization of indigenous women) programs are acting as the spearhead for a far-reaching strategic and military project.” They specifically claim the government wants to remove settlers so it can exploit the land for itself\textsuperscript{16}. There is evidence for this; at the time of the report, the Mexican government was preparing for intense development in nearby regions for the Plan Puebla-Panamá (now the Mesoamerican Project), which would severely damage the environment\textsuperscript{17}.

The opposition of the EZLN to the relocation of their communities and other restrictions in the name of environmental protection is consistent with their people-oriented relationship

\textsuperscript{15} Stevenson, “Unusual battle lines.”
\textsuperscript{16} Weinberg, “Lacandon Selva Conflict,” 27.
\textsuperscript{17} Ibid., 29-30.
with the environment. These measures would unfairly harm their communities and possibly allow the environment to be exploited by outside groups, instead of by those who live there. Unfortunately, as any further deforestation would severely impact the ecosystem, this pits them against environmentalists and conservation biologists, who oppose both the actions of the EZLN’s communities in the heart of the jungle and the broader exploitative plans of the Mexican government in the region\(^{18}\).

**Conclusion**

The EZLN, past and present, has a complex relationship with the environment that is largely shaped by the needs of rural indigenas and campesinos. They organized and rebelled in 1994 against ecological marginalization in Chiapas, one of the most pressing problems rural Chiapanecans face. In their writings, the EZLN do not address the environment as frequently as other issues, but when they do, they portray it primarily as a resource for their people to use. And with regards to the Montes Azules Biosphere Reserve, the EZLN has recently opposed environmental action which would conflict with the existence of their communities. In each of these cases, the EZLN is concerned with the environment to the extent that it impacts the rights and livelihoods of those they fight for. This approach to the environment reaffirms the strong commitment the EZLN has to its people, embodied by their phrase “aquí manda el pueblo y el gobierno obedece.” Yet due to the threatened state of the Lacandón, this perspective potentially raises doubts about the EZLN’s ability to work towards long-term protection of the jungle.

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Works Cited


Aliens!

William Li

**Writer’s Comment:** Part of me wishes I studied astrophysics instead of biochemistry because of how intriguing and mysterious I find celestial objects. From quasars to quantum mechanics, there’s so much we’re just beginning to understand about these complex phenomena. When Dr. Herring asked me to write an “explanation of a technical matter for the general public,” I knew I wanted to talk about pulsars – these incredibly dense and fast-spinning star corpses – and how they challenge our understanding of physics. Instead of focusing on more a technical explanation of pulsars (this is by no means my area of expertise), I opted to write about its discovery by Jocelyn Bell. Bell’s story is one of serendipity and the exhilarating feeling of discovering something unknown, all made possible by her unwavering dedication to the scientific process. I dream of a day when I’ll be able to contribute a fraction of what Bell has, but for now I hope my retelling of Bell’s story inspires you to look up at the stars a little more often.

**Instructor’s Comment:** Let me let you in on a secret: I don’t always understand everything my students write in their essays, and not through any fault of their own—an occupational hazard when you teach, as I do, the course Writing in the Professions: Science. Our students are often doing scientific work so advanced, and in such a wide variety of fields, that they regularly lose me. Here, however, is another secret: the solution is to create an assignment in which the students explain a difficult scientific subject so that any member of the general public can understand it. In the course of explaining things for the public, the students explain them for me, and I am no longer so befuddled.
William’s winning essay was written in response to such an assignment. In it, he explains pulsars and related phenomena in astrophysics that ought to be impossible to follow. Such topics are maximally challenging for any writer, but I found the essay easy to understand, because William does such a fine job explaining—and if I can understand it, then you should have no problem.

—Scott Herring, University Writing Program

Hunched over her desk at the Mullard Radio Astronomy Observatory outside Cambridge, 24-year-old PhD student Jocelyn Bell pored over the days’ worth of data from her radio telescope. She spent the past two years building a vineyard of radio antennas, connected by wires snaking through stakes protruding from the ground. It was 1967, and Bell was working under Professor Tony Hewish to study quasars, super bright objects thought to be emitted from black holes.

Without modern computers in existence to digitalize data, Bell sat down every night to analyze hundreds of feet of paper, spit out from the telescope’s chart recorder each day. Every so often, she noticed a “scruff” in the data. She squinted at that portion of the red line—she’d seen it before, and it didn’t look like a quasar signal nor interference from the lab next door. Bell switched to a better recorder to try recapturing the signal, and on November 28, 1967, Bell received one: a string of pulses, each exactly 1.3 seconds apart. The spacing between signals was precise; it felt like a beacon from an alien world. Bell found another signal shortly after and then two more by Christmas, all from different locations in the sky. Partly from a farfetched hope of discovering the first extraterrestrial and mainly to save her from saying “you know that funny pulsing source at right ascension

Figure 1. Bell’s original observation of the “scruffs.” Courtesy of New York Times.
1919, declination plus 20,” Bell gave it a memorable label instead: LGM-1, short for Little Green Men. Bell, in fact, had made one of the greatest discoveries in astronomy history. A prominent astrophysicist named Thomas Gold would later prove the signal’s source to be pulsars, mythical objects in the lore of astrophysical theories.

Pulsars are a special type of neutron star that has an incredibly strong magnetic field and fast spin. Pulsars are a hand-cranked flashlight, harnessing the power of their spin and magnetism to generate beams of radiation. As a flashlight dims when its fatigued owner stops cranking it, a neutron star ceases to become a pulsar when it lacks enough energy.

Like everything else in the universe, pulsars are born from the remains of dead stars, cosmic clouds called nebulae floating in space. When turbulence disturbs these interstellar nurseries, some regions form high-density clumps. These “knots” slowly condense, and the material starts to heat up and spin until a protostar is born. They’re hungry hippos, gobbling up neighboring material with the insatiable power of gravity until its core gets hot enough to form a star. Dust that escapes this scorching fate clump together to form planets, asteroids, or comets that orbit the star.

A star’s core can reach up to 7 million degrees Celsius, a necessity for it to produce energy. Inside, hydrogen atoms are smashed together to produce helium in a process called fusion, releasing massive amounts of heat and light that planets relish in. This same process exerts outward pressure, fighting against gravity to keep the star from collapsing. Once stars run out of hydrogen to burn, the reactions inside it become unstable, according to

Figure 2. “Pillars of Creation” from the well-known Eagle Nebula. Courtesy of Wikimedia.
NASA’s website “Stars,” causing it to periodically flare with bursts of energy. The result is a “pulsating” star, throwing out its outer layers and “enshrouding itself in a cocoon of gas and dust.” Stars with a mass like our sun will shed their outer layers to form a White Dwarf, a faint yet “hot stellar cinder” that gradually cools down.

This fate awaiting our Sun and solar system is mellow compared to the extreme conditions that birth neutron stars. Stars eight times our Sun’s mass have cores hot enough to support additional nuclear reactions and create heavier elements up until iron. Iron is a depleted shell of its lighter siblings – it has no energy to give and sits in the core, contributing only gravity to coax the star into collapse. The star gives in: its core shrinks from five thousand miles to a few dozen in seconds; its outer material rebounds against the collapsing core with enormous energy in a massive explosion called a supernova. Anyone lucky to witness one may be reminded of the opening scene from Super Smash Bros. Ultimate’s World of Light, where Galeem consumes our protagonists and the galaxy in a bath of light.

The core performs one final dance before its transformation is complete. As it shrinks, the core mashes charged protons and electrons together to form neutral neutron particles. Like a figure skater pulling her arms in, it accelerates its spin to reach up to forty-three thousand rotations a minute. The neutron star is now born – its density equivalent to “jamming the population of the globe into a sewing thimble,” according to Bell. Its magnetic poles, estimated to be up to 1 quadrillion times stronger than Earth’s, accelerate atomic particles to create beams of radiation; combined with its perpetual spin, these cosmic lasers sweep the expanse like a lighthouse, according to Stanford physics...
professor Roger Romani. Sometimes, these beams can point towards Earth which we detect as radio signals as Bell first did in 1967.

![Figure 4. Artist's rendition of a pulsar featuring beams of radiation (purple) and magnetic field lines (blue). Courtesy of NASA.](image)

In large part to the extreme pressure at its core, a neutron star’s inner composition pushes our understanding of physics to the limit. Most scientists agree that a thin layer of atmospheric hydrogen and helium coats the star and gives a façade of habitability. A two-centimeter crust of iron and silicon atoms bathe in a sea of negatively charged particles called electrons, sitting on top of a crushed soup of neutrons and electrons. Below that, scientists are still trying to figure out what’s inside. “It’s one thing to know the ingredients, and another to understand the recipe, and how those ingredients are going to interact with each other,” astrophysicist Jocelyn Read of California State University Fullerton puts it. James Lattimer of Stony Brook University told Quanta Magazine that neutron stars could contain “nucleon variations,” among them protons and neutrons. Other physicists like to think that the intense gravitational pressure smashes nucleons into smaller subatomic particles. David Blaschke of the University of Wroclaw likens nucleons to cherries: “you can compress them a bit, but at some point you smash them.”

However, we are starting to learn more about them.
Launched in 2017, an instrument on the International Space Station called the Neutron Star Interior Composition Explorer (NICER) has started to provide valuable data on how neutron stars work. With its 56 gold-coated telescopes, NICER detects X-rays from magnetic hotspots on the stars’ surfaces. Recent data from pulsar J0030+0451 suggests that it has two crescent-shaped and one circle-shaped poles. It’s the first “pulsar where the beams are not 180 degrees separated,” astrophysicist Natalie Webb from the Institute for Research in Astrophysics and Planetology comments. “That’s fantastic if true.”

The 1974 Nobel Prize in Physics for discovering pulsars was awarded to Hewish and Ryle instead of Bell, but Bell won the 2018 Special Breakthrough Prize in Fundamental Physics along with a 2.3-million-pound prize. She donated the prize money to create the Bell Burnell Graduate Scholarship Fund, which will fund a more diverse student research population in physics. When asked about the future of astrophysics, Bell remarks that modern telescopes like NICER have computers to sift through tons of data, but “how do you pick up the things you don’t know exist, the things you can’t tell it to look for?” Bell’s comments and legacy epitomizes the spirit of scientific discovery: she looked for what she knew, found something unexpected, and discovered the unimaginable. It’s something that can’t be automated.
Health Disparities and COVID-19: Moving Towards Vaccine Equity in California

MONICA TSUI

Writer’s Comment: It’s no surprise COVID-19 impacts communities differently. At the time when Professor Whitthaus assigned our class our final research project, COVID-19 vaccines were just approved for emergency use authorization and distribution was slowly spanning out across the state. After reading more about disparate COVID-19 health outcomes in disadvantaged communities, I wanted to investigate whether vaccine rollout followed similar patterns- and if it did, what public health interventions California could take to improve equity in distribution. Outside of the research I conducted in my literature review, many of my recommendations from this paper were informed by my volunteer experiences in a student-run clinic, which showed me the power of rooting public health and advocacy work in the community.

Instructor’s Comment: Monica Tsui’s essay, "Health Disparities and COVID-19: Moving Towards Vaccine Equity in California," makes an important case not only about vaccine (in)equity but also about underlying disparities in access to healthcare in California. It is also a fascinating essay in and of itself. Her writing is clear and tackles a complicated issue with verve. Most impressive, Monica does not stop with a critique of existing inequities. Instead, she uses her writing to develop a clear set of recommendations about how to move towards a more equitable distribution of vaccines. It would have been easy for Monica to write only about the unfairness of existing inequities. Her writing insists that something be done about them, and she sketches out how public health officials might actually begin to move in that
direction. There is real insight in this essay and a real call to action, a call for change.

—Carl Whithaus, University Writing Program

Introduction

California, with a population of nearly 40 million people, is one of the largest and most populous states in the nation. Given this statistic, it’s not surprising that California also leads the country in the number of residents vaccinated with at least one dose of the Moderna, Pfizer or Janssen COVID-19 mRNA vaccine. As of August 2021, over 46 million vaccine doses have been administered across the state with approximately 65% of the population fully vaccinated against COVID-19. (CA Department of Public Health, August 2021) With vaccination rates steadily increasing amidst the imminent threat of the more contagious Delta variant, California appears to be taking strong steps towards disarming COVID-19 and mitigating its devastating effects. Though vaccine trends in California are promising, equity in distribution remains a strong point of contention, especially considering the disparate impact of COVID-19 in communities of color and vulnerable groups. Thus, it is important to consider social factors influencing health and analyze their corresponding effect on vaccine access. By examining literature on COVID-19 health disparities and drawing from public health case studies, this paper will make a series of public health and policy recommendations to advocate for a more equitable vaccine rollout in California.

Background: Literature Review

To understand current gaps in vaccine access, it is essential to look at ongoing disparities in health outcomes and access to healthcare, along with their driving factors. Race and ethnicity plays a pivotal role in determining health outcomes in COVID-19 patients; African American, Latinx, and Indigenous communities
experience disproportionately higher rates of positive cases, hospitalizations and deaths from COVID-19 since the onset of the pandemic. Azar, in a cohort analysis of patients at Sutter Health, found African Americans were 52.5% more likely to be hospitalized from COVID-19 compared to 25.7% of white patients, and they were also 43.4% more likely to suffer serious complications. (May 2020) When health outcomes were analyzed at the sub-county level by Public Use Microdata Area (PUMA), Reitsma also reports “death rates in both Latino (59.2 per 100,000 cases) and Black (65.0 per 100,000 cases) populations were more than 1.5 times higher than that of the White population (38.3 deaths per 100,000 cases).” (May 2021) Poor health outcomes in these communities are driven by a combination of social factors underscoring a pattern of systemic barriers and racial discrimination. Many of these communities lack access to quality healthcare or insurance, face financial barriers preventing them from seeking treatment or live in environments considered ‘high exposure risk’ (which is defined as households with multiple generations, crowded spaces, and households with essential workers). These risk factors are influenced by race and ethnicity, along with financial status. PUMAs designated as possessing “elevated exposure risk” tend to have higher proportions of Latinx residents. Cultural barriers also amplify these disparities. Individuals may be hesitant to seek care due to distrust in medical institutions, lack of accessible vaccine information, or preference towards traditional medicine practices over modern medicine. From these statistics lies a grim takeaway: social determinants of health influenced by race, ethnicity, and income “play a pivotal role in determining how and when care is accessed, and what the outcome is.” (Azar, May 2020)

Medical insurance type, income level, and geographic location are also influencing factors. Patients with Medicaid or Medicare health insurance were twice as likely to be hospitalized from COVID-19 compared to patients with commercial insurance types. Income plays a significant role as well; COVID-19 patients “residing in the top two quartiles of income were less likely to
be admitted to the hospital than those residing in the bottom-quartile ZIP codes.” (Azar, May 2020) African Americans as a group were more likely to possess Medicaid health insurance and reside in lower-quartile ZIP codes. These studies paint a picture of the influence of intersectionality in healthcare: racial, social, and financial inequalities compound to produce overwhelming barriers preventing or delaying care and increasing exposure rates. These statistics demonstrate a strong need to consider the failings of the modern healthcare system in reaching vulnerable populations and revise current public health approaches to equalize access to care.

A major part of addressing vaccine inequity will require addressing vaccine hesitancy in minority communities. Because part of reaching herd immunity will require a majority of the population to receive the vaccine, it can be tempting to be resentful at individuals refusing to receive the vaccine where supply and access is readily available. However, it is important to understand the social and historical context of systemic racial discrimination and its motivating impact in driving distrust in large-scale institutions within communities of color. Bruckhaus, for instance, cites “only 42% of African American respondents express[ing] their willingness to receive the vaccine, compared to 61% of white respondents.” (July 2021) Past medical traumas, including incidents like the 1932 Tuskegee Syphilis Study, coupled with present-day racial biases in physicians, build upon the notion that large-scale institutions like healthcare are foundationally racist and cannot be trusted. A respondent in a study investigating attitudes towards COVID-19 vaccines and trust in government poignantly noted, “We have such a strong history in this country being experimented on unwillingly or without informed consent, and I know we were all taught that and it’s … almost embedded in our culture. [...] And so, there’s an inherent distrust.” (Strully, April 2021) This feeling of distrust is markedly absent in white participants in a similar study analyzing attitudes towards influenza inoculation. Jamison notes that for the majority of white respondents, “trust in the government’s role in influenza vaccination is implicit and unquestioned” while trust in
African Americans “is earned only after reconciling injustices of the past and addressing present racism.” (December 2018) Improving vaccine uptake will require jointly alleviating these justified fears and providing vaccine information through culturally competent means.

**Existing State Policy and Initiatives**

Public health officials revised California’s initial rollout plan in an effort to improve vaccine access in the hardest-hit neighborhoods. In the initial months of vaccine distribution in December 2020, distribution was prioritized solely by age group, under the reasoning that individuals aged 50+ are more vulnerable to COVID-19 due to comorbidities and pre-existing illness. Though this generalized approach allowed those most physically vulnerable to poor health outcomes to receive vaccines, it left behind many impoverished and marginalized communities, which bear the brunt of the impact from COVID-19. A disproportionate amount of doses were administered to more affluent neighborhoods, with “California’s wealthiest populations [being] vaccinated at nearly twice the rate of [the] most vulnerable populations. (CA Department of Public Health, March 2021) Prioritizing vaccine distribution by community vulnerability and geographic location is a much more equitable approach compared to general age-based thresholds given the disproportionate incidence of cases from these groups. A study with collaboration of leaders in public health and medicine recommend “states [consider] targeting broad swaths of the population in highly specific geographic contexts” using forms of direct outreach including “home visits, walk-in pop-up clinics, [and] assigning appointment slots to all residents.” (Wrigley-Field, March 2021) In March 2021, the state responded to these disparities by developing a vaccine equity matrix (VEM) to categorize individual counties by priority level and by reserving 40% of vaccine doses to communities in the lowest VEM quartile. These changes were implemented under an update to “Blueprint
to a Safer Economy”, a state-wide plan introduced in August 2020 to acknowledge the long-term effects of the pandemic and safely reopen the economy. VEM quartiles were established from the California Healthy Places Index (HPI) and ranked counties in California from unhealthy community conditions (Quartile 1) to healthy community conditions (Quartile 4). Since this major policy change in March 2021, vaccination rates in Quartile 1 counties have picked up. However, there are still disparities in vaccine coverage by geographic location organized by the VEM, with 78.7% of Quartile 4 residents being fully vaccinated compared to only 56.2% in Quartile 1 as of August 2021. (CA Department of Public Health, August 2021) Though this policy change improved conditions, there remains a need to tackle ongoing disparities.

Case Study Analysis

Successful public health interventions by the Michigan Department of Public Health to mitigate COVID-19 health disparities provides insight on similar policies that can be implemented in California. The Michigan Coronavirus Racial Disparities Task Force, established in April 2020 through an executive order by Governor Gretchen Whitmer, offers a potential case model of improving vaccine uptake in marginalized communities through community engagement and centering health equity. The task force set actionable metrics towards decreasing inequities by including a diversity of perspectives (from public health officials to local community figures) in task force leadership, fostering community engagement in vaccine uptake efforts, building partnerships with local organizations, creating long-term infrastructure to sustain progress, and providing resources to mitigate other compounding stressors on vulnerable communities. Strategies used to move towards these goals include providing implicit bias and cultural sensitivity training to state officials and providers, bringing vaccines to local communities through drive-through community clinics, providing grants to 30
local nonprofits to tackle community-specific issues, addressing other social determinants of health by providing essential resources (providing emergency rental assistance to residents, food packages and toiletries to quarantined individuals, etc.) and introducing targeted vaccine messaging on social media platforms. The Michigan task force also initiated partnerships with industry leaders and local civil rights organizations, including the state chapter of the National Association for the Advancement of Colored People. These efforts resulted in “the average number of new cases for Black residents drop[ping] from 176 million per day in March 2020 to 59 million per day in October 2020, with disparities in rate cases among Hispanic or Latino Michiganders also narrowed.” (National Governors Association, February 2021) Though the goals of this task force did not explicitly involve improving vaccine uptake in communities of color, the actionable strategies they take towards considering social determinants of health, cultural competency in public policy, and facilitating community investment in mitigating the disparate impacts of COVID-19, offer a strong case model for a similar campaign in California.

**Recommendations**

To improve access to COVID-19 vaccines and mitigate health disparities driven by socioeconomic factors, the following broad public health interventions should be instituted across the state:

- Establish regional vaccine equity task forces to set measurable goals towards equalizing vaccine access and developing long-term infrastructure for health equity
- Prioritize allocation of vaccines to VEM Quartile 1 counties, with the goal of vaccinating 70% of the population residing in these counties by December 2021
- Address social determinants of health by improving regional access to food, housing, and linguistically appropriate health care services and vaccine information
- Center community engagement by funding local initiatives/nonprofits, accessible community health
clinics, and community organizations

Working towards a more equitable vaccine rollout will require a culturally competent, community-centered campaign with tactful consideration of underlying social determinants of health to cater to the heterogeneity of communities in California. Given the unique cultural contours and challenges to access each group faces, a one-size-fits-all approach will not be effective. Community campaigns are essential to build trust, provide accurate vaccine information to combat misinformation, and help individuals understand modern-day health inequities and where they stem from. Broad strategies to reach these goals include supporting and partnering with community organizations, encouraging local leaders (including personal primary care physicians, religious leaders, educators, local city health departments, etc.) to inform residents and alleviate their fears, and providing culturally sensitive and linguistically appropriate vaccine messaging. Individuals are much more inclined to listen to the advice of a long-trusted doctor or friend over the disembodied voices of detached government authorities. Providing linguistically appropriate information can include information brochures in multiple languages, accessible translators and translated signage at vaccine clinics, and producing targeted information on appropriate social media outlets and community centers. In broad terms, vaccine campaigns by regional task forces will need to prioritize building relationships with community organizations, centering local leaders in distributing vaccine information, providing culturally competent messaging, and developing long-term frameworks to create measurable goals towards health equity.

Conclusion

The COVID-19 pandemic continues to expose deep disparities in the United States healthcare system, with marginalized communities disproportionally bearing the heft of COVID-19 infection, hospitalization, and mortality rates. These disparities
become especially evident in a diverse state like California, where localities and groups on the fringes of society face insurmountable barriers in access to care, information, and vaccines. By approaching vaccine distribution through the lens of health equity, California can begin to mitigate these disparities and address underlying determinants of health. All Californians deserve equal access to quality healthcare, especially during a pandemic. In adopting these policy recommendations, we can hopefully take essential steps towards accomplishing this goal.
References


Health Disparities and COVID-19: Moving Towards Vaccine Equity in California


When Strep Throat Gets Complicated

Amber Racina

Writer’s Comment: My freshman year of college, February 2020, I was in the hospital for 14 days fighting an extremely rare complication of strep throat called Lemierre’s Syndrome. Ever since this experience, I have been curious how this infection happened and how all the events leading up to my hospital stay affected my health. When Professor Stark assigned the Case Study paper, I immediately had the idea to research the infection that threatened my life. I have so much curiosity surrounding the mechanisms of infection and I thought this would be the perfect opportunity for me to research Lemierre’s Syndrome to educate myself and the people who read my paper. Additionally, I learned a lot of important lessons from my experiences that I’m happy to share with others. Timely medical care can be the difference between life and death and you should never be afraid to seek a second opinion.

Instructor’s Comment: Written for a lay audience, Amber’s case study documents her near death experience having Lemierre’s Syndrome, a rare illness. Through her detailed writing, we learn about the dangers of infections, how difficult it is for doctors to diagnose and treat novel illnesses, and how it’s vital that we know symptoms of a medical emergency. Through her clear story telling and research information, Amber’s prose takes us on an unforgettable medical journey, a testimony of the dangers of delayed medical treatment and a reminder that medical complications don’t discriminate by age. Amber’s story is one of the most compelling first person accounts I have read for UWP 104F
“Strep throat gone wrong.” That was the text I sent from my ICU bed, unable to get up, as friends and family flooded my phone asking what happened. For most people, strep throat is a very common illness that is relieved with a course of common antibiotics and resolves within a few days. I was an exception. In my freshman year of college, I was diagnosed with one of the nastiest complications of strep throat known as Lemierre’s syndrome. The incidence rate of Lemierre’s syndrome is one case per million yearly (Giubelan). Lemierre’s syndrome is characterized by septic thrombosis of the jugular vein, blood clots that block the vein during inflammation and infection (Lipe et al.), caused by the gram negative bacteria, Fusobacterium necrophorum, which develops as a complication of a localized tonsil infection (Valerio 495). In simpler terms, after someone has a some sort of tonsil infection (in my case it was strep throat), the bacteria enters their bloodstream and forms a blood clot in the jugular vein, a vein in your neck that provides the main blood supply from your heart to your brain, neck and face (Rivard et al.). Bacteria circulating the bloodstream results in sepsis or someone’s blood becoming toxic and infiltrating their organs. In February of 2020, I was the one in a million.

My freshman year of college was at the dawn of the COVID-19 pandemic; right before our world fell apart, mine almost did. Two weeks before my trip to the emergency room, I was diagnosed with strep throat and completed the 10 day antibiotic course. About 3 days later, my condition started to rapidly decline. I had a 102 fever, and I thought I had an ear infection because I had a radiating pain just below my ear.

I decided to go to the Student Health Center where they tested me for strep, mono, the flu, and an ear infection, which all came back negative. The doctor sent me home and told me I probably
had a virus. The next day my fever went up to 104, I was throwing up blood, and my whole body felt weak. I continued to feel worse so I made a trip back to the Student Health Center where, once again, the same doctor told me I probably had a virus and was dehydrated. He had me finish a gatorade then sent me home.

According to UChicagoMedicine, people should be advised to go to the emergency room if they are experiencing an illness that is affecting their entire body, have a high fever that won’t break, vomiting blood, etc. (Spiegel). According to these guidelines and the symptoms I was presenting with, I should have been told to go to the ER. Delaying my visit to the hospital made my condition much worse. Studies have shown that a lack of social support is associated with patients being less likely to go to the ER in a timely manner which, in turn, leads to worse health outcomes (Reisinger et al). The staff at the Student Health Center didn’t provide me the social support I needed to seek further care which worsened my condition. According to the study, 22% of people reported delaying their trip to the ER when they felt they should have gone sooner (Reisinger et al).

When I woke in the morning, I was hardly able to stand and decided to call an Uber to go to the ER. The whole time I felt imposter syndrome and like I would just be wasting the ER doctor’s time because according to the student health center doctor, “I just had a virus and should sleep it off.” It’s a good thing I listened to my body. When the medical assistant initially took my vitals at the ER, my fever was 104.2, my blood pressure was 80/50 and my heart rate was 140 bpm. To put that in perspective, normal vital signs, as stated by John Hopkins Medicine, are 98 degree temperature, a blood pressure of 120/80, and heart rate between 60-100 bpm.

There were a lot of people in the ER that morning and I was expecting to wait for a long time but I skipped the whole line and was immediately given a bed. The hospital staff frantically inserted IVs into me and started pushing fluids. After test results began coming back, it was deemed I was in septic shock (meaning I had been septic for at least a few days prior); the doctors were
questioning how I was still conscious. According to the National Institute of Health, sepsis is one of the top 10 leading causes of death in the U.S. and kills 1 in 5 people (“Surviving Sepsis”). I didn’t realize how bad my condition was until I FaceTimed my uncle who works at UCLA Medical Center and I saw the look on his face when the doctors were reading him my test results. The doctors’ told me if I even waited a few more hours to come in, things wouldn’t have ended well.

I was admitted to the ICU at Sutter Davis and stayed there for three days. They seemed to be trying to do anything they could to get a diagnosis and keep me alive. I started developing a really bad pneumonia because they were pumping my body with so much fluid and my lungs started to retain that fluid. It got to the point where I couldn’t lay down because fluid would fill my lungs and any time I moved I would cough so hard I would throw up. I was in the most vulnerable condition I had ever been in my life. I couldn’t walk, I couldn’t go to the bathroom by myself, I was on high flow oxygen, everyone had to help me with everything.

After three nights of being in that state at Sutter, they finally found the Fusobacterium necrophorum in my blood cultures. Sutter is a small community hospital, and so they don’t have the big research facilities that they do at other big hospitals. As soon as this bacteria was isolated, my doctor at Sutter said he had never seen it in his career and didn’t know the best course of treatment. I was then put into an ambulance to UC Davis Medical Center and assigned to one of the head doctors of infectious disease. She said this was only the second case of Lemierre’s Syndrome she had seen in her career.

The biggest concern was the pneumonia since it was being exacerbated by such an aggressive bacteria. They aspirated my lungs, but then they discovered that I had pockets of bacteria invading my right lung, so they placed a chest tube into my lung which stayed there for a week to drain the fluid out. Three times a day they would put a concoction of antibiotics and steroids up the tube, directly into my lungs, close off the tube so it could marinate, then
unclamp the tube to let my chest drain. There is no standard care of treatment for Lemierre’s syndrome because the infection manifests in a variety of ways in every case, but a cocktail of antibiotics is what is normally prescribed. During my hospital stay, I had a total of 12 doctors and a group of medical students who would come in to ask me questions. All these doctors were essential to my successful outcome because collaboration of infectious disease experts, pulmonologists, radiologists, etc. are essential to creating the most effective form of treatment for Lemierre’s Syndrome (Lee). After 14 days in the hospital with many procedures and every test you can imagine, I was finally discharged.

When I left the hospital, I was still on a very intense regimen of antibiotics. I had a PICC line so I could give myself IV antibiotics and I had a nurse who came to my dorm room once a day to do blood work and check my vitals. A PICC line, or peripherally inserted central catheter is an IV they place in your upper arm that connects to your heart, so the antibiotics can be directly pumped throughout your body. Since I hadn’t been able to walk for about 10 days, I had accommodations in school. A golf cart would come and take me to class and I had to take elevators instead of the stairs. I’m thankful for the accommodations the UC Davis Student Disability Center gave me in making my return to school easier. The biggest effect it had on me was the pain that persisted in my lungs for about a year and half after. I had sharp pains in my right lung that I felt every time I took a breath. The pain has reduced over time and now I only feel it when I’m in higher elevations or if I’m blowing up a balloon. Because my tonsils have been getting consistently infected ever since this incident, I will be getting my tonsils removed in June.

While my case ended successfully, I needed to seek care sooner. Lemierre’s syndrome has so few reported cases and a history of delayed diagnoses resulting in complications and death, giving the infection a legendary status in medicine (Lee). I’m lucky to be okay with the state I entered the ER in and if I would have gone sooner, I probably wouldn’t have faced the complications that occurred.
I learned that doctors can make mistakes or give incorrect advice and to that I need to listen to my body. Diagnostic delays in infectious diseases can result in increased mortality and is a public health issue (Suneja, 1). This is partly due to infectious diseases having common, nonspecific symptoms and ordering the wrong tests (Suneja, 6). Since infections can take over the human body so quickly, timely diagnoses are essential, but don’t always happen (Suneja, 1). Seeking a second opinion is necessary and you shouldn’t feel like you’re wasting someone else’s time for seeking a second opinion because that opinion can be the difference between life and death.
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The Social Construction of the Refugee: Borders and Imperialism

TASNIM SAAADA

Writer’s Comment: Upon reading The Social Construction of What by Ian Hacking in my Religious Studies class Religion, Magic, and Science, I became interested in the nature of the terminology we use and the political ramifications they may have. The Palestinian, Syrian, Bosnian, and more recent Ukrainian refugee crisis highlighted the loaded nature of the word refugee as public policy, and people’s livelihoods were all tied to this label and its seemingly ever-changing definition. The negative connotation of the word, specifically to describe people of color fleeing political and economic instability as well as ethnic cleansing, was troubling to me. I wanted to explore why the word has come to define a particular type of person while excluding others, directly affecting their access to asylum, safety, and the public perception their plight comes to mean in the media and the societies they are attempting to assimilate into. Through my research, I began dissecting this phenomenon and delved deeper into the social construction of refugeehood and its effect on Syrian refugees.

Instructor’s Comment: Tasnim picked up one of the core issues in our Religious Seminar on Magic, Science and Religion—the realization that these categories are socially constructed. We had many lively debates about the implications of this realization. Students eagerly adopting the idea without, to my mind, fully comprehending its implications. But not Tasnim, who grabbed onto the idea and subjected it to a rigorous investigation using a very relevant example. She studied the use of the term “woman refugee” in different contexts, making judicious and creative use of search engines. Compiling the data she had generated was a challenge, the difficulty of which is elegantly disguised in her
Words regularly metamorphize, continually altering their meanings, usage, and connotations with time, owing to man’s propensity for evolution and reform. Therefore, social constructionism, a term used to describe the sociological, historical, and philosophical projections that shape the conception and usage of words and ideas, is often used as a model to explain such changes in societies’ ever-evolving landscape. Although at times used liberally due to its propensity to explain or illuminate societal homogeneity, it often lacks nuance and evidential support as it is used to point out a phenomenon rather than explain or dissect why such a word or phenomenon exists. Ian Hacking’s *The Social Constriction of What* sets out to analyze the idea of social constructionism by examining the works of authors who use it to describe or present such claims. However, Hacking believes these works were not written to explain but rather to raise consciousness, which is deemed the value of social constructionism.

Although it is a thought-provoking book that achieves its goal, taking a case study of a topic may further illuminate such claims to the reader and begin to grapple with why certain terms make their way into our lexicon and take root, forming our discourse and perceptions of certain people or ideas. Hacking briefly discusses the women refugee in the second chapter; however, he fails to discuss the term in-depth, as it was employed merely as an example rather than the central claim in his argument. Therefore, by taking Hacking’s central claim on the subject, that the label woman refugee is not an inevitable category, but a classification used to describe one’s circumstance and current conditions leading to her displacement and arrangement within society, one can use this to explain other phenomenons. One can thus apply this to another topic within this
vein, the refugee in the post-modern world and the word’s effect on modern policy making, the international perception that comes with being belied with this term, as well as the socially constructed nature of borders that necessitated the category of the refugee.

**Who Is A Refugee?**

One must start by reaffirming that the refugee, defined as one who is displaced from their native land or home in order to flee war, persecution, or natural disaster, is not socially constructed as their plight and persecution is plain to see; however, the idea is. As Hacking describes, social constructionism is made or molded during a specific time and influenced by certain forces, policies, or movements present at the time, thus altering the usage and definition of the word (Hacking 125). Therefore, the word refugee emerged at a certain time and place and through the coining of the term by a particular person with established authority. The word refugee was first used to describe French Protestant Huguenots who fled France after the revocation of the Edict of Nantes in 1685, which was used to grant minority religious denominations civil rights and religious freedom (The Origin of Refugee). Thus, the word has historically been used to describe displaced people fleeing from political instability or persecution. The word was standardized in 1951 during the Convention Relating to the Status of Refugees, which defined and outlined the usage of the word in the political and humanitarian sphere after the effects of World War II and European mass displacement. It is defined as follows: Owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group, or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country; or who, not having a nationality and being outside the country of his former habitual residence as a result of such events, is unable or, owing to such fear, is unwilling to return to it. (The 1951 Convention)
Taking this into account, one can expand the usage of the word through the reading of Andrew E. Shacknove’s article, *Who is a Refugee?* which aims to examine the various definitions of the world in recent history as well as analyze the implications the adopting of these definitions can have on the population it is trying to represent. He claims that refugeehood is not captured exclusively through persecution or alienation, as these stipulations are sufficient but not necessary (Shacknove 277). Therefore, a better definition than, say, the international one defined through the 1951 Convention Relating to the Status of Refugees might encompass those who are displaced not exclusively through political events that destabilize society but rather any “person whose home state has failed to secure their basic needs” (Shacknove 281). Therefore, citizenship and nationality are key terms in defining a refugee and whether they qualify for international amnesty. Arriving back to social constructionism, one can see that the debate to define, in order to help, refugees is strife with difficulty as the one who defines it will ultimately be the one to decide how the word can be levied to their advantage. The refugee has often been compared with other social groups in order to characterize and alienate them, as defining something inherently limits it.

**Failure of The Word and its Usage**

In the post-modern age, the word has come to be redefined due to increased globalization, the near-constant status of ongoing wars, as well as the politicization of the term to serve governments, drive elections, and journalistic discourse surrounding the now contentious topic. Expanding on the word’s social constructionist nature, one can see through the reporting of ongoing refugee crises how the word is levied to describe and include some people while not others. Presently, new labels are forming; such as the migrant worker, internally displaced people, irregular migrants, and illegal aliens, further complicating the parameters used to describe people fleeing persecution; however, the refugee is still viewed as a neutral
term, most often used in journalistic reporting on the matter. However, one thing remains, these words often fail to humanize and explain complex structural causes for such a vast exodus of people. The Bosnian, Somali, and, more recently, Iraqi, Syrian, and Afghan humanitarian crises have highlighted that the vocabulary used to describe certain people feed a narrative in the host nation tasked with taking them in. The narrative around refugees is one of economic, political, and cultural threat as the discourse surrounding them and their plight is not seen as humanitarian but one of disturbing political and national hegemony.

The development of rigid borders as well as strict immigration laws has necessitated and heightened nationalism sentiment, as the other is very clearly established, forming a hostile and animus point of view towards those who are not part of the in-group. Despite calls for international connectivity and globalization, the border space has generated social categories of whom we let in or keep out in order to mitigate supposed risk and codify those who violate borders. Transgression of the border is thus viewed as a threat to sovereignty and a hindrance to the nation-state’s ability to safeguard borders for those who reside within them (Ibrahim 1467). Therefore, when this rhetoric is spread through the media, it feeds public discourse, which in turn informs governments’ risk management as opinion in public spheres reflects policymaking and data response. Citizens adopt these fears, which exchange the inherent risk they face to the other, weaponizing and dehumanizing the refugee to become a liable threat to democracy, stability, and cultural and national homogeneity.

Media Coverage of Syrian Refugees: A Narrative of Exclusion

Therefore, one can examine the social construction of the word refugee in relation to the media reporting that has taken place since the Syrian Civil War broke out in 2011. Currently, there are 13.5 million displaced Syrians, with 6.8 million Syrian refugees being
hosted in 128 countries, highlighting the severe humanitarian crisis that has taken place since 2011 (The Origin of Refugee). However, through examining the media coverage of the crisis, one can see the marked impartiality of the word’s usage as well as the negative connotation the word has adopted, especially to describe people of color fleeing persecution to neighboring Europe. Although journalists are tasked with unbiasedly educating readers about a conflict, rather than sympathizing and advocating for immigrants, the role of the journalist, and more broadly, popular media outlets’ coverage of news stories, is integral to how the public responds to such information. The CNN Effect, a term coined in the 1990s to explain the relationship between media coverage and policy action, further points to the fact that the language and coverage of certain stories affect public perception, which in turn alters how we use certain words and the subliminal connotations that become attached to them (Day 56).

Even the simple framing of a humanitarian crisis over a civil war can alter public perception of who a refugee is and if they gain the world’s sympathy or ambivalence. Thorbjørnsrud and Figenschou’s qualitative and quantitative analysis of Turkish newspaper coverage of the Syrian conflict found that the media’s framing of the people in question influenced public perception. For example, refugees were framed between victimhood and posing a potential threat dichotomy to the nation. Males were depicted as possible criminals and women and children as innocent and needy, highlighting the disparity the word comes to mean when placed in front of a qualifying attribute (Thorbjørnsrud 3). This points to the importance of framing in relation to the divulging of news to the masses, as words can be adopted to represent renewed meaning if used in conjunction with highly connotative vocabulary.

One must further examine Europe’s use of the word in order to further illuminate the deeper significance this label holds. Data conducted by the United Nations High Commissioner for Refugees through analysis of European press coverage of the Syrian refugee crisis illuminates this fact further. During the beginning
of the crisis, tolerance was the overarching theme dominating news outlets. Although reports of drownings and death on the Mediterranean Sea were common, the overarching theme was cautious humanitarianism. This drastically shifted after the wide circulation of three-year-old Alan Kurdi’s pictures in the media, with increased calls for humanitarianism and increased acknowledgment of the plight of refugees (Georgiou 8). Although this oscillation of attitude would shift throughout the ongoing situation, the press continually frames refugees’ arrival as a set of consequences that Europe will have to solve or eliminate. One can see the framing of their supposed inherent criminality or innocence plays a role in how they are perceived as well as how the receiving nation state’s citizens respond to the refugees’ presence and plight. Underlying racial undertones are also present, as more broadly, ethnicity and nationality play a role in who gets labeled a refugee and which connotative meaning the word begins to inhabit to the public. Therefore, those who wield the term have considerable power to influence public opinion and policy.

How are Refugees Socially Constructed?

Therefore, the narrative surrounding refugees is highly politicized, but none more so than the root cause of the inception of the word. Borders and rigid national hegemony through a national and international debate about what constitutes a citizen and an alien is central to understanding why refugeehood and the status this label affords its inhabitants are so contentious. Therefore, one can argue that the social construction of borders has led to the inception of refugeehood, which in turn becomes an additional social construct man adopts to understand the world and exclude the other from acquiring rights, resources, and dignity. National or tribal hegemony was once determined through lineage, relative geography, and being born into, invited, or initiated into the in-group. Although the exclusion of the other has existed since personal autonomy was established, mankind has
continually adopted vocabulary to explicitly exclude those they deem dangerous, radical, or of unsound thought or opinion.

In civilization's infancy, borders were roughly determined through physical demarcations such as mountains, rivers, and forests, as was the case for the world's oldest civilization, Mesopotamia. Mesopotamia is considered the first civilization to expand and, in turn, protect its borders from other settled tribes in the region, forming the first borderland. In ancient Greece and Rome, borders became more important as they determined citizenship, a new framework that would further influence the modern discourse surrounding citizenship and its effect on refugeehood. One's citizenship could thus determine land ownership, access to resources as well as rights to vote and hold office. Therefore, ideas surrounding borders grew to include ideology as well as geography. This sometimes manifested in physical walls to separate nation-states, further redefining modern ideas surrounding national borders. However, communities were still heavily defined through people rather than geography, as traveling from city-state to city-state and outside Greece or Rome's jurisdiction was relatively easy.

The Treaty of Westfalia in 1648 would additionally alter our shared understanding and adoption of the modern definition of borders as it outlined the modern state system and laid out, "The condition under which state could acquire valid title to territory either by discovery, cessation and annexation" (Jabeen 954). Therefore, colonialism and Western imperialism were the driving forces to establish borders and the strict implementation and interpretation of citizenship, which affords those who acquire it certain rights, privileges, and status within society. This necessitated vocabulary be created to define these new phenomena as ideas, political ideology, or simply one’s supposed inferiority, that will hinder them from proselytizing with the dominant in-group, are sufficient reasons to build walls, fight wars, and protect racial or ethnic "purity." Refugees come to adopt these labels once they cross borders, further illuminating the highly structural rigidity we have come to define our world.
The recent shift to globalization has further complicated the label’s efficacy as the language people use to describe themselves and others is becoming more fluid. However, ethnocentricism and strong national sentiment keep citizens from extending the inclusive language to include others, merely embracing more labels to describe themselves. Taking, for example, the European Union’s open-border policy creating a supra-state region within member states' borders, one can see that society is partially open to open borders; however, only if the border includes those it deems beneficial and homogeneous to the dominant ethnic and cultural ideology. Europe, although rich in national and ethnic diversity, is mostly homogeneous in its 'European Identity.’ However, this is challenged when members feel threatened by individuals of differing faiths and nationalities, as is the case with the present discourse surrounding refugees from Africa, Asia, and the Middle East. Therefore, taking in these individuals is viewed as an avenue to a marked decline in morals, liminality, and stability within the region, further pointing to a policy of exclusion or ambivalence as exclusion is easier to justify than inclusion. The social constructionist nature of the refugee has evolved due to the overemphasis on national borders, cultural and national hegemony, as well as a grandiose impression of a nation's collective consciousness.

Conclusion

Although radicals may express the invalidity or unnecessary nature of the refugee label in modern discourse, one would be wise to note that war, exclusion, and national or racial superiority narratives exist and will continue to exist as long as mankind prospers. Thus the use of such words will be preserved by the status quo and proliferate well into the future. However, the subliminal meaning this label has come to hold is demoralizing, dehumanizing, and robs those who are labeled with it agency and autonomy. Refugees were once doctors, teachers, mothers, daughters, and sons, and
erasing these self-identified labels to be instead substituted with the refugee can be dehumanizing.

These labels have come to mean different things within the social and political discourse as refugees have different rights than asylum seekers, illegal aliens, and legal residents within each respective country, making these labels necessary to ensure vulnerable people get the resources they need. However, outside the political realm, refugeehood can come to denote a compassionate and humanitarian response rather than the animus hostile one in use today. A person’s race, ethnicity, or country of origin should not make one refugee more desirable than another, nor should it pit individuals against one another. Therefore, recognizing that refugeehood would not exist without borders is the first step to redefining this label.
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The Legacy of Port Chicago

MAXWELL WILLIAMS

Writer’s Comment: At the beginning of the school year, Professor Downs and Professor Olmsted introduced me to the history of the Port Chicago Mutiny. Once I began researching the events, I was surprised that I had never heard of it before, despite the fact that it occurred only 36 miles away from Davis. I’ve always known that I wanted to study World War II history and the narratives and stories that came with it. When I entered Professor Azevedo’s writing class and she assigned us our final research project, I knew I wanted to focus on the history of Port Chicago. The history of Port Chicago illustrates a contradiction to the narrative that the Second World War was the “good” war. Through my research, I’ve become more interested in how diverse groups of Americans experienced and felt about the events of the war. I hope that this essay sheds some light on how oppressed groups were treated throughout WWII and how these events shape our perspective on American history.

Instructor’s Comment: Maxwell produced what proved to be one of my favorite research essays from my UWP 102C: Writing in History winter 2022 course. The topic he chose to write on captured my attention from the moment he explained it in his research proposal. Similarly to what Maxwell outlined in his writer’s comment, I too was surprised that I had little more than a cursory understanding of the Port Chicago disaster, especially considering its proximity to UC Davis. Not only is his essay therefore elucidating, but it’s also a great example of how an event like the one at Port Chicago can be used to highlight a bigger issue—here the pervasive racism that plagued
the U.S. military, and American society at large, during World War II. Well written and well researched, Maxwell skillfully weaves larger contextual information about the contemporary treatment of African American servicemen together with the events of the actual disaster and later the Port Chicago Mutiny thus providing an enlightening and engaging essay for his readers.

—Jillian Azevedo, University Writing Program

On the night of July 17, 1944, an explosion rocked the Port Chicago munition facility, instantly killing 320 American sailors and injuring 400 more. The harbor had been entirely destroyed, covered in debris and the dismembered remains of the working men who had been preparing to go to bed in the neighboring barracks when they were hurled through the air with an ear-rattling boom. It was a genuinely terrifying scene, one that would not vanish from the minds of the black seamen that were there. Prior to this, Secretary of the Navy Frank Knox emphasized that segregation and racism were “deeply rooted facts of life in American society,” before the war and desegregation “would hurt the war effort,” because white sailors would not work well with black sailors\(^1\). Black military personnel had to fight a two-front war, one at home and one abroad. Fascist regimes posed a threat to the freedom that Western democracies represented throughout the world. At home, the oppressed populations regarded the war as a method of achieving their own liberation. The Port Chicago explosion and mutiny trial exposed the racial inequalities of not only the era, but of American society as a whole. The incident also calls into question conditional narratives centered on the cultural concept of World War II as the “good” war. For African Americans

“the inconsistency of fighting Nazism with racially segregated military units was not lost in black Americans.”

Before the disaster, Port Chicago workers recognized that their working conditions were inadequate, indicating the militaries’ racially motivated disregard for the safety of the black stevedores. When an African American man enlisted or was drafted into the navy during World War II, he was transported to start training at the Great Lakes Training Center, the only training facility for black sailors. The young men would stay for two to three months before being sent to their regular duties. When they arrived, the majority of the men “expected to be trained to go to sea, to become sailors.” However, the majority of these men would be shipped to various ammunition bases, with no idea what their duty would be or where they were heading. African Americans found themselves in the same situation as they did in civilian life, as a “source of cheap, subordinated labor in both domains.”

The men had no prior training on how to load munitions before arriving at Port Chicago since they were originally trained to go overseas. The labor the black stevedores had to undertake had “special hazards requiring special training, and they were not trained for it.” Loading munitions onto the ships became a hands-on learning experience. African American sailors did all of the hard labor while the white officers stood off to the side and instructed the men. The officers at the munitions base prioritized speed as a technique of completing work, having two divisions compete for a prize. Multiple parties expressed concerns about the combination of inadequate training and an unreasonably fast-paced work environment. Weeks prior to the explosion, the longshoremen’s

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union reached out to warn the base that a disaster was imminent if they did not properly train the seamen to load munitions. The union volunteered to send experienced members to help train the black stevedores, but “this offer was apparently ignored by the Navy.” Some African American laborers at Port Chicago voiced their concerns with their work loading munitions, but were turned away to return to work. The higher-ranking military personnel at Port Chicago were disorganized and arrogant, ignoring grievances while putting black laborers in a hazardous work environment.

Historically, African Americans’ participation in the United States’ wars were limited to menial and manual labor, demands that primarily met those of white soldiers. During the American Civil War, for example, African Americans were only permitted to participate in the war effort following “a strident campaign by black and white abolitionists.” Three hundred thousand African Americans worked as laborers or servants. In comparison to their white counterparts, African American men received inferior equipment, inadequate medical care, and did not receive equal pay until 1864. In the Great War, of the 400,000 African Americans who served, “only 10% were assigned to combat units,” while the rest worked in labor battalions. These forms of discrimination against African Americans continued into World War II. Only 2,807 of the 116,000 enlisted naval men were of color when the war broke out in 1939. Discrimination against African Americans in the military ranks was not of any surprise, but rather an intrinsic feature of how the military industrial complex functioned in America.

The explosion at Port Chicago revealed the black seamen’s concern for their safety and the genuine racial inequalities that existed within the ranks of the United States Navy. Two ships, the

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6 Allen, The Port Chicago Mutiny, 42.
7 Ibid, 33.
8 Ibid.
S.S. Quinault and the S.S. Bryan, were docked in Port Chicago's harbor on the day of the explosion with thousands of barrels of explosives. At 10:18 p.m. that night, two powerful sequences of explosions lit up the pier, destroying everything in its path. The explosion shook the town of Port Chicago, collapsing the ceilings of a local movie theater onto the auditorium; however, no one was injured. The explosion was “equivalent to an earthquake measuring 3.4 on the Richter scale,” according to seismic graphs in Berkeley, California. Furthermore, the explosion's human toll was catastrophic, particularly the number of African Americans who were affected. The deaths of African American at Port Chicago accounted for “15% of total African American military losses during World War II.” Those who survived the explosion were left in shock and afraid of another explosion. These men assumed that they would be granted leave because such a catastrophic tragedy had occurred. However, “African American sailors were refused leave and were assigned the gruesome task of clearing the area of wreckage and searching for remains.” Their white counterparts, on the other hand, were granted a 30-day leave. To top it all off, the black stevedores were sent back to loading armaments at the Mare Island Navy Yard in Vallejo with no further guidance on how to prevent such an occurrence from happening again.

The Naval Court of Inquiry was tasked with investigating the incident, exposing the high-ranking navy commanders’ negligence and discrimination against the black enlisted men who perished. One hundred and twenty-five witnesses testified in court, including Port Chicago survivors, personnel, ordnance specialists, ship inspectors, and eyewitnesses to the event. Despite the fact that almost all of the people who handled the munitions and worked on the winches were African American, “only five black witnesses

11 Ibid, 2.
12 Ibid, 2.
were called to testify."\textsuperscript{13} The key point of contention in the court was whether the working conditions were safe enough for the men to be working in the first place. The issue of trained contract stevedores coming to Port Chicago to train the enlisted men came up again during the working conditions debate. The port director had suggested “contract stevedores be brought in to do the loading at Port Chicago.”\textsuperscript{14} Safety regulations could not be avoided during the investigation, but that did not stop the officers from pointing out who was to blame. They also heard testimony about whether there was sabotage, bomb defects, equipment problems, or organizational problems. The competition that the officers put the black enlisted men through was also discussed throughout the investigation, although it was not identified as a cause of the explosion. Captain Kinne, the man in charge of Port Chicago, merely stated that the junior officers, who said the competition in loading munitions was dangerous, didn’t know what they were talking about. The white officers were given a slap on the wrist for the competition aboard the ships, while the black men who died in the explosion were blamed for the disaster.

When the surviving men were ordered to return to work on Mare Island in Vallejo, 250 of them refused out of fear and shock. This demonstrated the workers’ determination to affect change and expose the racial injustices perpetrated against them. Joseph Small, a black seaman at Port Chicago, was one of the unelected leaders of the workforce at the munitions base. Small developed a strong reputation among the workers as a man who would stand up to the officers and voice their concerns. On August 9th, Small and the other men did exactly that. They all headed toward their allocated pier to load explosives when the officers directed them to. The division abruptly came to a halt, though, as the men were fearful that another explosion might occur since there had been no adjustments to the facility’s conditions or a plan to adequately

\textsuperscript{13} Allen, The Port Chicago Mutiny, 69.
\textsuperscript{14} Ibid.
train the men. Simultaneously, the men were frustrated that there were no white seamen who assisted in loading the ammunition. White navy men were treated more equitably, especially following the explosion. Small saw that the “work stoppage was inevitable. It would have happened. But something had to happen to give it a shove. The explosion was the instrument by which all of this injustice was brought to light.”\(^{15}\)

When the men refused to return to work, they were taken onto the barge and interrogated by higher-ranking officers. Some of the men were threatened with being shot in an attempt to scare them back to work. By the end of the interrogation, just 50 of the men had refused to break their commitment; they were all charged with mutiny against the United States government during a time of war.

The men at Port Chicago had no intention of staging a mutiny against the U.S. government; they desired a better working environment and sufficient training before returning to work. The decisions were made by the men independently, on an individual psychological level. Each individual had their own emotional connection to the event, uninfluenced by other group members. Martin Bordenave, an 18-year-old who had been thrown out of the military for being too young two years prior, expressed his dissatisfaction with the conditions at Port Chicago. He stated “every day was a miserable day there and when the explosion come up, that just made me make up my mind I wasn’t going to do it no more.”\(^{16}\)

Bordenave was not persuaded to commit to the work stoppage by any leader; instead, he recognized his opportunity when the explosion occurred. His personal experience echoed many of the other men’s concerns about not loading explosives. Another Port Chicago worker, Percy Robinson, saw the stoppage as


an opportunity—“well, if you don’t let us go home, we ain’t gonna work. It was one of those kind of deals.”

17 He watched how the white officers were allowed leave, but black workers who directly worked on the ships were not. Finally, Cyril Sheppard, a laborer who had previously worked aboard ships prior to Port Chicago, despised the navy’s segregated organization. He had been trained as a gunner and wished to serve in the Pacific. He stated “put me on a ship and let me fight out there; take my chances out there. Don’t want to lose my life due to somebody else’s negligence.”

18 Sheppard was not seeking to drag the other people he worked with down; rather, he was pointing out that their training was designed to prepare them for combat, not to load explosives. Even though he knew how to load ammunition, he was aware that another event would occur if all the men were not properly trained. Each of the men at Port Chicago described why they were on strike, revealing the development of individuals into a spontaneous self-conscious collective.

The men who refused to go to work, known formally as the Port Chicago Fifty, were tried for mutiny and refused to give in due to their strong commitment to exposing the wrongdoings at Port Chicago. The prosecution in the trial was very focused on the idea that the work stoppage was started by a ringleader. Small was perceived as the ringleader, although there was no formal leader who commanded everyone to decline work. He stated “nobody made me nothing. I said we don’t need a leader if you know what’s going on on that base.”

19 The men had no problem returning to work; their only issue was that they were “scared of ammunition.”

20 They never used force to fight the US military or planned to take over

an entire ship; they simply saw the situation as a work stoppage, in which they needed to be properly trained to perform their duties. Small remarked that the work stoppage “was just brought on by circumstances, working conditions – it was inevitable.”

The defense emphasized there was no mutinous conspiracy and that the men were still in shock following the explosion. They claimed fear was to account for the stoppage, describing it as “an uncontrollable fear, a fear actually that controls your actions and influences your normal reasoning beyond your ability to handle it.”

The defense went on to clarify that the men had the right to petition not to handle the ammunition, and questioned whether they could blame the men for being terrified to continue. All the men wanted was to be treated fairly, just like the rest of the white military personnel. However, the court decided not to consider the men’s individual circumstances. All of them were charged and sent to the Terminal Island Disciplinary Barracks in San Pedro.

The events at Port Chicago highlighted the racist undertones that hampered the black community during the Second World War. During times of war “civilians from a democratic-society, even an imperfectly democratic society, willingly submit themselves to such authoritarian direction only when they believe in the purpose and fairness of the system.”

The vast majority of African American men found this to be inaccurate. The men at Port Chicago believed that joining the war effort could help them overcome racial discrimination. In truth, the military was structured in such a way that it demanded complete obedience from its African American soldiers. The US military had zero tolerance for African Americans who stood up for their civil rights. Racial discrimination committed by the US government against the African American population during World War II needs more examination in the context of

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21 Allen, The Port Chicago Mutiny, 139.
WWII narratives. Port Chicago should be viewed as a common subconscious of the American psyche during this age, rather than an anomaly. African Americans understood that the U.S military was no different from any other facet of American society. Racism followed African Americans wherever they went, even while they were fighting the same battle to preserve democracy. War does not conceal any of the bigotry that afflicts a society; rather, it makes it more visible.
References


Don't be so Quick to Call it a Silver Lining: The Legacy of Mercury Mining in the Bay Area

Miranda Kushner

Writer’s Comment: I only took *Water in the West* by chance, hoping that a historical approach to natural resources would be more interesting than the policy and toxicology courses my department suggested I take. Ten minutes into the first lecture, I realized that I was not just more interested in this material than that of any previous science-oriented natural resource courses, but that it was directly applicable to my interest in the social impacts of environmental issues. My final assignment for this course was to choose a Southwestern water project and discuss how it ties into the broader history of water in the United States. While everything I learned in this course gave me a deeper understanding of the region I call my home, I wanted to use this assignment as an opportunity to research a water issue near where I grew up. I settled on a site only twenty minutes from where I grew up, New Almaden Creek and the adjacent mercury mines.

Instructor’s Comment: The environmental impact of the California gold rush is a much-studied subject, but relatively few people are aware that one of the lesser-known auxiliary industries, the mining of mercury, has left California with a particularly toxic legacy. Mercury was a key element in the gold mining process. The discovery of mercury deposits in San Jose and in the Pacific Coast range near Clear Lake meant that mercury mines began to open around the same time as California’s gold mines. Miranda Kushner explores the origins of California’s mercury mining industry and the highly toxic and intractable legacies it has left us, especially in the rivers and streams of the San Francisco Bay.
area, and in the bay itself. For many, the gold rush yet symbolizes new beginnings. In “Don’t Be So Quick to Call It a Silver Lining: The Legacy of Mercury Mining in the Bay Area,” Miranda Kushner points to the ways that enduring mercury toxicity creates barriers to environmental renewal and resilience, and the expensive precautions required to overcome those barriers.

—Louis Warren, Department of History

The Gold Rush of the 1850s had an immediate and obvious effect on the development of early California. Underlying the economic and population booms, though just as

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pervasive, is the direct environmental impact gold mining had on California’s water and natural resources. While so-called gold fever raged through the Sierras, gold’s partner in hydraulic mining, mercury, was being extracted from the foothills of the Santa Cruz Mountains. Mercury poisoning was a common cause of illness and death among gold, and, perhaps obviously, mercury miners during this time period, and its lingering presence in the South Bay’s watershed is still felt today. One of the more prominent mercury mines was the New Almaden Quicksilver Mine in Santa Clara County, California, just south of San Jose. In recent years, the regional water district has undertaken the Almaden Lake Improvement Project in an effort to improve the conditions of the adjacent Almaden Lake. The discovery of gold in California set off a chain of events, of which this water project is only one of the latest. Modern policy-makers and resource managers are left to grapple with the complicated legacy of America’s rapid expansion into the western territories, as the rash and opportunistic forms of resource exploitation still make their effects seen in the water residents consume.

When walking the trails of San Jose’s Almaden Quicksilver County Park, it is hard to ignore the signs of what was once a small, but lively mining town. In 1824, acting on a lead from one of the region’s native people, Mexican settler Antonio Sunol found numerous deposits of cinnabar in the area that would then become the New Almaden Mines.\(^2\) Cinnabar, known as \textit{mohetka} by the original Ohlone residents of this land who used it as face and body paint, is a bright red mercury compound. This \textit{mohetka}, or red earth, became a valuable commodity among native groups, making the area’s Ohlone the first to grow rich off the mercury deposits in the Santa Cruz Mountains. By the time Sunol caught wind of the resource, the Ohlone had abandoned the use of cinnabar on their

skin, even going as far as to label the red earth as “evil” due to its poisonous effects\(^3\). Sunol attempted to extract the silvery veins of ore from the rock, mistakenly believing they were silver, before abandoning the venture, which had proven to be too costly. Not long after, in 1845, the Spanish Andres Castillero became aware of the ore, and undertook the process of extracting the mercury. Castillero, already experienced in quicksilver mining from his time in La Mancha in Spain, named the venture *Nueva Almaden* after the impressive mercury mine in Spain’s old Almaden\(^4\). Predating the discovery of gold in California, New Almaden, and the adjacent so-called Spanishtown\(^5\), was the first mine and mining community in the state, making Castillero and his eventual British partners a substantial profit\(^6\).

This mercury mine was already making its owners a significant profit, but their industry really took off with the discovery of gold in California. In 1848, John Marshall spotted something glimmering in Sutter Creek, only a short distance out from New Almaden and it’s mine, and in doing so, altered the trajectory of the California territory forever. The impact the ensuing Gold Rush had on the growth and economy of California cannot be overstated, and that impact did not neglect the New Almaden mine. The most efficient form of gold mining, hydraulic mining, uses mercury as an essential part of the gold recovery process. Hydraulic miners use mercury as it amalgamates with gold, making it heavier and easier to separate from the rush of sediment created by hydraulic mining\(^7\). As practical as this was for both the mercury and gold

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\(^7\) Alexandria Herr, “Mercury in Our Waters: The 10,000-Year Legacy of California’s
mining companies, at least from a money-making standpoint, the dangerous effects of mercury were clear from the beginning, and were documented as far back as the Ohlone natives, who had stopped using cinnabar facepaint after connecting it to salivation and other symptoms of mercury poisoning. For smelting employees in New Almaden exposed to significant amounts of mercury fumes every day, the symptoms were pervasive and pronounced, to the eventual point of ten percent of mine workers experiencing salivation. The metaphorical “gold fever” that drew so many miners to California in the first place became a real illness, as miners risked exposure every time they went to work. People directly involved in the industry were not the only ones affected, as the nature of hydraulic mining infamously led to erosion and deadly flooding, and, significantly, washed sediments and other waste materials into surrounding environments. Now, amounts of mercury linger in Northern California’s watersheds, originating from gold mining residue in the Sierras, and mercury processing in San Jose. The mercury refinement process created a waste product known as calcines, which miners would casually discard along nearby waterbanks. It took next to nothing for this waste to wash into the water, flowing through the San Jose watershed and all the way out to the San Francisco Bay.

The south Bay Area and its tributaries contribute a large proportion of the mercury that ends up in the greater Bay Area watershed. A particular site of mercury contamination is Almaden Lake, which, as the name suggests, lies just five miles downstream of the now-defunct mine. Almaden Lake is a man-made body of...
water, created by the destruction of a levee that once separated the area from Los Alamitos Creek. This lake is a popular recreational site for residents of Santa Clara County, as well as a habitat for endangered native fish and other animals. Unfortunately for the fish that use it as a habitat corridor and for the humans and animals that eat them, Almaden Lake is essentially a dumping ground for the Bay Area’s single largest source of mercury. In fact, mercury levels in the greater Bay Area are one-hundred times higher than those of comparably sized estuaries elsewhere, and the Guadalupe River, which flows from Almaden Lake, has levels five times higher than the bay proper. Clearly, the Guadalupe watershed has a quicksilver problem, and one that is only enhanced by the chemical reaction mercury undergoes when it encounters organic waste and becomes the more dangerous methylmercury. In 2012, Santa Clara County’s water authority, Valley Water, began the planning and research for what they named the Almaden Lake Improvement Project. While the project, slated to start in 2020, has since been delayed due to COVID-related complications, it promises to deliver, if not a fully clean Guadalupe watershed, at least some relief from the contamination that continues to accumulate. The plan proposes building a new levee between Los Alamitos Creek and Almaden Lake, preventing future mercury-laden sediment from washing down from the mines. The risk of disturbing the sediment at the lakebed and creating a greater mercury flow problem is not insignificant, so this plan focuses instead on preventing future accumulation and improving water flow, both of which will lessen

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13 Santa Clara Valley Water District, “Almaden Lake Improvement Project” (report, Santa Clara County, California, 2019), 1-4.
the climb of mercury through the environment’s trophic levels\textsuperscript{15}. Valley Water presents a clear plan to lessen the impact of mercury on its environment, and while COVID delays mean its success remains to be seen, this project works to minimize the negative legacy of gold mining.

Outside of the New Almaden area, there has been less direction in mercury contamination projects. After all, mercury is not just a problem in the Guadalupe watershed, but rather an environmental concern that haunts large regions throughout northern California. While in the San Jose area, the history of quicksilver mining is so ubiquitous that the local paper named itself \textit{The Mercury News}, there were actually dozens more mercury mines throughout Northern California. One area with such mines is Cache Creek, a site to the northeast of San Jose, that is responsible for fifty percent of the mercury, and only two percent of the water, that flows into the Sacramento River\textsuperscript{16}. Just as the Guadalupe River washes into the San Francisco Bay, so does the Sacramento River, adding to the significant presence of mercury in the ocean. Cache Creek is located in Yolo County, California, near the city of Woodland. The creek runs from Clear Lake near Mendocino, where it collects sediment from the Sulfur Bank Mine Superfund site, to the Sacramento River\textsuperscript{17}. In wet years it flows through the Yolo Bypass, a wildlife area that provides a home to many species of migratory waterbirds throughout the year\textsuperscript{18}. Much like the Guadalupe River, Cache Creek owes its mercury contamination to upstream quicksilver mining, which likewise served to provide the essential

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\textsuperscript{15} Santa Clara Valley Water District, “Almaden Lake Improvement Project” (report, Santa Clara County, California, 2019), 1-4.
\textsuperscript{17} California Water Boards, “Cache Creek Sub-Watershed” (State of the Watershed Report, California, 2002), 1.
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gold-mining resource in the 1850s. While not near to an individual prolific mining site, the area near Cache Creek contains at least forty mines, all of which contribute sediment and pollution to the creek\textsuperscript{19}. All this mercury runoff has led Cache Creek to be one of the largest sources of mercury contamination in the San Francisco Bay watershed, washing through the Sacramento River, into Suisun Bay, and depositing in pockets throughout the East Bay region\textsuperscript{20}. The mercury becomes trapped in silt, which allows it to drift further down into the watershed. Larger pieces of mining debris sink to the bottom of the creek upstream, while lighter particles flow through, lingering in the Sacramento Delta or even joining other sources of mercury in entering the Bay itself\textsuperscript{21}. The risk of this, and in all parts of the Bay Area that feature high amounts of contamination, is that mercury bioaccumulates, meaning it remains in the food chain indefinitely.\textsuperscript{22}


This bioaccumulation of mercury, which is present in much of the greater Bay Area’s watershed, poses a hazard not just to humans, but to the ecosystem at large. When mercury enters the watershed, it combines with organic matter and becomes methylmercury, which is the specific neurotoxin that fish, birds, and even humans inadvertently consume. Additionally, due to the ecological process of biomagnification, animals at the top of the food chain consume far more methylmercury than those at the bottom. For this reason, as harmful as consuming a fish caught in mercury-filled waters may be, hunting and eating the waterfowl that eat these fish, a practice permitted in parts of the Cache Creek Settling Basin,

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is even more harmful. There is already existing legislation that intends to improve the quality of water, such as the Clean Water Act of 1969, which, among other things, requires governments to do their part in cleaning mercury out of contaminated waters. However, as has been seen by the New Almaden Project creating infrastructure as opposed to cleaning, this practice can be very difficult and expensive. In lieu of removing the contaminant from the greater Bay Area’s water, local governments have settled for a combination of monitoring programs and warnings. This system of prevention instead of action only staves off responsibility, and also puts the health of native tribes that traditionally consume river fish at risk.  

This approach, which is more reactive than proactive, is prominent in the mercury-contaminated parts of the Sacramento Delta, which is the area Cache Creek feeds into. The New Almaden Improvement Project in the south Bay Area is, while also not capable of removing mercury from the environment, at least a stronger attempt at keeping it from further entering the food chain. Beyond Cache Creek, there are dozens more sites of mercury-contaminated water in Northern California, all caused by the long-ago action of mercury mining. All these sites pose risks to their animal and human inhabitants, while the mines and their purpose themselves have faded into memory.

While not providing a surefire way to erase the impact of over a century’s worth of mercury mining, Valley Water’s Almaden Lake Improvement Project at the very least makes an effort to stop the problem from becoming any worse. Ultimately,

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the rush to exploit California’s natural treasures made a lot of men very rich, while causing an entire host of consequences that are not at all limited to the long term. Even while the mines were active, New Almaden workers were being poisoned as one of the first byproducts of the Gold Rush. This pattern only continues today, as residents of the same area are warned not to eat anything caught in the lakes or creeks of their own backyards.
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Santa Clara Valley Water District, “Almaden Lake Improvement Project” (report, Santa Clara County, California, 2019), 1-4.


Amidst winter quarter lockdowns, I was socially and physically isolated in my room. That was when my landscape architecture class forced me outside to complete a field study project that revolutionized my perspective on the world. I traveled a 5 mile stretch in Davis. I stopped at regular intervals to sketch, take notes, and pose questions about my surroundings. I began collecting potential narrative threads, hints of past stories woven into the spaces I typically overlooked. Then I took these threads and ran with them – researching, investigating, and interrogating what I had seen. I came to realize that the built environment of Davis is a historical chronicle of how the town has expanded from its agricultural roots, how it is intertwined with UC Davis, and how all of this is shaping the city’s future. My field study and subsequent research taught me about the city I live in, the language of landscapes, and the fact that the mundane is never as dull as it seems.

The ambitious goal of this assignment is to change how students interpret, understand, and experience the world around them. After their first field visit, students often return to the classroom frustrated saying there is nothing to see or say about the landscape they visited. Annie embraced this challenge. Her enthusiasm for learning the secrets of a place – who lives and lived there, why it looks the way it does, what was there before – came through clearly. Motivated to learn as much as she could about her new community of Davis, and as a convenient reason to escape the pandemic-induced confines of the dorm, Annie exceeded
the requirements of the assignment by repeatedly visiting study sites, researching their histories, and producing beautiful annotated-sketches of the places. Her newly acquired skill of reading the landscape will serve her well in future coursework and as a design professional.

—Patsy E. Owens, Department of Human Ecology

When I plotted the course of my transect, classes were entirely online to combat Omicron. I was trapped alone and miserable in my dorm. Amid this social and physical isolation, I decided that I would use my transect to force myself to explore and get to know Davis. My transect is divided into two halves. This is the suburban portion (stops 1-3), traveling westward along Russell/5th Street.

During these stops and in the research I conducted afterwards, I learned about Davis’s expansion (past and present) and the stories underlying seemingly bland structures. Throughout my travels I was fascinated to look more closely at the landscape surrounding my new home base. I was able to develop both stronger observational and research skills, all whilst I began learning the vocabulary of a previously hidden language: the landscape.
Stop 1: the Davis Police Station

Considering the continuing tension between students and police over the pepper spray incident, I could not resist choosing the Davis police station as a stopping point. When I visited the station at the far east end of my transect I was struck by its subtly complex architecture and quiet surroundings, in contrast to what I had heard of its rocky history.

I was intrigued by the concrete stumps in front of the entranceway; a feature I have seen on other buildings but never took real notice of. These are called “bollards” and are a form of target hardening. Bollards are placed in front of (glass) entranceways to buildings to prevent cars from driving straight through. (Figure 2, “Bollard”, n.d.) In the Davis police station the bollards are no-nonsense concrete protrusions which may seem spartan and unimaginative, but successfully straddle the divide between a pure pragmatism and interesting architecture. It is the small details, upon closer inspection, which make the police station feel harmonious and not-entirely bland.

Law enforcement in Davis began with its incorporation in
1917, with the appointment of a city marshal and the first police facility standing on Oak Street. It was known as a “plank jail”. The first full-time and paid police officer was hired in 1927, and the location of the police station has continued to shift over time. (Davis Police Department 2013 Annual Report 7) Upon first glance, I assumed that this iteration of the Davis police station was constructed during the 1970’s, based on the architectural similarity to my 70’s elementary school. Despite a surprising amount of difficulty finding newspaper articles about the construction of the police station, it actually appears to have been built during the 2000’s by the Indigo Architecture firm (“Davis Police Department - Davis”, n.d., “Our Projects — Indigo | Hammond + Playle Architects, LLP,” n.d.) My hypothesized date for the construction of the Davis police station is further corroborated by careful examination of the expansion of Davis’s city limits.

![Figure 3. 1870 blueprint of Davis.](image)

Figure 3 is a historical blueprint of Davis which essentially ends the city at fourth street—my transect runs through fifth. (“Davis”, n.d.) Logically this makes sense. Davis began as a whistlestop town (initially “Davisville”) which would have begun at first street. As the town expanded, new streets would have been added to the North, increasing in sequence. This grid-based
approach is common in American city development, and corresponds to the meridian-base approach of the Jeffersonian grid.

Figure 4 is a development phasing map of Davis from the mid-70’s indicates that the probable location of the police station was a part of the “urban reserve”, a term which is undefined and ambiguous. It also includes a road named “Wilson Boulevard” which ran between Mace Boulevard and Pole Line Road and seems to no longer exist. (“City of Davis development phasing,” 1975) My hypothesis about this “urban reserve” label is that it indicates that the land was intended to be held back for long term later development, not a part of the shorter-term phase one and two they indicated here. The archival specialist helping me explained that the city of Davis intentionally restricts the outward expansion of the city in order to keep property values high. Keeping areas in reserve for the future would have been a part of a long-term approach towards development, and very in-character for the city. Figure 5 is a section of a later map of Davis, from 1984. This closeup shows the Rancho Yolo Mobile Home Park, whose memorable concentric circles remain a distinguishable aerial landmark today. The map also indicates that the city limits end only a couple of blocks away from where the park ends. (“Zoning and house numbering map, City of Davis, California,” 1984) This is roughly where the police station stands.
Stop 2: G and 5th Street

My second stop was at a four-way intersection between 5th and G Street. This included several buildings, the most notable of which were the Avant Garde Salon, Yolo Federal Credit Union, an unnamed office space at 434, and Hibbert Lumber (see Figures 7-9). While walking past 434 G Street, I was surprised to spy a large plaque reading “Mars” and a significant amount of construction underway. It looked as though the whole floor was being replaced. I failed to capture what I saw of the building’s interior thanks to the glass’s reflection (Figure 10). For such a seemingly quiet building (Figure 11), there appeared to be a lot going on inside. What I immediately concluded after seeing the “Mars” plaque was that the building was slated to be a future office for the candy company Mars Wrigley, known for being the creators of M&M’s, Twix, Skittles, Snickers, and more. But my next question was why would a major food corporation really choose to locate themselves in Davis?
During my agriculture development and plant science classes, I received a hint as to why: the university conducts cocoa bean research funded by Mars. The partnership between Mars Wrigley and Davis began in 1974, leading to research on specific crops (such as cocoa, peanut, and mint), natural dyes, aflatoxins, and other agroecological subjects. (About MARI, n.d., Filmer, 2020) During a tour of the Mars Wrigley greenhouses on campus Allison enthusiastically told me about the company’s plans for 434 G Street: the facility is intended to be a level 2 biosafety area to study integrated pest management (IPM). The location was chosen to place it within the vicinity of other Mars facilities, but far enough to protect the rare genomes they tend to.
Stop 3: Anderson and Russell

Stop 3 is the one I was most familiar with before the transect: the crossing of La Rue and Russell. I struggled to depict this in my sketches, but the intersection is bustling with cars, pedestrians, and cyclists. I noticed two women on the medians trying to sell flowers to the cars nearby. Groups of students on bikes and on foot crossed together, chatting whilst they went here and there. And the cars—they whizz and zoom unpredictably by (the reputation of Californian drivers is justifiably poor). (Figures 12-14) It is interesting to compare what the current experience of the road is like to what it might have been in the past. 1960’s Davis looked entirely different from today. The 1960 numbering map (Figure 15) shows that land south of Russell was university property and hints at the extent of the university’s research and training farmland. There was some residential, but mostly farm lots north of Russell. (City of Davis, California: including the University of California at Davis,” 1960)

Two years later, the Davis university became a part of the UC system. According to the City of Davis website, this marked the beginning of several decades of population and construction boom (similar to that occurring in other parts of California) before a more environmentally conscious attitude caused growth to level
out. (“History,” n.d.) I found a photograph of Davis two years after it became a part of the UC system, and four years after the numbering map: Figure 16 was taken aerially in 1964. The four original Segundo dorms are visible in the southeast corner. (“Aerial photos of Yolo County, California,” 1964) The majority of the area is still farmland. Where the Rite Aid is located there seems to be an unidentifiable structure. But the corner where the AM PM is now was just fields. Where the Segundo Service Center and Market are there are fields. Though Figure 15 hints at the extent of rural spaces in Davis, it is the clear imagery in Figure 16 which truly drives the difference home.

**Figure 16a: 1964 closeup on aerial photograph of Davis.**

**Figure 16b: Comparison to today.**

**Conclusion**

Though Davis may appear to be a sleepy and non-descript university town, I learned from this assignment that there is always more than meets the eye. Stop 1 at the Davis police station helped me see just how much the city has expanded since its whistle-stop days. Stop 2 at the intersection of G and 5th Street gave me the chance to see how UC Davis has had ramifications on the sorts of businesses and corporations which establish a presence in Davis.
Anderson and Russell (Stop 3) was the closest to home—it helped me capture a glimpse of what UC Davis might have been like in the “good old days”.

John Brinckerhoff Jackson, quoted in a paper by Lewis, said this: “Over and over again I’ve said the commonplace aspects of the contemporary landscape—the streets and houses and fields and places of work—could teach us a great deal, not only about American history and American society, but about ourselves, and how we relate to the world. It’s a matter of learning how to see.” (“The Monument and the Bungalow”, Jackson, in Calo 1989, quoted by Lewis 1998) What I enjoyed most about this assignment was not just learning about Davis, but also learning how to read a new language: the landscape itself. Rather than overlook the mundane, I have built a bigger toolbox to better view and describe the places I see—in Northern California, and beyond.
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Come Hell or High Water: The Effect of Housing Discrimination on Environmental Justice within the United States

Lauren Ward

Writer’s Comment: It is recklessly simple to overlook the details when tasked with a challenge such as climate change. Within the United States, climate change will disproportionately affect communities of color and resource-limited communities. Part of this inequity is purposeful as it is based on the historic practices of housing discrimination. In UWP 104J: Writing in Social Justice, students explore social justice topics from an interdisciplinary approach. As an aspiring ecologist, I examine climate change from a scientific perspective. In my coursework, we’d look at sea level rise as predicated in the next 50 to 100 years. When viewing these maps, all I could think about we’re the people who lived in those communities—how my family lived in those communities—communities that are slated to one-day be underwater. With the constant, spasmodic thoughts of future climate impacts, I needed to discern that the intersection between housing discrimination and climate justice. It is my hope that this paper provides the groundwork to inspire local action and potentially broader change as is necessary for the continued survival of our communities and ourselves.

Instructor’s Comment: Written for my UWP 104J: Writing in Social Justice class, Lauren’s important essay on the intersection of climate change and racial inequality proves engaging from the first sentence. By beginning with her own family friend’s story of living in New Orleans in 2005, readers are invited to consider climate catastrophes and how they disproportionately affect BIPOC communities throughout
the country. Expertly weaving together the United States’s history of colonialism, racism, and environmental policies, Lauren demonstrates the heightened vulnerability communities of color continue to face as the effects of climate change only increase from year to year. As she notes, even climate change fails to serve as an equalizer as those who have been historically marginalized continue to disproportionately suffer from these catastrophic climate events. After skillfully highlighting this for her readers, Lauren closes with a crucial call to action: we need to advocate that our government enact environmental policies that are sensitive to the social justice inequities at play as well.

—Jillian Azevedo, University Writing Program

Introduction

On the second floor of her generations-old home, all Anne Jacobson* could do was pray and rock herself back and forth. The water had started rising early in the morning and it didn’t seem to stop as New Orleans faced one of the most devastating hurricanes to make landfall in decades. Whenever Anne is asked to relive what that moment must’ve felt like she recites the same phrase she always has: the only thing she could do then was pray, come hell or high water. It seems all too common of a story now—communities ravaged by floods or wildfires or extreme heat or polluted air or poisoned water. All are left wrecked and overwhelmed by the effects of greater malfeasance in action. As the effect of climate change continues to devastate our planet and climate catastrophes become increasingly more common, there are communities of people who will be severely more affected than others due to factors that stem from the same overarching problems climate change itself is caused by: colonialism and capitalism.

Racism is greatly associated with the development of

* Please note that Anne Jacobson, in actuality, is a close family friend. After the flood in 2005, she decided not to rebuild and now lives in Dallas, Texas.
Climate Change is a Racial Justice Issue

Human activities have unequivocally warmed the atmosphere, ocean, and land due to exceeding carbon emissions. According to the EPA, human activities are responsible for almost all the increase in greenhouse gases in the atmosphere over the last 150 years (EPA, 2022). Our anthropogenic activity is deeply entrenched in capitalistic motives, which have now subjected the global community to suffering and endangerment. Since 1988, just 100 companies have been responsible for 71% of carbon dioxide emissions (Faria et al, 2017). The health-related impacts of climate change are slated to expose vulnerable populations most heavily to heat-related illness and death, injury and mortality from extreme weather events, respiratory illnesses due to increased pollution, water-borne diseases, and other water-related health impacts, to name just a few (WHO, 2021).

Earlier this year, the Intergovernmental Panel on Climate Change (IPCC) released its sixth assessment on the state of climate change naming “colonialism” as a historic and current driver of the climate crisis. Though colonialism was declared over decades ago, the historic practice to exploit a group of peoples and their natural resources has further exacerbated the climate crisis burden on low-income communities and communities of color

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(IPCC, 2022). Historical and present-day structural inequities that were formed under unequal power relationships have left indigenous communities, communities of color, and resource-limited communities exposed to more climate-sensitive health risks (WHO, 2021). Even though these communities, which are disproportionately affected by climate change, tend not to be those most responsible for causing it (WHO, 2021).

Racism—as we’ve noted—heavily correlates with colonialism as it is a continuous system based on socially constructed categories, of which equal power and position are not distributed. In the United States, racism is so pervasive that it exists within the core structure of our nation from the time of its creation and has thus shaped nearly every aspect set forth since. The ubiquitous nature of racism allows it to occupy a variety of spaces, such as homeownership or climate catastrophes.

As the climate crisis worsens, communities of color and low-income communities in the United States and around the world will systematically shoulder most of its catastrophic effects. A 2009 report from the University of Southern California estimates that extreme heat and weather events, devastating floods, and increased air pollution will result in higher risks of mortality for African Americans and low-income individuals compared to white and wealthier neighborhoods (Morello-Frosch et al, 2009). In fact, a more recent study found that African Americans are three times more likely to die from exposure to air pollutants than their white counterparts based solely on where they live (Di et al, 2017). These consequences of climate change do not have a greater effect on communities of color and low-income communities by mere coincidence. Rather, systemic inequities, like housing discrimination, have purposefully intensified the burden of the climate crisis, further contributing to the disparities people of color and low-income communities already face.
The Historic Practice and Policies of Housing Discrimination

When Anne was granted the keys to her great-grandfather’s home after an onerous legal battle, she was overcome with great elation. Homeownership is a highly desired achievement for many American families and is exceptionally difficult to obtain and preserve for Black and brown communities and their future generations. There is a substantial divide in who has the ability and the privilege to own a home. In the United States, the gap in homeownership rates between Black and white Americans is wider than it was before the Civil Rights movement (U.S. Census Bureau, 2022). This divide is intentional, as it is the product of historic policies that have shaped homeownership, property values, and more for decades. However, these effects on an individuals’ ability to shelter themselves substantially impacts other sectors of their life, such as their ability to make a livable wage.

Outside of earned income, owning property is one of the most central aspects of an individual’s net worth. In the United States in 2019, the median wealth for black families in America was $24,100, while the median wealth for white families was $188,200 (Bhutta, 2020). This means that on average Black families’ wealth is less than 15 percent of that of white families. Centuries of systemic racism have effectively kept financial security from the hands of Black and brown communities, leading to the racial wealth gap we see today. Specific policies with a foundation in systemic racism, like racially restrictive housing covenants or redlining, are the cause of such great financial divides, and if we don’t see that these deeply rooted issues are remedied soon then a more severe crisis will be on our hands.

“Subject, forever, to the covenants, agreements, and restrictions hereinafter set… 48, 49, 50, 51 and 52 in Ingleside Addition to the City of Columbia, and Lots 40…None of the said lots shall be sold or rented to anyone other than a member of the white race” (“Racial Restrictions in Columbia, MO,” 2022).
This is a direct excerpt from the deed of a home in Columbia's Western Heights neighborhood. This specific language remained a part of the deed until 2004 and is the result of racially segregated housing covenants. It was common for suburbs and primarily white-occupied areas to establish housing covenants that excluded members of a specific race from buying or renting homes within a certain area. In 1949, congress passed the Housing Act which declared that “every American family deserves a decent home and a suitable living environment.” However, access to safe and secure housing was only bestowed upon white families and housing covenants, such as the one above, were still permitted. It was not until 1968 that racially restrictive housing covenants were outlawed; however, many such covenants can still be found within deeds today (Thompson et al, 2021). Furthermore, the government encouraged white movement from urban areas to suburbs, contributing to what is known as white flight, which further worsened the financial divide between Black and white families (Rivlin, 2020). As white families—which had on average higher incomes—left inner cities, urban centers quickly became impoverished since their revenue from the tax base of white families was now depleted (Digital History Chicago, 2022). Housing covenants such as the one detailed above consist of elements that are derived from systemic racism and have fed into historic policies regarding the discrimination of resources against communities of color.

In response to the drastic fall in home loans and ownership during the Great Depression, the National Housing Act of 1934 created the Federal Housing Administration (FHA), which sought to reverse the housing market at the time. To boost the market, the FHA employed a new chief economist, Homer Hoyt, who implemented policies and procedures that ranked various races and nationalities by order of “desirability” (Rothstein, 2017). In effect, this ranking exalted Anglo-Saxons to the top of the totem pole while their white counterparts then filed in the middle bracket, leaving Black and brown communities in disparagement as their home loans were denied and any current properties were significantly
undervalued. This was the beginning of redlining in America. With Hoyt’s racial hierarchies as their framework, the Homeowners’ Loan Corporation (HOLC) sought to avoid undue risky lending by plotting racial maps of American cities and assigning risk levels to each neighborhood (Rothstein, 2017). Black and brown communities were often outlined in a red pen or marker to indicate that banks and businesses should avoid financially participating in these areas (Thompson et al, 2021).

Redlining became common practice for housing lenders starting in the 20th century until it was outlawed in 1968. The 1968 Fair Housing Act prohibited redlining on paper; however, the catastrophic consequences of redlining continued and are still in effect today as they function to retain economic disparity between Black and White Americans (Bhutta et al, 2020). Today, we often consider redlining to mean racial discrimination of any kind regarding housing policies and practices. Policies set in place after the ban in 1968 have shown that “predatory inclusion,” coined by Keeanga-Yamahtta Taylor, a professor of African American studies at Princeton, allowed the government to work in conjunction with real estate brokers and bankers to support housing policies that strengthened racial inequalities, all while the private sector made billions of dollars while communities of color suffered (Taylor, 2019). Although policies, such as the Fair Housing Act of 1968, sought in part to reduce racial segregation in these historically redlined areas, today these communities continue to have higher

![Figure 1. This is a redlining map of New Orleans that intends to show bankers and real estate brokers mortgage lending risk by neighborhood type. This source comes from the Records of the Federal Home Loan Bank Board. (“City of New Orleans,” 1933-1939).]
populations of Black, Latino, and Asian people than those that were well appraised at the time (Bhutta et al, 2020). And climate change is set to most heavily impart devastation and loss within these communities, where housing discrimination has forced primarily resource-limited individuals and people of color to reside (Cusick, 2020).

**Housing Discrimination as More Than a Racial Justice Issue**

As climate change continues to impact our global community there is a growing divide in who will survive the effects of climate change and who will not. Currently, higher-income and white communities have the advantage as they are bestowed the privilege to live in clean, healthy, and safe communities—rudimentary elements of which anyone should be granted the ability to live (Funes, 2022). Unfortunately, historically redlined areas face a multitude of environmental challenges primarily due to a lack of investments and funding that stem from housing discrimination (Plumer et al, 2020). For example, a recent study found that historically redlined areas are the most vulnerable to suffering from extreme heat due to climate change (Hoffman et al, 2020). Researchers found that 94% of the 108 cities recorded, exhibited increased temperatures in redlined areas when compared to non-redlined areas (Hoffman et al, 2020). While heat does vary across urban areas, because of discriminatory housing practices, resource-limited communities and communities of color still live in the hottest areas (Hoffman et al, 2020). As a result of redlining, funding in redlined areas was primarily directed towards industrial or manufacturing projects causing urban areas to be concentrated with asphalt and concrete. While banks and government organizations encouraged suburban developments to be full of yards, trees, and parks (Cusick, 2020). This difference in available greenspace has contributed to increased levels of heat and climate change in the areas where communities
of color call home and further exacerbate extreme levels of heat that can cause illness and, at times, death.

This is simply one example of many that show how housing discrimination has further worsened or manifested environmental issues for communities of color. Perhaps the strongest example of how pervasive systemic racism within discriminatory housing practices and policies when regarding environmental issues is the story of New Orleans after Hurricane Katrina. After Hurricane Katrina, 75 percent of damaged areas within New Orleans were previously housed by predominantly African American communities (Pastor et al, 2006). This led to the displacement of more than 175,000 black residents who left New Orleans one year after the storm and more than 75,000 of these residents, like Anne, did not return (Paster et al, 2006).

Katrina did not distribute its devastating effects equally across the board. A Black homeowner in New Orleans was more than three times as likely to have been flooded as a white homeowner and as Gary Rivlin of the nonprofit organization Talk Poverty writes, “that wasn’t due to bad luck” (Rivlin, 2020). Because of racially discriminatory housing practices, like redlining, communities of color were often forced to reside in the most vulnerable of areas to environmental catastrophes (Rivlin, 2020). In fact, as climate change worsens, historically redlined communities are four times more likely to face a greater risk of intense flooding when compared to non-redlined communities (Katz, 2021). Scenarios such as this can be found across the country from Tampa to Sacramento, which tops the list of metropolitans where formerly redlined areas face a greater risk of flooding (Katz, 2021). In New Orleans, what’s worse is that today many of the white neighborhoods within the city are entirely renovated and recovered; in fact, some White neighborhoods are better off than they were before. While Black and brown communities, however, continue to suffer from partial recovery or in some cases none at all (Rivlin, 2020). Rivlin writes this is in large part because New Orleans did not experience “an equal opportunity recovery, which in no small part was because of
the white civic leaders who openly advocated for a whiter, wealthier city.” So, not only is the historic effects of redlining further establishing the likelihood that Black and brown communities are set to suffer greatly from climate change but their ability to recover is also thwarted by discriminatory policies that intensify the climate burden on communities of color.

**Conclusion**

Even though historical housing discrimination against communities of color has left them with a greater risk of environmental harm due to climate change, the intent of those who’ve implemented such policies and practices is often called into question. Some people contend that housing discrimination and environmental impacts due to climate change are separate issues, of which housing discrimination primarily affects communities of color while climate change affects all of us. Some may also argue that housing discrimination and climate change are false, and evidence presented for such arguments is inaccurate or distorted, these arguments, however, we will not deem worthy of a response.

Climate change is often misconstrued as having an equal impact on all of us. And yes, while we will certainly all face the effects of climate change, the degree to which we experience climate change will vary depending on our social-economic background, our race, and, of course, where we live. And while it is difficult to know what developers and politicians were thinking when historic housing policies were implemented, there are many examples of how housing discrimination has left communities of color with a greater climate burden as we’ve discussed above. In the book, *The Color of Law*, Richard Rothstein acknowledges that it is difficult to know the intentions of city officials and city planners in the early 20th century; however, whether their racism was intentional or not is regardless because their decisions have and continue to have disproportionate harmful effects on African American communities
(Rothstein, 2017). When system racism has become so ingrained in society as it has here, it can operate without obvious intent.

As climate change continues to impact our global community, low-income communities and communities of color in the United States will face more severe effects as housing discrimination has left them at heightened risk of environmental harm. The situations many communities are set to face are dire as our housing projects, infrastructure, and local regions are not mitigating or adapting at the required rate of change, despite increased interest and commitment (Douo, 2021). It is imperative we as society demand politicians at the local and national levels analyze their current policies and initiatives to ensure equitable climate adaptation for the most socially vulnerable and historically marginalized communities. Communities of color did not cause climate change, but because of discriminatory housing policies with a long-lasting legacy of racism that dictated where they live and what resources are available to them, they are set to suffer climate change’s drastic effects the most.
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"Herd" it Through the Grapevine: The Mission of Wild Horse Advocate Ellie Phipps Price

Natalie Hays

Writer’s Comment: As a political science major and aspiring investigative journalist, my ultimate goal is to bring awareness to unconventional issues and amplify underrepresented voices. When tasked with profiling an interesting individual for Dr. Greg Miller’s UWP 104C (Journalism) course, I wanted to highlight someone working behind the scenes and fighting for social issues that aren’t discussed nearly enough in the mainstream media. In my article, I spoke with fellow animal lover Ellie Phipps Price, a Northern California business owner who protects wild horses and burros from abuse at the hands of the federal government. Determined and exceptionally kind, Phipps Price is a powerful voice in grassroots advocacy. I highlight her talents as an accomplished winemaker and influential figure in the animal rights movement and explore the issues that wild horses of Western America face today.

Instructor’s Comment: In journalism a successful profile should unfold with a pleasing spontaneity that belies the artfulness of the article’s construction. An author needs to tell a person’s life story, and to arrange it around a compelling theme that draws together past and present while avoiding the dreary linearity of an encyclopedia article. By the time readers encounter any backstory—childhood, historical context, and so on—we should already be hooked. The person being profiled should come across with vivid singularity and yet also be relatable in one way or another: her interests become our interests, her passion becomes ours. As with a good cinematic experience, readers
appreciate a mixture of close-ups and long shots and an evocative location, a sense of having really been somewhere.

I believe you’ll find all of this and more when you read Natalie Hays’ riveting profile of Ellie Phipps Price. Note how she puts us there in Elk Creek from the start, breaking its ghost town silence with the “rumbling crescendos” of a mustang herd that turns out to have been rescued by the article’s protagonist. An inspiring mixture of observation and research, Natalie’s article moves seamlessly within Phipps Price’s world and into larger societal issues. I especially admire Natalie’s pacing and her presentation of dialogue. Even the outrageousness of the title’s pun turns to be well-judged.

—Greg Miller, University Writing Program

At first glance, Elk Creek, California resembles a countryside ghost town. With a population of 200 people, the buildings are empty and the residents are scarce. But a few miles away,
the silence is drowned out by a thunderous noise coming from the rolling hills of the Central Valley. The rumbling crescendos as a crowd of cream, chestnut, gray, and dark-colored horses charge across a field.

Welcome to Ellie Phipps Price’s backyard. “Not many people get to see anything like this,” she tells me. “Not this many at once.” She is referring to the hundreds of horses that gallop across her property. Since 2012, Phipps Price — an entrepreneur with a love for horses — has been rescuing wild horses and bringing them to safety at her Montgomery Creek Ranch just outside of Elk Creek. So far, the 2,000-acre property with a training and adoption program has saved over 1,000 wild mustangs from slaughter. Over 200 mustangs currently live on the ranch, along with a variety of rescued wild burros. “I know there’s more I could be doing,” she says. “When I started helping out, I said to myself, ‘Okay, I’ll just save this group.’ Now, I hope we can make a difference for all horses.”

Growing up, Phipps Price lived everywhere from California to Colorado to Connecticut, but always took her love of animals with her. “I was never very good at sports, and I was never a fast runner,” she laughs. “So I became the kid that always wanted to be in a barn riding a horse.” Phipps Price was introduced to horseback riding at age 7 on a visit to her grandfather’s ranch. Soon after, she began riding lessons and begged her mother to take her on trail rides. By age 10, she was accompanying her grandfather on fox hunts and riding lesson-horses in local horse shows. As a teenager, however, Phipps Price shifted her priorities to focus on school and business endeavors. “I still loved horses, but I wanted to work, find a career that would let me eventually have a horse of my own,” she says.

Phipps Price graduated from UC Berkeley with a degree in English Literature and moved to San Francisco full-time to pursue a marketing career. After working in restaurant guides selling advertising, she developed an interest in the wine business. This eventually led her to take a summer program in enology and viticulture at UC Davis, where she learned about grape farming
and the art of making wine. At the same time, she rekindled her relationship with riding. “One day, I drove by a barn out in West Marin, stopped in to see what was going on, and then I was riding again and never looked back,” she recalls. A few months later, Phipps Price got her first-ever domestic horse, an off-the-track thoroughbred. In her late twenties, after riding other people’s horses for so long, this was the first time she could call one her own.

In 1998, Phipps Price bought her first business, Durell Vineyards in Sonoma County, where she grew grapes for various wineries. In 2009, she expanded the business, focusing on Chardonnay and Pinot Noir under her brand Dunstan Wines. She celebrated the accomplishment by adopting a wild mustang. “The wine story and horse story tie into each other,” she explains. “Dunstan is also the name of my first mustang.” Despite her excitement, Phipps Price discovered an ugly truth about mustang ownership — these animals are often bought for profit or sold for their meat. Abuse and exploitation are extremely common at rodeos and government auctions. “I remember going to a rodeo with my kids in Colorado,” she says grimly. “They used a wild mustang for a bucking horse competition. It panicked, impaled itself on a gate, and was bleeding out in its pen. No horse should be put in that situation.”

Phipps Price called the police and spoke to the local press about what she witnessed. “I was asking around and trying to understand how a wild horse got there in the first place,” she says. “When I see something like that happening, I want to do something about it.” What the animal lover had seen was a turning point in her career. She wanted to know if there was more she could do to protect the mustangs from harm and get them out of those situations. This led to her working with the American Wild Horse Campaign (AWHC).

Horses evolved on the North American continent and then crossed over to Europe and Asia before going extinct on this continent over 10,000 years ago (Bradford and Pester). American wild mustangs arrived on the West Coast as domesticated animals
that accompanied 16th-century Spanish explorers. The mustang population grows by 15% each year according to a study from National Geographic, and while 86,000 live on public land today, only 31,000 are “free-roaming” with no government intervention. The remaining 55,000 are kept in captivity by facilities funded by the Bureau of Land Management (BLM) and will often be sent to slaughterhouses or auctioned off to “kill buyers” for thousands of dollars (Daly). For the first time in history, there are more horses in government holding pens than there are in the wild.

Phipps Price says that while mustang populations need to be managed, there are humane alternatives to stabilizing the herds through fertility control and better management by the BLM. “It’s very expensive and inhumane for the U.S. government to round up wild horses, put them in holding pens, and then auction them off to buyers who are turning around and selling the horses to auction yards and kill pens,” she says. “What we have right now is a total waste of taxpayer money, and the horses are paying the price with their lives.”

Phipps Price attended her first auction in 2010 and found herself in a bidding war against kill buyers to rescue a group of horses. After bidding thousands of dollars, she ended up with all 172 mustangs up for bid. “They had five big semi-trucks ready to pick up 35 horses each and drive them up to Canada for slaughter,” she recalls. “At that point, I didn’t hesitate to save them all.” Since then, she has visited numerous auctions and BLM holding facilities trying to adopt as many wild horses as she can take care of.

In 2012, she bought the land that would become Montgomery Creek Ranch. She operates MCR as a nonprofit that raises awareness about mustangs and the failed government policies that have caused them to lose their place on western public lands. MCR also operates a training and adoption program for younger horses. “The purpose is to connect people with horses and show the value of these horses and how they’re beautiful and trainable,” she says. “They have their own families, relationships, best friends, and opinions about things just like we do as human beings.”
In addition to her nonprofit, Phipps Price produced the 2013 documentary, “American Mustang,” a 3-D film following a young girl who discovers that wild horses are in danger. She also serves as Board President of the American Wild Horse Campaign, which works at the national level to protect wild horses and their habitats. “I think it’s a combination of things that will get the word out. Any movie, any article, or professional photographs of the herds make a difference.”

Although kill buyers are active across many states, the most daunting challenge according to Phipps Price is “trying to change the status quo at the BLM”. Phipps Price says we need to reform the BLM’s broken wild horse program. “We’re tired of seeing the horses scapegoated,” she says. MCR and the AWHC strive for people to understand that it is not the horses that are the problem, but rather an unfair allocation of resources and bad government management.

When asked how the public can get involved, Phipps Price says strengthening grassroots advocacy, like what AWHC is doing, will help put forth legislation to stop the mistreatment of wild horses and fund effective fertility control. “83% of Americans believe horses should not go to slaughter,” she says. “Luckily, there is more awareness about it and the cruelty of it all.”

With a hopeful smile, Phipps Price leaves me with a closing statement on her current projects and her hope for saving the animal she adores so much. “With everything I do, I hope to energize the American people to take a stand on the wild horse issue and keep wild horses wild.”

More information on the mission of Ellie Phipps Price and her work advocating for wild horses can be found on montgomerycreekranch.org and americanwildhorsecampaign.org, as well as their social media pages (@mcrmustangs and @freewildhorses on Instagram).
"Herd" it Through the Grapevine: The Mission of Wild Horse Advocate Ellie Phipps Price

References


Help to Save Our Veterinarians: Policy Brief

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Writer’s Comment: The issue of veterinarians mental health and high suicide rates is very important to me as I hopefully be part of the vet community one day. So, when Professor Stark presented the policy brief assignment for the UWP 104F class I could not pass up the opportunity to discuss this issue. As I researched and looked more into the problem, I got to learn how big and deeply rooted it is. Starting all the way from veterinary school to practice, veterinarians’ mental health issues build up for years. With this writing I hope to raise awareness about the problem and hopefully bring some options for possible solutions. Although this is an issue that affects mostly veterinarians there are so many stakeholders that are part of both the cause and also get indirectly affected by it. I hope to continue the work on this subject in my future education and career.

Instructor’s Comment: To my knowledge, Policy Briefs are an unusual genre in UWP 104F classes (Writing in the Health Professions), but this quarter my students researched the genre conventions and a specific health issue of their choice, looking for best practices and the latest research to write their policy recommendations. Oftentimes, information researchers learn doesn’t reach audiences who can enact meaningful policies with real world impact based on those findings. My’s policy work on the mental health of veterinarians reveals how much is known about the rates, causes, and possible solutions to address the poor mental health of vet students and professionals. In a condensed and useful format, her policy brief communicates a clear issue and shows what must be done to alleviate the burdens faced by our much
needed, but often unsupported vets. I can attest that while this policy brief takes a critical look at the education and experience of vets, My, as a future vet herself, is one of the most forward looking and invested students heading into the profession. With her clear and determined research writing, I have no doubt that she will strengthen the field both for animals and for our vet med professionals.

—Agnes Stark, University Writing Program

The Issue:

For many years, the issue of veterinarians’ mental health has been swept under the rug. In recent years, more and more veterinarians have been bringing up the challenges they experience and how it affects their mental health. Some organizations like Not One More Vet help (Shirey, 2021). According to Dr. Megan Hughes (2021), people in the veterinary profession are 3.5 times more likely to die from suicide in comparison to the general population. To reinforce this point, a survey done by American Veterinary...
Medical Association (AVMA) found that 1 in 6 veterinarians had suicidal thoughts during their career (Shirey, 2021). In addition, Alice Pettway (2018) reports that veterinarians are 1.5 times more likely to experience depression compared to the general population. This starts during vet schools. Pettway cites an article from AVMA that found that 67% of vet students experience depression and 5% were thinking about taking their own lives. In that report, a survey found higher rates of depression, self-harm, and suicidal ideation in vets during their clinical year and an increase of 0.5% for every $50,000 a student is in debt.

**Solutions / Recommendations:**

For the clients:
- Educate the clients about the struggle of veterinarians. Have posters/fliers in the vet clinics that ask them to be kind, supportive of their veterinarians, and share their positive experiences with them (Hughes, 2021).
- Teach the clients to plan ahead for their veterinary expenses (Hughes, 2021). Explaining the option of getting pet insurance. Handing out fliers regarding pet insurance might help as well.
- Refuse giving free services/consultation when asked (Hughes, 2021). This can help to balance the work-life balance with a clear no work policy after work hours.

For vet schools:
- Prepare students for interactions and communication with future clients (Pettway, 2018)
- Have mental health classes/programs incorporated into the vet school curriculum (Pettway, 2018)
- Change/build programs that allow students to have time off (Pettway, 2018)
- Have on campus, free counseling (Pettway, 2018)
- Find other ways to promote self-care and wellness in school (Pettway, 2018)

For the general population:
- Notice the vets around you (friend or relatives), and support them (Hughes, 2021).
- Talk about the struggles of veterinarians and raise awareness to the mental health issue in the profession.

**Reasons:**

Veterinarians’ mental health is affected due to multiple reasons. A combination of classes, difficult clinical cases, exams, rotations, and peer interactions cause high levels of pressure in vet school (Pettway, 2018). Furthermore, this source suggests that the emotional challenges that vets experience in their career stems from the detachment between what is taught in vet schools and the real practice of veterinary medicine after graduation. The contrast between expectation and reality of the profession is drastic. The
majority of vets chose this profession because they love animals and want to help them. However, being a vet does not involve playing with different animals all day and saving every single life. Euthanasia and death are big part of the profession. Lacy Shirey (2021) mentioned a statement from Dr. Denette Cooke (a vet with 25 years of experience), who said that due to the short lifespan of their patients, veterinarians deal with death 7 times more than any other medical professional. Animals that can be saved are euthanized due to financial reasons or overpopulated shelters. Most vet schools do not teach students how to deal with a situation when a client cannot afford or does not want to pay for their pets’ treatment. This leads to vets facing these difficult situations for the first time after their schooling and dealing with them alone (Pettway, 2018). Facing these types of challenges might lead to compassion fatigue and depression (Hughes, 2021).

Following vet school, veterinarians also face the challenge of high debt to income ratio. While vets and physicians spend approximately the same number of years in school, veterinarians get a much lower salary compared to physicians, Dr. Megan Hughes (2021) claims. She also states that it might take a whole
career for a vet to pay off their debt. Statistics presented by the AVMA from 2016 finds the average veterinary student’s debt to be about $143,700 (Pettway, 2018). Alice Pettway continues to show findings from the Bureau of Labor Statistics, where the average veterinarian annual salary is $88,770. In comparison, Pettway presents medical students’ 2016 average student loan debt to be $190,000, with an annual salary approximation of $205,560.

Another reason for the mental state of veterinarians is the abuse they suffer from their clients. According to Dr. Megan Hughes (2021), clients can get angry at vets because of the veterinary expenses. Veterinary medicine and treatments, like human medicine, are expensive. Verbal abuse, social media bullying, and physical harm from the clients affect the mental health of the vets, Dr. Hughes asserts.

To add to the struggle, in the last few years there is a shortage of veterinarians. More veterinarians leave the profession than enter. This causes an understaffed problem which leads to overworked vets. Vets sometimes work multiple jobs and shifts (to cover the shortage and their debt). The long hours lead to a poor work-life balance that can cause stress and burnout (Hughes, 2021). A 2019 survey done in collaboration with the AVMA found that only 43% of veterinarians would recommend their career to others (Burns 2020).
Why it is important / impact:

The toll that veterinarians carry is huge. Not being able to save a life, and even taking a life, is extremely challenging. Veterinarians are there for the pet and for the client (especially at their difficult last moments). A Perret et al. (2020b) research theorized that vets showing more compassion to clients results in higher client satisfaction. At the same time, the Perret et al. study implies that the same situation has a negative impact on the vets’ own mental health due to the emotional labor that is required for showing empathy. There is a lack of support regarding the vets’ mental health as they deal with the challenging situations of their profession.

When adding all of the mentioned reasons together, we get a destructive path that drags on for many years. Veterinarians have a long list of mental health issues such as depression, burnout, compassion fatigue, work overload, high student debt-to-income ratio, low wages, cyberbullying and mistreatment/disrespect from clients (Shirey, 2021).

According to a Perret et al. (2020a), research combining all of these factors with the vets’ cultural acceptance of euthanasia, we find very high suicide rates in the veterinary community. It is mentioned in the Perret et al. (2020a) article that veterinarians’ mental health and wellbeing are important because not only do they take care of pets, but they also facilitate food safety and support the agriculture industry.

In Summary:

We need vets to help and save our loved family members. We need vets for our own health, in the food and agricultural industry. But our vets also need us! Help to save our veterinarians. #NotOneMoreVet
References


Brachiopods and Bivalves: Clam Metabolism and Really Old Molluscs

EMMA ENSSLLE

Writer’s Comment: The prompt for this assignment was to write an article for a general audience based on published scientific research. I wanted to write about a topic in paleobiology that a lot of people might not know about. I decided on brachiopods, a type of mollusc whose evolutionary history is debated amongst scientists. Although they may not seem as exciting as dinosaurs, these molluscs and the methods used to study them are surely worth reading about. My goal in this article was to inform more people about brachiopods and also to demonstrate how scientific beliefs can change overtime.

Instructor’s Comment: The plight of prehistoric molluscs might automatically garner the attention of paleobiologists, but generating lay audience interest in the subject is a much greater challenge—and one that Emma Enssle meets gracefully in this article written for my UWP 102B: Writing in Biology course. Here, Emma weaves together two stories. The first is the story of the brachiopods and bivalves, which she explains using clear terms and comparisons for the benefit of the lay reader. The second story—of equal importance—is that of the recent evolution of scientific understanding on these two types of mollusc. As Emma puts it, the research that she covers in this article is significant because it presents us with a “new way of looking at an old problem.” In recounting this challenge to previous research, Emma also offers us a useful example of how scientific thinking changes over time as new knowledge and tools become available.

—Melissa Bender, University Writing Program
You are probably familiar with clams and oysters, but unless you have taken a paleobiology course, chances are that you have never heard of brachiopods. Brachiopods are a type of mollusc with two shells, but they are separate from the bivalve class, which includes clams and oysters. Today brachiopods are very rare, but if you happened to be alive 150 million years ago you would have found that they dominated the ocean floor, being far more numerous and diverse than the bivalves. The reason for the brachiopod and bivalve switch in dominance has been a long standing question for paleobiologists, who have proposed many possible explanations for the bivalve takeover. This has led to decades of studies testing the impacts of predation, competition, and environmental changes on the two groups. However, a 2014 study by Jonathan Payne and colleagues at Stanford University found that brachiopods may never have been dominant over bivalves in the first place, challenging a commonly accepted scientific belief and putting decades of research into question (Payne et al.).

If we expect to benefit from scientific discovery, it is important to understand how and why changes in scientific understanding occur. Learning more about brachiopods and bivalves specifically might not change your life, but it will help you understand why scientists can change their mind about Pluto being a planet or how the infamous DDT was once considered by many to be a blessing of chemical invention. The truth is that scientists can be wrong, like they were about brachiopods and bivalves, and scientific opinions can change if new information is gathered.

But first, what exactly are brachiopods and bivalves? Appearing similar at first, brachiopods and bivalves both have shells made of two parts, which are referred to as valves. In Latin, “valve” translates to “one of the halves of a folding door,” an apt description if you picture a clam opening and closing (“Valve”). Despite their apparent similarities, brachiopods and bivalves are quite different. For one, brachiopods are symmetrical when cut down the middle of both valves, like a sandwich. However, bivalves have symmetry on a plane between the two valves, like if you pressed both of your
hands together. When cut down the middle, the two sides of a bivalve are not symmetrical.

Brachiopods attach to the substrate on the ocean floor using a stalk-like organ called a pedicle. Once they attach to the substrate, brachiopods tend to stay there, while bivalves can change their position more easily. This is partly because bivalves do not have a pedicle, instead having a muscular foot which they can use for movement. Both brachiopods and bivalves have a burrowing lifestyle. Burrowing allows for protection while still allowing brachiopods and bivalves to feed through the water column (de Fourestier 3).

Another key difference between brachiopods and bivalves is their method of feeding. Brachiopods feed using a special structure called the lophophore, which contains fine tentacles arranged in a rake-like shape. These tentacles are then covered in tiny hairs called cilia, which comb through the water for food molecules and direct these molecules towards the mouth for feeding. Having both tentacles and cilia allows for a greater surface area for more successful water filtration. In contrast, bivalves do not have a lophophore, but instead feed using a siphon to suck water into their body cavity. There, the water is filtered for food particles using gills which are also covered in cilia (de Fourestier 2). Although they have different feeding structures, brachiopods and bivalves are both filter feeders, leading some to consider the possibility of competition for food sources between the two groups.

The main event concerning brachiopods and bivalves is the Permian-Triassic extinction, when the switch in dominance of the two groups appears to have taken place. The Permian-Triassic extinction, which occurred around 252 million years ago based on radiometric dating, was the largest extinction event in earth's history (Burgess et al.). Brachiopod diversity was high prior to the extinction event, with bivalves having lower diversity. After the extinction, a sharp change occurred as brachiopod diversity declined and bivalve diversity increased. This was a major extinction event which led to the loss of most marine species, so a drop in brachiopod
diversity is expected. But why did bivalves recover more quickly after the extinction and proceed to dominate over brachiopods? This question has occupied scientists for decades. Many have believed that the extinction event gave bivalves an opportunity to outcompete brachiopods while their numbers were low. Others postulated that predators preferred brachiopods over bivalves, or that environmental changes lead to inhospitable conditions for brachiopods. However, recently a group of researchers decided to ask a new question entirely. What if brachiopods were not actually dominant over bivalves as previously believed?

Payne and fellow researchers challenged the traditional method of using taxonomic diversity and abundance to measure species dominance, the method which put brachiopods on top of bivalves prior to the Permian-Triassic extinction. This method suggested that because there were more species of brachiopods and more brachiopod individuals, they must have been dominant over bivalves. One issue with using taxonomic diversity is the fact that brachiopods and bivalves are of different average sizes and different amounts of tissue, so using the number of individuals to infer dominance may not actually be accurate. Taxonomic diversity is not able to compare the amount of energy transferred between the two groups and their environment, which is a downside because energy transfer better reflects the behavior of organisms in a given environment. For this reason, metabolic data is a more accurate measure of ecological dominance, because it accounts for how much energy is being used and produced by brachiopods and bivalves (Payne et al. 6)

In order to use energy levels to estimate ecological dominance, Payne et al. used information from fossil record databases to calculate the metabolic rate of thousands of brachiopod and bivalve species. These calculations were possible to compute using body size data, even though the actual living organisms were not present. Three different shell measurements were taken of each specimen, and the approximate geologic time period of each specimen was also estimated. Specimens were grouped into
their different species, and the feeding mode of each species was taken into account. This is important because there are several different feeding methods of brachiopods and bivalves, and the metabolic rate of species with different feeding modes cannot be easily compared. All of this data together allowed the researchers to calculate the metabolic rate of different species of both brachiopods and bivalves at different times. They also used calculations to account for differences in temperatures over time and for biases caused by large or small species sizes, as temperature and body size both influence metabolic rate (Payne et al. 2,3).

In the end, the researchers found that bivalves were metabolically dominant over brachiopods prior to the Permian-Triassic extinction, which is when scientists have previously believed that brachiopods were dominant. In fact, bivalves were dominant about 100 million years before the extinction event. After the extinction, the difference was even more striking - between brachiopods and bivalves, bivalves conducted 95% of the metabolic activity beginning in the Triassic. This extremely high level of metabolic dominance right after the extinction is different from the previously accepted story of a gradual increase in taxonomic diversity leading to bivalve dominance (Payne et al. 3).

Another crucial aspect of this study is that it debunks a common theory, which is that bivalves gained dominance by outcompeting brachiopods. This is because bivalve metabolism increased far too rapidly to be explained by the simple outcompetition of brachiopods. Even if brachiopods were driven to complete extinction by bivalves, this would not explain the huge increase in bivalve metabolism. This adds another significance to the use of metabolic data, because it shows that bivalves were not only dominant over brachiopods, but that the evolutionary trajectory of the two groups cannot be explained by direct competition. Instead of stealing resources from brachiopods, bivalves may have gained dominance by tapping into resources that brachiopods were simply unable to use (Payne et al. 5,6).

Surely, the bivalve acquisition of so many new resources
must have caused a stir on the seafloor. Payne et al. mention that the amount of primary productivity has not greatly increased over the past 350 million years, suggesting that bivalves may have outcompeted other organisms as they greatly increased their metabolic activity. This adds yet another layer to the story of brachiopods and bivalves, as it means that although brachiopods were not outcompeted by bivalves, there are probably some creatures out there that were (Payne et al. 6).

The results of this study showed that not only were brachiopods not dominant over bivalves as previously believed, but that the evolution of the two groups is not closely related. This paves a way for future studies to investigate how these two groups may have evolved over time, apart from each other. The high metabolic dominance of bivalves is especially interesting, and future researchers may look for species that actually were outcompeted by bivalves in order to understand how they were able to utilize such a high number of resources.

This research by Payne et al. is groundbreaking because it provides scientists a new way to look at an old problem. In biology classrooms, the evolutionary trends of brachiopods and bivalves are commonly used as an example of how complicated ecological relationships can be, and how different explanations can be used to explain an increase or decrease in diversity. However, this study shows how different methods of calculating ecological diversity can tell entirely different stories. Specifically, metabolic data can be a much more useful method of calculating the dominance of different groups, and can give very different results than taxonomic diversity measures. More generally, this way of thinking can be applied to other areas of paleobiology and ecology, serving as a reminder that things are not always as they seem.
Works Cited


Writer’s Comment: For the past year, I have had the privilege of working as a clinical researcher in the UC Davis Medical Center Heart Failure clinic. I have seen firsthand the significant impacts of cardiovascular diseases on patients’ quality of life, and subsequently developed an interest in understanding the most prominent risk factors that lead to such conditions. Thus, when Professor Danica Taylor assigned us a paper proposing a new, cost-effective policy addressing a public health topic of our choice, I knew I wanted to write about cardiovascular disease. Another requirement of the assignment was that we address our chosen public health topic in the context of a low- or middle-income country. I decided to investigate cardiovascular disease in Vietnam, since many of my close friends are Vietnamese and have been affected by family members with cardiovascular disease. Through this paper, I hope to bring awareness to the different metabolic and behavioral risk factors that contribute to cardiovascular disease, and the need for continued research on cost-effective interventions.

Instructor’s Comment: When Emily mentioned she wanted to submit her policy paper to the Prized Writing journal was ecstatic. Not only was it an opportunity for Emily to showcase her excellent writing skills, but it was also a chance to spread awareness about an ongoing global health crisis, cardiovascular disease in Vietnam. Upon reading Emily’s policy paper, I was particularly impressed by her opening statement, where she fully embraced the purpose of the assignment and took on the role of the health minister of Vietnam. Additionally, I found her solution of
using a multifaceted approach that included prevention inspired and a core competency of this course. Emily is truly an innovative thinker. I know her creativity and ability to apply knowledge to practice will serve her well in her future career. Her fantastic policy paper reflects her commitment to global health and provides feasible solutions to managing cardiovascular disease in Vietnam.

—Danica Taylor, University Writing Program

Abstract

Vietnam is currently in a decades-long epidemiological transition, wherein patterns of morbidity and mortality are shifting away from communicable diseases towards noncommunicable diseases (Nhung, 2014). Stroke and ischemic heart disease are now the leading causes of death in Vietnam (IHME, 2019), resulting in about 170,000 deaths each year (WHO, 2016). Cardiovascular disease primarily affects adults over the age of 25, especially older women living in urban conditions (Nguyen, 2012). Individuals with this disease experience a much lower health-related quality of life as compared to Vietnam’s general population, with pain/discomfort, anxiety/depression, and death being common outcomes (Tran, 2018). Cardiovascular disease is the leading cause of burden for adults in Vietnam, resulting in 27% of total years of life lost (YLL) due to all diseases (Nhung, 2014). Therefore, a cost-effective mass media program targeting the predominant risk factors for cardiovascular disease—salt intake, cholesterol, and tobacco—must be implemented throughout Vietnam to prevent the rise of cardiovascular disease (Ha, 2011).

Nature and Magnitude

Cardiovascular disease encompasses all disorders of coronary and blood vessels, including stroke, ischemic heart disease, and hypertension (WHO, 2016). It is the leading cause of morbidity and mortality globally, especially in low- and middle-income
countries like Vietnam (Nguyen, 2012). In Vietnam, 31% of all deaths result from cardiovascular disease (WHO, 2016), while 37% of deaths from noncommunicable diseases can be attributed to cardiovascular disease (Vietnam Ministry of Health, 2014). Cardiovascular disease accounts for 145,000 more deaths than the next leading cause of death in Vietnam, road injury (Nguyen, 2012). In addition, one study extrapolated data for adults aged 30 to 74 years in Vietnam and found that the risk of these individuals experiencing a cardiovascular event in 10 years is about 9%, or 3.4 million events (Nguyen, 2012).

**Demographics Affected**

In Vietnam, the incidence of both stroke and ischemic heart disease is higher in women over the age of 30 (Ha, 2011). Clustering of metabolic risk factors for cardiovascular disease was found to be more common for women living in urban environments, with urban women having an odds ratio 2.6 times that of rural women and an odds ratio 0.7 higher than that of urban men (Nguyen, 2012). This is of particular concern, since the urban population of Vietnam has increased by 7% over the last decade, with the urban population making up 37% of the total population in 2020 (The World Bank, 2018). As for behavioral factors, women with higher education and men with manual jobs have higher odds ratios for clusters of these cardiovascular risk factors (Nguyen, 2012). Research on age and gender differences in cardiovascular health-related quality of life has revealed that elderly female patients are more likely to suffer from a lower health-related quality of life (Tran, 2018). In fact, elderly female patients had a higher number of reports related to mental health, anxiety/depression, and pain (Tran, 2018).

**Risk Factors**

The risk factors for cardiovascular disease can be classified into two categories, metabolic and behavioral (Nguyen, 2012). Metabolic risk factors include hypertension, dyslipidemia,
diabetes, and obesity; behavioral risk factors encompass smoking, excessive alcohol intake, unhealthy diet, physical inactivity, and stress (Nguyen, 2012). Among both sexes, lipid abnormalities and unhealthy diet are the predominant risk factors for cardiovascular disease, extrapolating to 28.5 million people and 25.9 million, respectively (Nguyen, 2012). This can be attributed to the increasing prevalence of overweight and obese adults, as well as the elevated levels of sodium commonly used in traditional Vietnamese dishes (Ha, 2011). In men alone, tobacco use and excessive alcohol intake were shown to be prominent (Nguyen, 2012). 56% of Vietnamese males above the age of 16 are smokers (Ha, 2011), while 25.1% of Vietnamese males above the age of 15 are heavy drinkers (Nguyen, 2020).

Location, socioeconomic status, and occupation also play important roles in determining cardiovascular disease risk. For both sexes, having more than half of the metabolic risk factors or all major risk factors has an odds ratio 1.8 to 2.6 times higher in the urban population than the rural population (Nguyen, 2012). In regards to socioeconomic status, women with a high school level of education or higher are more likely to have a cluster of behavioral cardiovascular disease risk factors (Nguyen, 2012). Researchers hypothesize that this pattern is linked to the higher rate of excessive alcohol intake and physical inactivity in these women (Nguyen, 2012). Men working manual jobs also commonly have individually clustered behavioral risk factors for cardiovascular disease, due to higher proportions of smoking and self-reported unhealthy diets (Nguyen, 2012).

Social and Economic Effects

Cardiovascular disease puts a significant burden on Vietnam’s economy, as well as on the individuals who have it. According to a review written by Nguyen and Trevisan, cardiovascular disease was the second highest health expenditure among noncommunicable diseases in Vietnam (2020). Cardiovascular disease is also the leading
cause of disability in Vietnam, and individuals with cardiovascular disease amounted to 27% of total YLL from all diseases (Nhung, 2014; Nguyen, 2020). This disability is likely associated with the pain/discomfort and anxiety/depression reported by patients (Tran, 2018), which doubly harms Vietnam’s economy as many individuals with cardiovascular disease are unable to perform manual labor and support their families.

**Recommendations**

Current interventions to mitigate cardiovascular disease in Vietnam follows the WHO HEARTS technical package and improves cardiovascular health, prevention, treatment, and management at the primary healthcare level (Novartis Foundation, 2018). Improving primary care interventions allows for individualized treatment of those at high risk of a cardiovascular event (Ha, 2011). However, this approach ignores the many individuals who do not have access to primary care, which is of great concern since 63% of the population lives in rural conditions (The World Bank, 2018). Furthermore, these strategies leave many risk factors untreated. For example, of the 32.4% of hypertensives being treated, only 2.8% of hypertensives have controlled blood pressure (Nguyen, 2020). Even worse, only 26% of hypertensives are aware of their condition (Nguyen, 2020). Prevention and treatment of such risk factors could affect 90-94% of cardiovascular disease cases (Tran, 2018). These issues highlight the need for a national education program on cardiovascular disease risk factors.

To reduce the burden of cardiovascular disease on Vietnam’s economy and citizens, several studies have suggested the implementation of a mass media education program that addresses prominent risk factors (Ha, 2011; Nguyen, 2012). Since unhealthy diet and lipid abnormalities are prominent risk factors in both sexes, and tobacco use is a prominent risk factor for men (Nguyen, 2012), the cost-effectiveness of health education programs targeting salt intake, cholesterol levels, and tobacco consumption was evaluated.
(Ha, 2011). The programs involved the dissemination of health education messages on these three risk factors through television, radio channels, newspapers, wall posters, and fliers/leaflets (Ha, 2011). This method was the least costly at $0.06 per capita per year, as compared to $2.90 per capita per year for an individualized drug treatment for those with a significant risk of a cardiovascular event (Ha, 2011). In regards to effectiveness, mass media education programs averted 7,000 to 75,000 disability-adjusted life years (DALYs) per year, while individual interventions averted 50,000 to 400,000 DALYs per year (Ha, 2011). Since resources are scarce in Vietnam, implementation of programs to reduce salt intake, cholesterol levels, and tobacco consumption is the most cost-effective solution. In the future when more resources are available, individualized interventions offer a more effective, viable option which has been deemed cost-effective by the Commission on Macroeconomics and Health (Ha, 2011). By tackling prominent risk factors of cardiovascular disease throughout Vietnam, cases will decrease and the burden on their economy and citizens will be lifted.
References


Cost-Effective Interventions for Cardiovascular Disease in Vietnam


Writer's Comment: When I was thirteen years old my mom was diagnosed with breast cancer. Now eight years cancer-free, she continues to face the repercussions of aggressive antibiotics and post-treatment complications. After years struggling to find a solution, my mom began an anti-inflammatory diet, and I watched firsthand the noticeable shift in her mental and physical well-being. It was amazing to watch the positive effects such a seemingly simple solution could have; although, it perplexed me that conventional medicine did not address such preventative and healing methods to combat post-treatment complications and psychological distress. For this reason, I was compelled to write a review addressing alternative treatments to conventional medicine. Thus, I decided to focus on PTSD, since it's known to be a highly treatment-resistant disorder. With conventional methods lacking efficacy for PTSD patients, my paper focalizes on the use of MDMA as an adjunct to psychotherapy. I hope this review excites people about not only the medical value of psychedelics but the possibility of more effective and safe alternatives to conventional, Western medicine.

Instructor's Comment: Even though Kennedy developed a wealth of expertise on the resurging clinical use of an uncommon therapeutic in researching and writing her review paper “Efficacy and Safety of MDMA-assisted Psychotherapy”, upon reflection, her learning during the quarter ran much deeper. When preparing to write her personal statement, the brainstorming and drafting process helped her reflect on how her recent personal and academic growth intersected with
her passions, leading Kennedy to a powerful realization. Her interests and passions had changed. She also realized that when she ran into challenges in her classes or work, by applying herself fully she would gain valuable experience and learn new skills, even if things didn’t go as planned. These self-reflective moments in Spring Quarter of 2022 helped Kennedy feel confident that she could make choices to listen to herself, follow her passions, and no matter what happened, she would be learning and growing.

This questioning of expectations and willingness to challenge the status quo that resonated so strongly with Kennedy is officially a thing. Not just with the broader societal landscape we find ourselves in right now, but also with the ways in which we approach science. Take MDMA for example, decades ago it was commonly used to support therapy in supervised contexts with success, until the broader war on drugs led the US Government to ban all use. However, beginning in 2010, the surging mental health crises, fueled in part by Veterans suffering from PTSD and a lack of treatment options helped shift policy. Here, Kennedy reviews recent research from clinical studies to highlight that even though MDMA-assisted psychotherapy seems to be effective for treating certain disorders, the small sample sizes, lack of consistency across cohorts and legal red tape suggest a dire need for more in-depth trials to validate and mobilize this much needed therapeutic. This timely, thoughtful and engaging review explores the present and the potential future of an often maligned but potentially potent treatment for PTSD and other disorders.

—Russ Carpenter, University Writing Program

Abstract

Posttraumatic stress is a common psychiatric disorder, typically associated with comorbidities such as depression, substance abuse, and suicide. Even with this disorder’s high prevalence, especially in first responders and veteran populations, there fails to be an effective and long-lasting treatment for PTSD
and its common comorbidities. Prior to the criminalization of 3,4-methylenedioxymethamphetamine (MDMA) in 1985, clinical records showed promising results in using MDMA as a catalyst for trauma-focused therapy, especially with PTSD patients [11]. In efforts for a novel treatment, after an almost thirty-year hiatus, a focus on the therapeutic potential of MDMA for PTSD patients has reemerged. The purpose of this review was to evaluate recent studies on the efficacy and safety of MDMA-assisted psychotherapy for PTSD patients. We limited the scope of our research to clinical trial studies from 2010-present. Springer, Taylor & Francis, and PubMed databases were searched for peer-reviewed studies that included “psychotherapy,” “MDMA,” and/or “3,4-methylenedioxymethamphetamine,” and “PTSD” and/or “posttraumatic stress disorder.” Precedence was given to phase 2, or ideally phase 3, clinical trial studies. The consistent result found MDMA as an adjunct to psychotherapy to be both effective and safe, with long-lasting PTSD symptom relief. However, recurring limitations across studies included small sample sizes, inconsistent doses and study durations, and stigma around the clinical use of psychoactive drugs. Thus, in order for significant conclusions to be established regarding the clinical use of MDMA-assisted psychotherapy, further efficient studies need to be conducted.

Introduction

Posttraumatic Stress Disorder: Conventional Treatments

Posttraumatic stress disorder affects about 8% of the general population, 17% of military personnel and veterans, and 10-32% of first responders [1]. This psychiatric disorder is characterized by hypervigilance, re-experiencing phenomena, affect dysregulation, and fear and avoidance associated with traumatic events [10]. While PTSD symptoms alone are debilitating enough, more than 80% of patients with severe or chronic PTSD have associated psychiatric and mental comorbidities such as
depression, substance abuse, and suicide [2,9]. Consistent evidence shows that PTSD patients with comorbidities are more resistant to conventional treatment methods.

Common treatments for PTSD include pharmacotherapy and psychotherapy, both of which have high non-response and dropout rates. Pharmacotherapy is the use of selective serotonin reuptake inhibitors (SSRIs), and there are currently only two FDA-approved SSRIs to treat PTSD: sertraline and paroxetine. These compounds are used as first-line therapeutics for treatment, yet lack efficacy with only a 20-22% higher response rate than a placebo in clinical trials. Psychotherapy is more commonly used to treat PTSD, yet clinical trials have shown a dropout rate of 20-30% and an inconsistent response rate between 60-95% [2,9]. The issue with using psychotherapy treatment for PTSD is that patients commonly experience emotional numbing, retraumatization, dissociation, and anxiety upon revisiting memories of traumatic events [2,6]. Hence, to combat high rates of emergent and treatment-refractory PTSD a surge of research for a novel treatment has led to studying the therapeutic potential of 3,4-methylenedioxymethamphetamine (MDMA).

**History of MDMA**

MDMA is an illicit psychoactive drug, commonly known for its recreational use under the name ‘ecstasy’. In 1914 MDMA was initially synthesized to function as an intermediate for another drug to stop bleeding; it wasn’t until later that the psychoactive component of the drug was first studied [2]. Observing the empathogenic effect MDMA has, increasing empathy and prosocial feelings, established the rationale for using it as an adjunct to psychotherapy. By the 1980s it is estimated that 500,000 therapy sessions involved the use of MDMA as a therapeutic catalyst. It was used to treat a variety of psychiatric disorders, yet physicians agreed its most useful effect was in trauma-focused therapy [6]. However, while the drug gained clinical traction it was simultaneously being
used recreationally. The recreational misuse of MDMA caused the DEA to classify the drug as a Schedule I drug in 1985, shutting down all legal use, and halting clinical research [6,11]. However, a need for improved treatments for psychiatric disorders has caused a refocus on exploring MDMA’s therapeutic potential.

**MDMA’s Therapeutic Potential for PTSD**

MDMA’s unique psychopharmaceutical profile makes it a promising adjunct for trauma-focused psychotherapy. Active dosages of purified MDMA can alter one’s consciousness without impairing psychological factors such as visual perception or cognitive process. This ameliorative effect helps participants access traumatic memories with more ease by preventing overwhelming fear and anxiety while simultaneously increasing communication. This aids in maintaining a therapeutic alliance, which is vital for the psychotherapeutic process of treating PTSD [6,10]. PTSD psychotherapy is considered effective when an appropriate level of emotional engagement without overwhelming feelings or dissociation – commonly referred to as working with the ‘optical arousal zone’– is achieved [2,13]. MDMA makes reaching this ‘zone’ more attainable by reducing amygdala activity, which controls fear-and-anxiety behaviors, and increasing connectivity between the hippocampus and prefrontal cortex. This is critical because according to the current neurocirculatory model PTSD is caused by an imbalance of the amygdala and the prefrontal cortex [7, 10]. Additionally, MDMA promotes the release of serotonin, oxytocin, norephedrine, and dopamine. The dynamic interaction of these neurotransmitters and hormones causes acute effects such as euphoria, extroversion, and empathetic social interaction. All of which can facilitate therapeutic effects and create motivation to engage in therapy [10,12]. A growing body of clinical research suggests that MDMA-assisted psychotherapy might be the novel treatment for treatment-refractory PTSD. This review presents the results of recent studies aimed to address the efficacy and
safety of MDMA-assisted psychotherapy to treat PTSD and the co-morbidities that typically confer treatment resistance.

**MDMA-assisted Psychotherapy: Clinical Trials**

*Phases of Clinical Trials*

To assess the efficacy and safety of new treatments, it is common practice for several clinical trials to be conducted in phases. Phase I trials function to assess the effect the drug has on the body and if it is safe. When a new treatment is found to be safe in phase I trials, phase II trials are conducted to further evaluate what specific disorders/diseases this treatment might benefit. If enough participants benefit from the treatment, without severe side effects, phase III clinical trials are begun.

Phase III trials compare the safety and efficacy of new treatments compared to current standard treatment. Compared to phase II trials, there are a large number of participants, usually around or over 100, and tend to last for longer durations. Placebos are rarely used alone in Phase III trials. Control groups commonly are given a placebo, to begin with, and then endure what is called an ‘open-label crossover’ where they too receive the standard treatment. The importance of phase III trials is that if a new treatment proves to be safe and more effective than the current treatment a new drug application (NDA) can be submitted to the FDA [3,6,12,13]. Thus, if enough phase III trials prove the efficacy and safety of MDMA as an adjunct to psychotherapy further action can be implemented for its clinical use to treat PTSD.

**Therapeutic Methods**

Phase 2 clinical trials use therapeutic approaches developed before MDMA was classified as a Schedule I drug in 1985. Psychotherapy methods follow the same manualized supportive therapy modality outlined in ‘A Manual for MDMA-assisted Psychotherapy in the Treatment of PTSD’. There is a male and
female co-therapist team provided to ensure an appropriate patient-therapist relationship. Before the administration of MDMA, patients are given three 90-minute preparatory psychotherapy sessions. During the MDMA-assisted psychotherapy session, MDMA is given orally in a capsule form, and the participant wears eyeshades and listens to relaxing music. Therapists encourage discussion of emotions regarding traumatic events. This approach is observational, looking for MDMA's effects such as increased recall ability and reduced emotional numbing or dissociation. After each MDMA-session participants have three additional 90-minute psychotherapy sessions [2,12].

**Participants**

Clinical trials for MDMA-assisted psychotherapy typically recruit subjects via internet advertisements and letters to psychotherapists. Standard enrollment criteria consist of a CAPS score of 50 or above – meaning the participant has moderate to severe PTSD symptoms. Additionally, participants must have chronic PTSD which is defined by symptom duration of at least six months and non-response to at least one first-line treatment. Since PTSD is commonly associated with several psychiatric and mental comorbidities studies permitted comorbidities such as anxiety disorders, affective disorders (expect bipolar disorder), substance abuse, and eating disorders without active purging [1,2,8,9,13].

**Phase 2 Clinical Trials of MDMA-assisted Psychotherapy**

After almost thirty years since MDMA was classified as a Schedule I drug, in 2010 Micheal C Mithoefer was the first to publish a randomized, controlled clinical trial testing MDMA as a therapeutic catalyst. After one course of MDMA-assisted psychotherapy, 85% of the patients no longer met the criteria for PTSD. The participants that received an active dose of MDMA had a significant decrease in CAPS scores from baseline compared to the
placebo group [2]. To ensure long-term effects, a follow-up study of the same cohort concluded no substance abuse or harmful effects. Four years later and that same 85% of the cohort remained free of PTSD symptoms [3]. These promising results from Mithoefer et al clinical trial and follow-up catalyzed further clinical research on the therapeutic potential of MDMA.

**Dose-Response Effects**

With Phase I clinical trials establishing the safety of MDMA as an adjunct to psychotherapy for PTSD treatment, further Phase II trials were conducted to find the best level of sporadic dosages of MDMA. However, dose-response studies failed to provide consistent results of efficacy. In efforts to secondarily confirm Mithoefer et al study in 2010, a study by Oehen et al attempted to address the question of if an active control, 25mg of MDMA, could optimize the blinding of the double-blind experiment. The experimental group received a full dose of 125mg followed by a 62.5mg dose 2.5 hours later; the active placebo dose consisted of a 25mg dose followed by 12.5mg 2.5 hours later. There were subjective clinical and patient reportings of improvements in PTSD symptoms. However, Oehen and colleagues did not find statistically significant reductions in CAPS scores. Since conclusions did not align with Mithoefer et al 2010, it was predicted that three MDMA sessions would have more effective in decreasing CAPS scores [7].

Whereas, in 2018, Mitoefer et al conducted a dose-response clinical trial to test the efficacy and safety of MDMA-assisted psychotherapy for PTSD, specifically in military personnel and first responders. Mithoefer found that active doses of MDMA, 75mg and 125mg, had significant decreases in PTSD symptoms compared to the active control of 30mg. Furthermore, the open-label crossover administration of 100-125mg of MDMA, in all three experimental groups, showed a significant decrease in PTSD symptoms in the active control group. This proved that a full dose
of MDMA had a difference compared to the active control. After a twelve-month follow-up, PTSD symptoms had significantly improved compared to baseline after all groups had received active dosages of MDMA [1]. Or’alora et al study in 2018 found dose-response differences that aligned with Mitoefer et al 2018 study findings. The groups that received active doses of MDMA, 125mg and 100mg, had significant improvements in PTSD symptoms compared to the low dose of 40mg. Additionally, a twelve-month follow-up post-open-label crossover found that 76% of participants no longer met PTSD criteria [8].

**Phase 2 Trials: Common Limitations**

Phase 2 trials pose limitations of small sample sizes and between-study variabilities, such as inconsistent doses and study durations. The stigma around the use of psychoactive drugs has also created limitations. For example, in 2006, a clinical trial in Madrid published data that included only 6 participants because political and social pressure terminated the study prematurely [6]. Additionally, with the limited literature on the benefits of MDMA, clinicians and psychiatrists might stray from exploring clinical use. Findings from phase 3 trials will be able to validate and further expand upon the results of MDMA-assisted psychotherapy found in phase 2 trials [1,2,5,6,9].

**Phase 3 Clinical Trials: Creating A Generalized Effect**

With the recent approval of phase 3 clinical trials, the safety and efficacy of MDMA-assisted psychotherapy have been further validated, and additionally have shown a generalization of MDMA’s therapeutic benefit in simultaneously aiding common PTSD comorbidities. Oehen et al prediction that three active dosages of MDMA would be more effective was validated in the 2020 study by researchers at the University of San Francisco. It was demonstrated that the administration of MDMA in three dosages significantly improved PTSD symptomology and decreased rates of withdrawal.
and non-response to treatment. This study also found that MDMA treatment was equally effective in patients with comorbidities often associated with higher treatment resistance. Comparing BDI-II scores from baseline to study termination, a decrease in depressive symptoms was found [9].

As noted in the previous paragraph, clinical trials have been able to generalize the effect of MDMA-assisted psychotherapy to also decrease depression symptoms; a study by Nicholas et al in 2021 explored additional outcomes of MDMA-assisted psychotherapy by examining changes in alcohol and substance abuse. Alcohol and substance abuse disorders (ASUDs) have a 17-46% co-occurrence with PTSD. ASUDs are commonly comorbid with PTSD, particularly because PTSD patients rationalize the abuse as a way to alleviate PTSD symptoms. Participants that received MDMA-assisted psychotherapy had significant decreases in alcohol consumption and risk for hazardous use compared to the placebo group [5].

Conclusion

In this review, we examined the findings of notable modern studies on the efficacy and safety of MDMA-assisted psychotherapy for treating PTSD. The review detailed information on MDMA's therapeutic potential and its relevance to PTSD and the comorbidities that typically confer treatment resistance. This elucidated the current state of research on this topic, and while it is expanding, the literature on the clinical use of MDMA remains rather limited. However, phase 2 and 3 trials found harmonious results which leads us to the conclusion that MDMA as an adjunct to psychotherapy might be the novel treatment needed for treatment-resistant PTSD.

The scheduling of MDMA, and the stigma around the use of psychoactive drugs, have made it difficult to validate findings due to limited clinical studies on the therapeutic benefit of MDMA. Now with fewer regulations on clinical research for MDMA, it
is important for more phase 3 trials to be conducted in order to assess larger sample sizes and help educate physicians on MDMA's therapeutic potential in psychotherapy, especially trauma-focused therapy [7]. MDMA's unique psychopharmacological profile gives it an advantage over conventional treatments for PTSD. As previously discussed, pharmacotherapy uses SSRIs, which target the neurotransmitter serotonin, while MDMA is able to target multiple neurotransmitters: serotonin, dopamine, and norepinephrine [10,13]. MDMA’s ability to decrease amygdala activity, increase prefrontal cortex activity, and release specific neurotransmitters and hormones makes it a promising psychotherapeutic adjunct [2,10].

In efforts to create a more effective psychotherapy, recent studies have tested the efficacy and safety of administering MDMA during psychotherapy sessions in order to catalyze the psychotherapeutic process. In doing so, significant reductions in PTSD symptoms compared to placebo groups were found. Only one study did not report a statistically significant reduction in CAPS scores in participants that received active dosages of MDMA. However, this study did report clinical and patient reports of symptom relief. Dose-response trials found additional significant evidence in the effect active dosages of MDMA had compared to a low dosage.

Phase 3 trials were able to generalize MDMA’s therapeutic effect to also reduce depressive symptoms and substance abuse. Further studies should be conducted on the efficacy and safety of MDMA-associated psychotherapy regarding other specific comorbid conditions for PTSD patients. Thus, MDMA’s empathogenic qualities have been proven to be an effective catalyst for psychotherapy to treat PTSD, yet to establish significant conclusions for clinical use additional phase III trials need to be conducted.
References


Huntington's Disease: Etiology, Research Models and Treatment

MARAM SAADA

WRITERS' COMMENT: As a student in the social science discipline, my past writing has revolved around explaining psychological theory in practice. Although similar in style and method to writing any research paper in that one must focus on empirical evidence, this class pushed me to look past theory and focus on the topic's scientific background as well as its physical and psychological impact on the patient. Thus, when presented with this term paper for Professor Carey's Longevity class, I sought to challenge myself and research a topic I knew little about. I chose to explore Huntington's Disease as it intersected with many of the themes we discussed in class, including health, mortality, and the genetics of longevity. Huntington's disease is often discussed when highlighting heritable disorders; however, I aimed to approach the subject more holistically in my literature review. This influenced my decision to focus on the etiology, so readers can understand the condition's origins while also highlighting research models and treatment options available to those who live with the disease.

INSTRUCTOR'S COMMENT: Starting with her paper's title and ending with its last bibliographic entry, reading Maram's essay on one of the world's most devastating neurodegenerative diseases was as gratifying as it was informative. Her paper's organization is impeccable, her writing style engaging, direct and succinct, and her research due diligence thorough and complete but not excessive. Especially impressive was not only the time Maram invested in carefully cropping figures and re-typing their legends rather than simply cutting and pasting entire screenshots, but also in her meticulous use of typographical best practice (in her original in-class submission) including her choice of font and
Huntington’s disease is a hereditary disease marked by both physical and cognitive deterioration. The disease is caused by a mutation in chromosome four that elongates a protein to include more Cytosine-Adenine-Guanine (C-A-G) repeats in the huntingtin gene. The number of mutations will determine the severity and onset of the disease, with more C-A-G repeats indicating earlier onset and more aggressive symptoms. This mutation inevitably causes the degenerative symptoms characteristic of the disease, including chorea, abnormal eye movement, difficulty in speech and swallowing, apathy, irritability, and the development of psychological disorders like depression. The disease typically progresses in four stages: prodromal stage, early-stage, moderate stage, and advanced-stage Huntington’s disease. Progression between the stages is often slow and may take years or even decades, depending on the severity. Research on the disease has been ongoing since the discovery of the gene responsible. With the use of both small and large animal models, scientists have begun to develop possible therapies. One promising advance in the field is RNA interference, which hopes to directly reduce gene expression of huntingtin by turning off protein translation. This therapy is believed to reduce or hopefully eliminate the mutations altogether, and thus by conjunction, the symptoms seen in patients.
Introduction

The emergence of chromosome mapping in the 1980s enabled scientists to discover the gene responsible for Huntington's disease (HD), and with it came efforts to better understand and treat the condition. To obtain the necessary pedigree information for genetic mapping, scientists followed the disease in two communities. One was in a family in Ohio with a high incidence of the disease and another in the Lake Maracaibo region in Venezuela, where interbreeding has caused a large population of individuals with Huntington's (Chial, 2008). The researchers documented more than seven hundred individuals and tested them for several DNA markers. However, even with the abundance of data, it proved a difficult task. It took researchers over six years to find the DNA marker G8 that was linked to the disease (Gusella, 1984). Its discovery led to greater knowledge of the genes' role in the formation of the neurodegenerative disease, as well as possible therapies.

Overview

History

Huntington's disease was first documented by the Long Island doctor George Huntington who noticed cases of dementia and chorea, which are unpredictable movements, that seemingly ran in families. After seeing a similar pattern with his father's patients as well, Huntington began documenting in great detail the symptoms and onset by following generations of a family who exhibited the condition. Some hallmark symptoms of 'Hereditary Chorea' that he observed included muscle spasms or rigidity, slow and twitching eye movements, impaired cognitive abilities, and lack of impulse control. Perhaps his most astute observation was that if one or both parents showed signs of the disease, then their offspring will likely suffer from the condition as well (Bhattacharyya, 2016).

It is noteworthy that before the earliest medical accounts of
the disease in the 1840s, the condition was still present, although misunderstood and seldom documented. One explanation for this lapse in documentation is a result of the increased life expectancy of the population during the 19th century (Wexler, 2013). Before Huntington and his contemporaries documented the disease, individuals who carried the condition seldom lived long enough for the symptoms to manifest. This may have concealed the conditions’ hereditary nature. It was not until advances in technology and the widespread acceptance of physicians that lifespan increased, and thus the progression of the disease could be witnessed more readily (Wexler, 2013).

Etiology

Huntington’s disease is a degenerative disease that is caused by a mutation on chromosome four. A healthy individual will have up to 26 Cytosine-Adenine-Guanine (C-A-G) repeats in their DNA on the specific region on the chromosome responsible for the huntingtin protein (Langbehn et al., 2019). However, people with Huntington’s disease have a higher prevalence of the sequence repeats due to a mutation, usually 40 or more, and will thus exhibit symptoms of the condition. The elongated protein will get cut into smaller sections that attach themselves to the neurons and thus disrupt the cells’ functioning. The symptoms associated with the condition are caused by the changes occurring to the nerve cells as a result of the mutated huntingtin gene. Damage caused to the basal ganglia and cerebral cortex leads to disease symptoms associated with delayed or disrupted movements and conscious thoughts (Langbehn et al., 2019).
Carriers of the gene will manifest the disease, with the number of C-A-G repeats indicating the severity of the symptoms. Scientists have categorized the disease into three subsets: adult-onset, which is the most common, and juvenile and infantile-onset, both rarer. Those with early-onset typically have more than 60 C-A-G repeats and thus show earlier signs. As the gene mutation is passed through the generations and is dominantly inherited, parents have a fifty percent chance of passing on the mutation to their children, and the risk of inheritance is no different for the sexes. However, research has shown that women display more symptoms and are more prone to developing depression than men (Hentosh et al., 2021). Individuals who carry between 27 and 35 repeats will not manifest the disease but will pass it on to their children, who are then at risk for developing it. This is because the mutation can enlarge and lead to increased anticipation, meaning the children may have an earlier onset compared to their parents (Mahalingam & Levy, 2014). However, individuals with more than 37 repeats of the mutation, as shown in figure 1, will undoubtedly get the disease and typically develop it as an adult, with symptoms beginning to manifest between the ages of 30 and 50. The elongated protein responsible for the HD mutation can disrupt the protein folding process and lead to synaptic dysfunction and brain damage characteristic of the condition (Shacham et al., 2019). As it is a progressive disease, the

Figure 1: A strain of DNA that indicates the C-A-G repeats present in a healthy individual (on top) and one with Huntington’s disease (Source: Australian Academy of Science, 2018).
earlier the onset, the more fatal and aggressive the symptoms will likely be (Hogarth, 2013).

**Progression**

Regardless of onset, the course of the disease is quite similar for those afflicted, with researchers and physicians usually categorizing the progression into four stages: prodromal, early stage, moderate stage and advanced stage Huntington’s disease (HD) (Stages of Huntington’s Disease, 2021). The progression of the disease can be seen in Figure 2 where motor, cognitive and psychiatric symptoms that are impacted are highlighted. Symptoms associated with the first prodromal stage typically occur 15-20 years before motor symptoms manifest. This stage is mostly categorized by mild cognitive and behavioral changes often only noticeable to the family. The second phase is Early Stage Huntington’s, which is where more pronounced motor signs are seen. A major symptom is chorea which is unpredictable movements. This can include abnormal eye movements, changes in facial expressions, and speech. Other mood and cognitive symptoms include apathy, irritability, and the development of psychological disorders like anxiety, depression, and obsessive-compulsive disorder (NHS, 2021). Symptoms continue in moderate stage HD with the progression of symptoms listed above. The worsening of symptoms often leads to the loss of independence due to the faster decline in motor functions. The prevalence of suicide in this stage increases as well. The final stage is advanced-stage HD, where speech becomes very difficult, and around-the-clock care is necessary. Swallowing is impaired, which may lead to the patient being malnourished, susceptible to infection, and even heart failure (A Caregiver’s Handbook, 1999).
Many neurodegenerative disorders, including Huntington's disease, are markedly human conditions, making them difficult to mirror in models. However, models remain one of the few ways to test possible therapies, and so their importance has persisted. With the discovery of the mutated gene, it became possible to use models to better understand the disease and investigate potential therapies. The findings from animal models are especially important in illuminating the disrupted pathways caused by the diseases. Although invertebrates, including fruit flies and nematodes, have been used in the past, most research uses rodents.
as genetic engineering is advanced in the model and is quite accessible (Stricker-Shaver et al., 2018). In order to replicate the disease onset, the mice are engineered to express the huntingtin mutation and, as a result, exhibit the associated behavioral and anatomical symptoms. There are two main categories of genetic mouse models, transgenic in which the mice get randomly inserted with a portion of the mutated human gene, and knock-in, where the gene sequence where the mutation is found is altered through substitution (Ramaswamy et al., 2007). The transgenic model is the most widely used; however, it is important to note that specific species are better suited to model certain aspects of the disease (Pouladi et al., 2013).

Figure 3: A human and mouse brain model showcasing the cerebral cortex, indicated in blue. Brains are not drawn to scale. (Source: Miterko et al., 2018).

Although the mouse model is necessary to understand Huntington’s disease, its use in research does come with limitations. The most significant being the mouse’s short lifespan. Huntington’s disease is characterized by its progressive nature, and it takes up to forty years to manifest and decades more before a patient succumbs to the disease. This limitation restricts scientists’ research as its short lifespan inhibits the possibility of a long-term study. Other models may be better suited for studying the progression at a closer time interval over which the condition progresses in humans. Another limitation is their small brain size which restricts the number of electrodes used when studying the organ. Although the mouse and human brain share 90% of the genes responsible for operating the brain, the human brain is markedly bigger (Kiderra & LaFee,
For reference, as shown in Figure 3, the cerebral cortex of a human is a thousand times larger than that of a mouse, and has 1,000 fold more neurons (Hodge et al., 2019). Their variance in size also means that treatment methods tested on mice need to be scaled up when used on humans. This difference makes it hard to scale therapies as it is difficult to determine whether patients need more or less drugs in their system.

Another issue is that rodent brains lack some of the key neuroanatomical characteristics that are present in human brains and that have an important connection to the disease. For instance, the basal ganglia and cerebral cortex of mice are considerably different in structure compared to the ones in humans. The difference in structure is important to note as the basal ganglia is responsible for smooth and coordinated movements (Gonzalez-Usigli, 2021) while the cerebral cortex controls language, motor activity and decision making, all agents that are impacted by Huntington’s disease (Estrada-Sánchez & Rebec, 2013). These evolutionary distinctions can complicate scientists’ ability to test treatments’ effectiveness, and thus it is important for researchers to understand a model’s limits when developing therapies (Morton & Howland, 2013).

Large Animal

In order to address some of the pitfalls of employing mice as a model, research has moved to using large animal models. The ideal test subject would be a non-human primate, such as a chimpanzee, as we share much of our DNA and brain structure. However, research on primates has slowed and is quite costly, so it is rarely done (Morton & Howland, 2013). Thus, scientists have looked toward other large mammalian models, especially farm animals, as they come with some significant and practical benefits. For one, the farming industry already has breeding and rearing systems in place, which makes it a convenient model. Two models in use today are pigs and sheep. They both come with some
important benefits, including being outbred, domesticated, docile, and that housing, caring, and feeding them is relatively inexpensive as they live outside. Another advantage that is useful for clinical research is their weight, which is comparable to that of humans in some species. Their longer lifespan also helps researchers track progressive neurological diseases with greater accuracy than mice models. However, perhaps the most significant advantage is that they have a large and anatomically similar brain to that of humans. Vital structures such as the gyrencephalic cortex, basal ganglia and thalamic nuclei are present in models such as sheep that are not found in mice models (Morton & Howland, 2013). These advantages make it possible to look at the animal's brain structures through magnetic reasoning imaging (MRIs) and test therapies that are meant to be delivered directly into the brain.

Sheep are promising models in the study of Huntington's disease as there are several naturally occurring mutations found in their DNA that can manifest into neurological disorders. Some have been found to show resemblance to human neurological disorders such as Batten's and Gaucher's Disease (Weber & Pearce, 2013). This implies that the huntingtin mutation may be able to cause a sheep to exhibit progressive symptoms of the disease as well. A recent study by Jacobsen and company uses transgenic sheep to model the disease and is in the process of being conducted. (Jacobsen et al., 2010) Although none of the sheep have yet to exhibit symptoms of the disease, this was expected, as the sheep are only five years old, and onset is not until late childhood. This study is promising as it paves the way for gene therapy and a better understanding of the disease.

**Treatment Options**

*Pharmacological*

Most pharmacological therapies prescribed to patients with Huntington's disease target the symptoms, most notably chorea, as
it is the most common. In 2008, the Food and Drug Administration approved the drug tetrabenazine, otherwise known as Xenazine, for treating chorea associated with Huntington's disease. It is thought that the jerky movements that characterize chorea result from an increase in the activity of monoamines, such as the neurotransmitters Dopamine and Serotonin (FDA, 2008).

Monoamines are responsible for homeostasis and physiological functions, but more importantly, they are involved in nerve and muscle functions. As highlighted in figure 4, Xenazine operates by reducing the amount of the hormone in the brain, and it does this in two ways. First, through blocking vesicular monoamine transporters (VMAT’s), which are proteins responsible for transporting neurotransmitters to vesicles in the nerve cells. The drug binds to VMAT’s and prevents them from storing excess dopamine in the vesicles. Xenazine also prevents dopamine from passing the signal to other receptors (Bio News Incorporated).

Although the drug has helped patients manage some of the disorder’s symptoms, it does come with some risks, most notably an increase in depression and suicidal thoughts. This is a major risk for patients because as many as 33-69% of those with the disorder also show symptoms of a depressed mood (Epping & Paulsen, 2011). Also troubling is that reported rates of completed suicide are also high among the population ranging from 3-13%, with as...
many as 25% of patients citing they have attempted suicide at least once during their illness (Epping & Paulsen, 2011). As a result, patients are notified of these adverse effects, and with the help of a physician, the need to address chorea in patients is weighed with knowledge on the patient’s psychological wellbeing to prevent suicides. Patients should be screened, and Xenazine stopped if suicide ideation persists.

**Therapeutic Advances**

Since the literature has been expanding over the years and knowledge on the pathogenesis of the disease has broadened, several therapeutic approaches have been tested. One promising therapeutic tool being studied is RNA interference (RNAi) which works by directly reducing gene expression (Abdulrahman, 2011). In the case of Huntington’s disease, it decreases the number of the mutant Htt proteins being produced. It can thus help delay the onset of symptoms for patients before debilitating neuropathology occurs. It selectively targets genes by binding to the mRNA of the selected gene and either blocking or hindering the transcription process (Aguiar et al., 2017).

There are two types of RNA interferences being studied that hold some promise. First, in vitro synthesis, which is double-stranded small interfering RNA (siRNA) and promoter-expressed short hairpin RNA (shRNA), which are made through viral vectors. Both silence genes; however, the methods differ in their persistence as siRNA needs repeated administration to suppress the gene, whereas shRNA’s can be permanent if an appropriate viral vector is used (Harper, 2009). Several preclinical studies in model rats have been shown to be effective in improving Huntington phenotypes, including behavioral deficits. RNAi treatment is especially promising as it has a large therapeutic window and can be administered early to patients with Huntington’s disease in hopes of treating the disease before extensive neuropathology occurs (Meghan & Neil, 2011). It may potentially be able to delay onset. However, the therapy does come with side effects, including

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**Huntington’s Disease: Etiology, Research Models, and Treatment**
the activation of the immune responses and off-target effects if the mRNA binds to the incorrect gene (Meghan & Neil, 2011). The former can be especially problematic because it can change the expression of the non-target mRNA in unknown ways. As a result, it will take some time before this therapy is available to patients.

Conclusion

Since George Huntington’s work on documenting the disease, knowledge on the subject has expanded. Over the past three decades, technological advances such as genetic engineering and animal models have enabled researchers to locate the specific gene mutation responsible for the disease. This has fortunately led to a better understanding of the condition. However, despite the efforts of the global community to find a cure, progress toward therapeutic treatment has been slow compared to the rapid success in finding the gene. Physicians can now treat specific symptoms of the disease, such as chorea and depression, with pharmaceutical options, yet a substantial cure has not been found. Thus, the disease remains largely untreatable, but a deeper understanding of the pathological process may lead to advances in the future.
References


Huntington’s Disease: Etiology, Research Models, and Treatment


Prized Writing 2021–2022


 Genetic Interactions of Trisomy 21, Carney Complex, and Bloom's Syndrome with Cancer

Nelly Escalante

Writer’s Comment: Many years ago, my younger sister was diagnosed with acute lymphoblastic leukemia. She also had Down syndrome, and, on our many visits to the hospital, my family and I learned that leukemia was more common in people with Down syndrome, though we did not know why. This gap in knowledge informed the topic for my final report for MCB 023. With my background as an undergraduate researcher, I decided to take a more technical approach to my paper to accurately convey and understand how intricate the genetic nature of cancer is. The field of cancer research has been evolving and now there is a greater emphasis on using a person’s genetics to see if someone may develop cancer later in life. Using people with genetic disorders as an example, we can see how necessary and revolutionary individualized cancer treatment can be for everyone. Three years after my sister was diagnosed, she was declared cancer-free and has been ever since, and this type of cancer research may provide the same fate for others.

Instructor’s Comment: Throughout our time together in the Winter 2022 MCB 23: History of Cancer, Nelly demonstrated a strong interest in developing a better understanding of the biological basis of cancer. I was iteratively impressed with Nelly’s inquisitive approach to the course material and how she so gracefully shared the personal significance of the course topic to her and her family. Her motivation to understand the biological connections between Down Syndrome and cancer resulted in this comprehensive research review that provides a detailed and technical synopsis of the molecular mechanisms contributing to increased risks of cancer in individuals with Trisomy 21 and other related conditions.
Nelly exemplifies the true spirit of scholarship, letting curiosity motivate the pursuit of knowledge and disseminating that knowledge with others.

—Marina Crowder, Department of Molecular and Cellular Biology

Introduction

Cancer arises through the accumulation of genetic mutations over a person’s lifetime. For this reason, cancer is classified as a genetic disease. There have been over 1,000 genes identified that have a known association with cancer, corresponding with over 1 million possible cancer genotypes (Wishart 2015). Those with genetic disorders already possess specific mutations that cause their particular disorder. Genes, and more importantly mutations, do not have one, single effect on the phenotype of an individual. We have many genes that affect different aspects of our biology or physiology, which are known as pleiotropic genes. Many of the mutations present in individuals with trisomy 21, Bloom syndrome, and Carney complex are also correlated with higher cancer incidence and can be classified as pleiotropic mutations that are present either in a single gene or a chromosome. Identifying specific genetic or chromosomal mutations that predispose an individual to cancer can help in diagnosing and treating cancer earlier.

Trisomy 21

Trisomy 21, commonly known as Down Syndrome, is a genetic disorder caused by a chromosome imbalance that confers a higher risk of developing specific types of cancer. Affected individuals have either a complete or partial extra copy of the 21st chromosome, which causes physical abnormalities and intellectual disability. Every year, about 1/700 births result in a child with trisomy 21, making it one of the most prevalent genetic disorders in the present day (Down Syndrome (Trisomy 21) – Pediatrics). Trisomy 21 can be diagnosed during pregnancy through the use of genetic testing. Beyond the physical characteristics of trisomy 21, affected individuals have an increased risk of developing specific cancers such as leukemia and testicular cancer.
Trisomy 21 and Cancer

One of the physical characteristics of trisomy 21 is weakened immune responses due to irregular thymus function. As a result, the number of T cells, which mature in the thymus, have been observed to be lower than in non-affected individuals. T cells, a type of lymphocyte, are important in preventing autoimmune diseases by regulating the adaptive immune response and recognizing antigens (Cellular Components of the Immune System – Immunology; Allergic Disorders). Trisomy 21 individuals have been observed to have decreased levels of leukocytes and lymphocytes overall, which results in a higher occurrence of acute lymphoblastic leukemia (Bloemers et al. 2009). Genome wide association studies (GWAS) have shown that single nucleotide polymorphisms (SNPs) in the CDKN2A/B and ETV6 genes are commonly present in Down syndrome individuals. These same genes are altered during the development of acute lymphoblastic leukemia (ALL) and are correlated with an increased chance of developing ALL (Hatton et al. 2020).

Additionally, infants with trisomy 21 are 500 times more likely to develop acute megakaryoblastic leukemia (AMKL), a subset of acute myeloid leukemia, due to a variety of mutations (Satge and Bernard 2008). A common somatic mutation present in trisomy 21 individuals results in a shortened GATA1 transcription factor, which affects the development of blood progenitor cells. Specifically, megakaryoblasts are arrested in a premature development state and proliferate uncontrollably, leading to AMKL (Mansaro et al 2011). Furthermore, this GATA1 mutation phenotype has been observed exclusively in trisomy 21 individuals with AMKL. However, it has also been noted that trisomy 21 and GATA1 mutations alone are not enough to cause AMKL in affected individuals (Roy et al 2009). This further illustrates how no one single mutation is responsible for the development of any cancer, making the behavior of cancer more difficult to decipher and predict.
AML/RUNX1 is another transcription factor gene present on chromosome 21 that is involved in the development of blood progenitor cells. Mutations in this gene have been observed to contribute to the development of acute myeloid leukemia. Though the mutation is not exclusive to trisomy 21 individuals, when it is present, it usually confers a poor prognosis for the patient (Taketami et al 2003).

Affected individuals also have a higher risk of developing testicular cancer because of delayed and increased expression of POUSF1, a transcription factor that results in the under-expression of a gene that controls the formation of germ cells (Satge and Bernard 2008). This results in testicular germ cells that are unable to mature properly and have increased genomic instability. This instability causes an increased rate of mutations that can ultimately cause testicular cancer.

Trisomy 21 individuals are at a higher risk of developing other diseases besides cancer and have higher chances of developing complications from disease. When a trisomy 21 individual presents with cancer-like symptoms, the genetic interactions between extant mutations and cancer mutations that may have developed must be considered to obtain a complete clinical picture.

**Carney Complex**

In addition to trisomy 21, Carney Complex (CNC) is a rare syndrome that has also been associated with an increased risk of cancer. CNC is caused by mutations or deletions of the *PRKARIA* gene on chromosome 17. This gene codes for the regulation of protein kinase A (PKA), which regulates several biological processes through phosphorylation. *PRKARIA* is also classified as a tumor suppressor gene that, when mutated, produces an incomplete protein product.
Carney Complex and Cancer

When PKA is mutated, proteins are indiscriminately phosphorylated and cell division continues uncontrollably, allowing cancer the opportunity to develop (Caretta and Mucignat-Caretta 2011). Affected individuals develop “pigmented lesions” on the skin and in several other tissues as well as benign growths in the heart, known as myxomas. This syndrome is autosomal dominant, meaning that parents who are carriers are likely to have an affected child. However, because of the variety of ways that CNC presents itself phenotypically, the precise incidence is unknown (Correa et al. 2015). Currently, less than 400 people have been officially diagnosed with Carney complex, so many of the genetic interactions that contribute to the development of cancer in affected individuals have not been completely elucidated.

Because CNC presents itself in several parts of the body, one of the leading causes of death in affected individuals is the presence of metastatic tumors. This disorder has many complex interactions with the endocrine system which increases the risk of ovarian cancer in female patients (Siordia 2015). Thyroid cancer is one of the most common cancers observed in affected individuals due to the role of tumorigenesis caused by the mutation of the PRKARIA gene (Boikos and Stratakis 2006).

Bloom’s Syndrome

Bloom’s syndrome is an autosomal recessive disorder caused by single-gene mutation in any of the genes in the Bloom syndrome complex: BLM, TOP3A, RMI1, RM12. This complex codes for many enzymes that maintain genomic stability during DNA repair by homologous recombination. Any mutations in the complex compromises the accuracy and precision of recombination and leads to the accumulation of further mutations (Bythell-Douglas et al. 2020). High rates of sister chromatid exchange have also been observed as a result of mutations in the BLM gene, which
results in a shortened or nonfunctional RecQ helicase, a protein that is important in stabilizing the unwinding of DNA (Cuniff et al. 2017). Bloom’s has many clinical and biological manifestations including growth deficiency, reduced life span, dermatological abnormalities, and increased cancer incidence.

**Bloom’s Syndrome and Cancer**

Colorectal cancer is one of the most common neoplasms observed in the population of Ashkenazi Jews, who have the highest prevalence of Bloom’s syndrome. Approximately 1.8% of this population was observed to carry a mutation in the *BLM* gene as compared to 0.8% in a control group, suggesting a correlation between the development of mucinous colorectal cancer and *BLM* mutations. Sporadic colorectal cancer, cancer that is not due to inherited mutations, also frequently contains somatic mutations in *BLM* (Hodgson et al. 2014).

Leukemia and lymphoma are also common neoplasms observed in Bloom’s syndrome individuals. *BLM* is important in the proper development of the immune system and affected individuals usually present with generalized immunodeficiency. This immunodeficiency is partially attributed to abnormal B and T cell development (Ababou 2021). Apart from having a greater risk of developing cancer, affected individuals develop cancer at an earlier median age and can develop multiple cancers at the same time. 20% of all affected individuals develop neoplasms with about half being diagnosed before the age of 20. Dermatological manifestations of the syndrome and extreme sensitivity to sun exposure also contribute to a higher risk of skin cancer, specifically basal cell carcinomas. Cancer is the most common cause of death for Bloom’s syndrome individuals and has prompted increased and systematic surveillance of affected individuals in order to improve patient outcomes (Cuniff et al. 2017).
Genetic Screening

Genetic screening is an incredibly powerful public health tool that has the potential to save lives through prevention. Because of the correlation between genetic disorders and cancer, many people choose to undergo genetic testing to determine their or their children’s risk of developing cancer. Most of the mutations that we have are present in our somatic cells and cannot be passed down to children. However, mutations present in our germ line cells have the possibility of being passed down. Many of the genetic disorders presented here also have a hereditary element where parents can be carriers of a disorder-causing gene. Because of this, each of these disorders have screening procedures to determine if individuals have the disorder or are likely to develop it.

Trisomy 21 Screening

Trisomy 21 can be diagnosed during pregnancy and as early as 10 weeks of gestation. One screening method is known as amniocentesis and can only be performed after the 14th week of pregnancy. This procedure involves inserting a needle into the abdomen and the amniotic sac to collect amniotic fluid and fetal cells. Chorionic Villus Sampling (CVS) is another prenatal screening method. Chorionic villi are present on the surface of the placenta, which are collected using a syringe and then cultured. This procedure can be performed between 10 and 12 weeks (Genetic Evaluation – Gynecology and Obstetrics). Both procedures examine the cells collected to detect the percent of chromosome 21 fragments present. A higher-than-normal percentage indicates a third copy of the chromosome, confirming a diagnosis of trisomy 21 (Burke et al. 2011).

Carney Complex Screening

Diagnosis of Carney complex is usually performed by observing a patient’s clinical manifestations and determining whether they
meet the diagnostic criteria of CNC. These include the presence of dispersed skin pigmentation, myxomas, and acromegaly. Histological analysis confirming the necessary mutation in the \textit{PRKARIA} gene must also be performed to confirm the diagnosis. Not all patients have a complete null mutation of \textit{PRKARIA}, but they will still have the same clinical manifestations as those who do. Many of the manifestations of Carney complex appear, on average, at age 18. Diagnosis is usually made at the median age of 20, but there have been some cases of diagnosis at birth (Boikos and Stratakis 2006). If an individual is diagnosed with CNC, their family members may be prompted to undergo genetic screening as well to determine whether they are carriers of the mutation and prevent unnecessary interventions if found to be non-carriers.

Once Carney complex is diagnosed, several additional screenings are recommended across a person’s lifetime to detect malignancies early. Over half of individuals with Carney complex die due to cardiac-related issues and 30% of related deaths are due to cardiac myxomas. Echocardiograms, cortisol urine analysis, and thyroid ultrasonography are recommended to be performed annually, with additional screenings being performed as manifestations of malignancies develop (Stratakis et al. 2001).

\textit{Bloom’s Syndrome Screening}

Screening for Bloom’s syndrome involves determining the rate of sister chromatid exchanges (SCE) occurring in the patient’s cells and sequencing of the \textit{BLM} gene, which is present on chromosome 15. To determine the rate of SCE, chromosomes are visualized during cell reproduction. DNA sequencing, PCR, and Southern blots are used to analyze abnormal \textit{BLM} gene products (Arora et al. 2014). Bloom’s is an autosomal recessive disorder, so parents can be carriers for the mutations that cause the syndrome. Bloom’s syndrome is more common in populations with higher rates of consanguinous relationships (Ababou 2021). Overall, there are
less than 400 people who are affected by Bloom’s syndrome (Bloom Syndrome).

**Cancer Screening**

Family history has always been part of a standard clinical examination. Present day genetic cancer risk assessments are considered an extension and application of a family history, taken to the genetic level. Genetic mutations are the driving force behind cancer development, so genetic risk assessments have become more appreciated as another tool in the fight against cancer. Genetic cancer risk assessment is different from screening because it does not seek to diagnose a person with any one cancer. Rather, it can indicate whether a person is likely to develop a specific kind of cancer due to mutations present in their genome. In adults, cancer screening may provide information on whether one or both parents are carriers of a mutation that may predispose their child to a specific type of cancer.

Genetic risk assessment usually includes taking blood and tissue samples and sequencing the DNA from those samples. Commonly, whole genome sequencing is performed, mutations are identified, and those mutations are compared to known cancer-associated mutations. If cancer-associated mutations are identified, proper risk reduction practices can be implemented, treatment options can be discussed, and informed health decisions can be made (Aiello-Laws 2011).

However, genetic risk assessment, like any other screening method, is not a perfect prediction tool. Many non-genetic environmental factors can affect the likelihood that someone will develop cancer. Health behaviors such as smoking and exposure to carcinogens may still cause cancer in an individual not considered “at risk” from risk assessment. The field of cancer genetic screening is still evolving and being optimized to accurately portray an individual’s risk for developing cancer.
Conclusion

As a genetic disease, cancer has a complex relationship with pre-existing genetic disorders in an individual. Trisomy 21, Carney complex, and Bloom’s syndrome are just some examples of how inherent mutations can cause a greater risk for cancer. The interactions between these inherent mutations and cancer incidence have not been completely elucidated, but they are a good clinical tool to assess whether someone has an increased risk of developing cancer.

However, not all cancer-causing mutations are equal. In the genetic disorders presented, the risk of developing mutations varies widely and varies for different types of cancer. Therefore, it is important to individualize observation and treatment for each patient. In recent years, scientists and oncologists have gained an appreciation for the heterogeneous nature that cancer can have. Genetic risk assessment technology has helped in elucidating the complex genetic interactions of cancer with mutations and in determining an individual’s likelihood of developing specific types of cancer. Evaluating a person’s genome can help in highly individualizing treatment and do what is best for patients.

There are several other genetic disorders that have not been presented here that may also confer a higher likelihood of developing cancer. Being aware of the correlation between genetic abnormalities and mutations that can lead to cancer can be a useful tool for both physicians and family members. For caretakers of people with genetic disorders, it is instrumental to know what to expect when taking care of that person. This can cause changes such as becoming more vigilant of neoplasia symptoms and undergoing cancer screening more often or at an earlier age. This knowledge can also provide comfort if a genetic cancer risk assessment shows that someone does not have an increased risk of cancer.

Although several genetic disorders are rare, the information that can be obtained from a genetic risk assessment can greatly contribute to the field of cancer research. Efforts are being made
today to diversify the genetic information available for research to find more effective and targeted therapies for everyone. In doing so, in the near future, we may be able to identify more cancer-associated mutations and develop targeted therapies against them and reduce the mortality caused by cancer in people with trisomy 21, Bloom’s syndrome, and Carney complex.
**Works Cited**


Bee Venom Therapy as an Alternative Treatment for Neurodegenerative Disorders

Clarissa Otto

Writer’s Comment: After discovering my bee allergy at a high school swim meet, I became fascinated by the healing and debilitating effects of bee venom. I had heard of bee sting acupuncture treatment for Lyme’s Disease patients that resulted in miraculous recovery, and chose to research the unknown properties of bee venom in the field of medicine. My initial search yielded diverse results, with research articles suggesting that bee venom could potentially treat everything from cancer to arthritis to HIV. Counteracting my desire to research all of these, I chose to focus on neurodegenerative disorders because of the complete lack of an effective treatment available for patients, despite the devastating effects these diseases cause on memory, personality, and function in affected individuals. My continued research made it clear that major gaps in the research on bee venom therapy exist, preventing clinical trials and a possible cure for these diseases. My review discusses these gaps in the literature and suggests future topics of research that can aid in the urgent development of bee venom treatment.

Instructor’s Comment: In my UWP 102B: Writing in the Biological Sciences course, students spend most of the term researching and writing a literature review. They choose their own topics, with the requirements that the topic must connect to biological sciences in some way (a pretty broad guideline) and that the topic must be timely and relevant, helping to answer some of the big questions of our time. Selecting a topic is often the most difficult part of the project, but Clarissa knew from early
in the term that she wanted to research bee venom. It's an exciting review because Clarissa explores how we can take an old idea (bee venom) and apply it in new ways (as treatment for neurodegenerative diseases). Writing a strong review is no easy feat, however. It requires discipline, motivation, and persistence. Clarissa put in a lot of time doing the research and doing extensive revision, building on what she had learned from our class community. By the end of the term, her goal had shifted from understanding what was happening in the research to finding the clearest and most engaging way to share her discoveries with readers. This final version is the result. I'm thrilled to see it published here, representing excellent undergraduate research and writing.

—Amy Goodman-Bide, University Writing Program

Introduction

Over the past 200 years, average human life expectancy has doubled in most developed countries due to improved food and water quality, better living conditions, and advanced medical services. However, this increase in lifespan does not align with an increase in health, and many neurodegenerative diseases associated with age, such as Alzheimer’s disease (AD), Parkinson’s disease (PD), and dementia are increasing in the general population.¹ These diseases account for 12% of deaths worldwide and are stigmatized because they cause social incapacitation, behavioral disorders, cognitive impairment, and even depression and suicide.¹⁴ Additionally, no cure has been found for any of these disorders, and current treatments solely alleviate symptoms and slow degenerative progress. Researchers have begun to focus on bee venom therapy (BVT), a branch of alternative medicine dating back to 3000 BC, as a potential treatment for these diseases, as well as other neurodegenerative disorders, such as epilepsy and amyotrophic lateral sclerosis (ALS).

In recent years, researchers have begun to explore the biochemical mechanisms, components, and applications of this
ancient form of therapy in order to develop treatments that can cure or counteract degenerative progress. However, due to the potential of adverse effects and limited research, most studies are in preclinical stages. Nevertheless, awareness of this treatment is expanding, and the urgent need for a cure is pushing researchers to begin clinical trials. This review will evaluate the current literature on bee venom therapy and its potential to treat neurodegenerative diseases. It will also recommend future prioritization of research of components, administration, clinical applications, and safety.

Biomolecular Components and their Applications

Bee venom (BV) is a transparent, odorless mixture of various biologically active compounds that contains peptides such as melittin, adolapin, and apamin, as well as enzymes such as phospholipase A2 (PLA2). It is slightly acidic with a pH that ranges from 4.5 to 5.5, and one drop consists primarily of water (88%) with only 0.1 µg of dry venom. The use of whole bee venom is risky due to its inconsistent and potential adverse effects, and thus exploration into single components might provide safer and more specified care for patients.

Melittin constitutes 40-60% of dry BV and is believed to be the major biologically active component. In large doses, it causes pain, itching, and swelling, but in small doses, carries anti-inflammatory and antinociceptive properties. Melittin has been found to cause neural plastic changes in pain-signaling pathways in the brain. These changes activate and sensitize nociceptor cells, thus producing its antinociceptive effects. Researchers also found that melittin decreases signaling pathways that activate inflammatory cytokines, which leads to a reduction of inflammation in liver, skin, joint, and neuronal tissues, as well as in the lungs and spleen. Additional properties associated with melittin are an increase in capillary permeability, decrease in blood pressure, and a binding to the enzyme PLA2 to create a complex and inhibit the enzyme’s activity. Overall, melittin may be the most promising component
for treatment of neurodegenerative diseases, as its cytokine activation and PLA2 deactivation are critical components involved in neurodegeneration healing.

The enzyme PLA2 constitutes 10-12% of dry bee venom and is the most lethal enzyme found in BV. However, it does have beneficial applications, some of which include nerve regeneration, nociception, and delayed neurotoxic effects, as well as inactivation of microglia and reduced T-cell infiltration. The complex it forms with melittin is beneficial in that it occurs during erythrocyte lysis, and melittin can help expose membrane phospholipids by opening melittin-induced channels.

A study conducted in 2018 found that PLA2 reduced accumulation of Aβ peptides and hippocampal neuroinflammation, thus improving cognitive function, as well as increased glucose metabolism in the brain. Two smaller peptides include apamin, which constitutes 2-3% of dry bee venom and is primarily known for its inhibitive action on calcium/potassium channels in the CNS, as well as adolapin. This peptide constitutes about 1% of dry bee venom and is the only peptide in BV that has anti-inflammatory, antinociceptive, and antipyretic properties, though minimal research has been done in its precise effects on the brain.

**Modes of Administration**

The administration of bee venom includes a variety of methods, one of which is bee venom acupuncture (BVA). This method involves directly applying venom to the tip of a small needle, and inserting the needle into an acupoint in the skin. Many studies have found that direct application to acupuncture points increases the benefits of bee venom due to combined biochemical mechanisms and acupuncture stimulation. Researchers studying rheumatoid arthritis found that BV acupuncture of the Zusanli acupoint greatly improved anti-nociceptive and anti-inflammatory effects when compared to injection. Studies have also shown that BVA as a potential mechanism of treatment may a safer method. BVA is the primary mechanism used in human studies, and its
effectiveness thus far shows it may be the best method for clinical trials. Additionally, future research should study the mechanisms of acupuncture and investigate specific acupoints pertaining to BVT.

Live bee sting acupuncture is performed by directly inserting the stinger of a live bee into the patient’s skin using tweezers to hold the bee in place. Researchers utilized this tactic and found that this treatment did not improve disability, fatigue, or quality of life in patients with multiple sclerosis (MS), or produce any serious adverse effects. However, another study suggests that this method increases the risk of fatal allergic reactions. Overall, this method appears to be largely ineffective and potentially dangerous.

BV injection involves administering the venom into the skin with a syringe, allowing for accurate collection and injection of venom. This form of administration is less effective than BVA in decreasing pain and inflammation for neurodegenerative diseases, and may not be the most effective mode of administration.

Clinical Applications

Parkinson's Disease

Parkinson’s disease (PD) involves the loss of dopaminergic neurons and motor function, yet the mechanisms underlying the death of dopaminergic cells are unknown. However, mounting evidence points to neuroinflammation as the cause. Bee venom has been shown to protect dopaminergic neurons from degeneration and injury by modulation of Treg cells and reinstatement of TNF-α and IL-1β in brain tissues. A possible mechanism by which BV protects these neurons is via interactions with proinflammatory cytokine pathways. A study found that this interaction reduces inflammation in the brain associated with PD. BV was also found to increase neurotransmitter levels, ameliorate neuroexcitation, and protect against neurotoxicity, all of which could aid in PD treatment. A preclinical study involving mice subjects induced with Parkinson’s-like symptoms found the
enzyme PLA2 to be effective in treatment.\textsuperscript{13} Additionally, a clinical study demonstrated the benefits of bee venom acupuncture over injection in participants with PD,\textsuperscript{11} suggesting that acupuncture may be the best method to utilize in clinical settings and specifically in PD patients. Bee venom is extremely promising in the treatment of PD, and future studies should expand on this information, including PLA2 and BVA in the treatment of PD, while also moving into clinical settings.

\textit{Alzheimer's Disease and Dementia}

Alzheimer’s disease and dementia are characterized by progressive cognitive decline and inflammation in the brain. Researchers have proposed that the modulation of Treg cells is vital in research because of their anti-inflammatory effects in the brain.\textsuperscript{18} Multiple preclinical studies have used bee venom as a method to regulate these cells and found it to be successful.\textsuperscript{[10,18,20]} One of these studies simultaneously found that the enzyme PLA2 halted progressive decline in rat models induced with Alzheimer-like symptoms through its anti-inflammatory mechanisms mentioned previously. Alternatively, another study showed that the peptide apamin increased hippocampal neuronal-excitability and synaptic plasticity in rodent models, suggesting its potential to treat AD in clinical settings. Dementia affects the brain in similar ways, and a study on vascular dementia found that treatment with BV improved spatial memory, increased neurons in the hippocampus, reduced damage to microglial cells, and reduced brain inflammation.\textsuperscript{23} While BVT shows promise in treating both neurodegenerative diseases, most if not all studies have yet to advance to the clinical stage. Before this can happen, researchers should explore which specific components of BV will have the best result and design a treatment that produces consistently beneficial results.
Amyotrophic Lateral Sclerosis

ALS is a progressive and severe paralytic disease characterized by the death of upper and lower neurons in the motor cortex, brainstem, and spinal cord. Current clinical treatments focus on blocking the release of glutamate in the brain, which extends patient survival and alleviates symptoms. However, the various properties of bee venom could potentially benefit patients more effectively than these treatments. Preclinical studies have found that melittin in BV reduced lung, spleen, and neuronal tissue inflammation by blocking cytokine signaling pathways in the brains of mice induced with ALS. Because many ALS patients suffer from decreased spleen size and respiratory insufficiency, which often leads to death, these findings are crucial to ALS treatment research. It’s even possible that BV administration at a precise stage in ALS can block activated microglia. Unfortunately, most studies involving BV treatment of ALS models are currently preclinical due to the uncertainty of the mechanisms and lack of research. Future studies should evaluate components such as melittin and their precise mechanisms in order to move toward clinical trials.

Epilepsy

Epilepsy is a neurodegenerative disease that causes recurrent seizures through imbalances in GABA (inhibitory) and glutamate (excitatory) neurotransmissions in the brain. Current treatments involve antiepileptic drugs (AEDs), which are largely ineffective. However, a preclinical study found that BV acupuncture ameliorated changes in expression of blood electrolytes, neurotransmitters, and voltage-gated channels and prevented consequences associated with increased levels of glutamate and DOPA in the hippocampus. The researchers concluded that BVA could be successful in treating epilepsy in conjunction with AEDs. Another preclinical study found melittin effective in decreasing seizure severity and astrocyte activation (which plays a role in glutamate uptake) in the hippocampus. Overall, BV research on epilepsy is limited but
Bee Venom Therapy as an Alternative Treatment for Neurodegenerative Disorders

has great potential, and more research is needed to ascertain the mechanisms and effects of BV before clinical practice.

Safety Implications

Bee venom therapy can elicit immune responses that range from mild skin irritation to life-threatening anaphylaxis and should therefore be treated as a potentially dangerous form of treatment. Adverse reactions consist of difficulty breathing, skin reactions (hives), swelling of the throat, weak pulse, dizziness, and loss of consciousness. A systematic review and meta-analysis of 145 studies found that adverse reactions from BVT occurred in 28.8% of all participants. Additionally, patient deaths caused by BVT have been reported, including a woman who experienced adverse reactions during a second treatment of BVA and died of hypovolemic shock the next day, as well as another woman who died of anaphylaxis two years into BV treatment, with no previous record of adverse reactions. Because adverse reaction are so unpredictable in patients, the key to institutionalizing this treatment in medicine lies in competent and overly-cautious care.

The same meta-analysis found that BVT is often given without an initial skin test for an adverse reaction, which accounts for a significant proportion of these negative effects, and is also often administered by unqualified professionals, which can have fatal consequences for patients. Additionally, it is difficult to determine the optimum dose, method of administration, and frequency of dose to succeed in effect and safety. Recent research has proposed that administration through acupuncture needles could be a safer route of therapy. One study found that treatment with acupuncture needles reduced adverse effects, though participants did not experience less pain. It is clear that great caution should precede any study or treatment, and BVT should possibly be considered as a last-resort option for less-severe cases of neurodegenerative disorders. Its unpredictability and poor administration are
problems which need to be solved through further research and more rigid regulation in medicine.

Conclusion

The purpose of this review was to evaluate the safety, components, and applications of bee venom therapy for neurodegenerative disorders such as Alzheimer’s, dementia, Parkinson’s, epilepsy, and amyotrophic lateral sclerosis. The current research on the topic reveals that BV and its individual components have significant anti-inflammatory and overall beneficial effects on the brain when in small doses, and the key to specialized treatments may lie in utilizing the mechanisms and characteristics of specific components, of which melittin and PLA2 seem the most promising thus far. However, as studies are primarily in the preclinical stage, further research is needed to advance to clinical settings, especially regarding the safest methods, properties of the components, and the most effective way to apply in conjunction. Bee venom therapy has great potential to change the field of neuro-medicine, yet inconsistent results and insufficient research limits its applicability, and there is much research to be done before these benefits can be utilized and potentially treat neurodegenerative diseases.
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References


Tracing Tomato Timelines: The Domestication of Solanum lycopersicum

Samantha Tang

Writer’s Comment: As a kid, I loved gardening with my dad. While we rotated through various squash and herbs every year, the one plant that could always be found in our backyard garden bed was the tomato. Fast forward to this past year when I had the honor of working in Distinguished Professor Dr. Venkatesan Sundaresan’s lab, studying methods of clonal asexual reproduction in tomatoes. Then, the perfect opportunity for me to build on my tomato knowledge presented itself in the form of the PLB 143 term paper, where Distinguished Professor Dr. Paul Gepts challenged students to dive into the history of the evolution of a crop of choice—and mine was quite obvious. As is with many subjects, looking back in history can guide future research and discoveries while building a better understanding of processes all around us. I hope that this paper not only captures my passion for agriculture but also highlights my fascination with tracing various forms of evidence to recreate an evolutionary timeline.

Instructor’s Comment: Why is a course dealing primarily with evolutionary and historic events that affected our crops still relevant in our contemporary societies? Because these events generally have long-term consequences related to environmental adaptation (think global climate change) and geographic distribution of our crops and their wild ancestors (think ownership of biocultural diversity). Samantha’s excellent paper on the origin of tomato provides an first-class example of the types of evidence used to trace back the dissemination and center of domestication of tomato in the Americas and its human-mediated dispersal to other continents, especially Europe. In the case of tomato, an ingenious combination of botanical, historical, and linguistic information sheds light on the evolutionary and anthropic selection and dissemination steps that have made tomato, the all-important, world-wide vegetable crop it is today. For example, did you know that tomato—
mainstay of Italian cuisine - appeared in Europe only in the 16th century after Columbus' voyages? Well, you definitely have to read Samantha's paper!

—Paul Gepts, Department of Plant Sciences

Abstract

*Solanum lycopersicum*, the tomato plant, is the second most important vegetable crop in the world. Cultivated for its fruit, the globally grown crop is believed to have originated in Mesoamerica or South America. While early researchers theorized a linear domestication path based on botanical evidence, new research has revealed potential de-domestication events before reaching the modern fruit we know today. Historical evidence such as references to tomatoes in European herbals and Spanish journals allow us to trace the spread of tomatoes across the globe. Moreover, linguistic studies show a Nahuatl origin before the Spaniards brought the tomato to Europe, which led to its expansion. Despite the lack of archaeological evidence, genetic studies have greatly elucidated the tomato’s center of origin and have painted a picture of the movement of the tomato’s wild ancestor to the plump fruit harvested all across the world. An analysis of the existing research on *S. lycopersicum* allows us to trace its evolution from the New World to the Old World, and back.

Introduction

With over 100 million tons of fresh fruit production annually, the tomato plays a significant role not only in worldwide diets but also in budding agricultural research (Food and Agriculture Organization). Scientifically named *Solanum lycopersicum*, the tomato offers high levels of nutrients through a plethora of cuisines and preparations. Despite the vegetable-like uses of tomatoes, it is classified as a fruit and, more specifically, a berry (Bjarnadottir 2019). It belongs to the nightshade or Solanaceae family, along with other vegetable crops such as potatoes, eggplants, and bell
peppers (Costa and Heuvelink 2018). Tomatoes make up nearly 20% of all vegetable crop consumption, and with a growing list of over 10,000 cultivars, the tomato is grown in large quantities all across the globe (Reimers and Keast 2016, Moore 2021). While they are often eaten fresh, the majority of tomatoes are processed into canned tomatoes or tomato paste, which opens up a larger variety of uses for the fruit.

Water makes up 95% of a tomato, with carbohydrates and fibers making up the remaining 5%. Even still, the tomato remains an excellent source of vitamins and minerals that contribute to blood pressure control, bone health, tissue growth, and cell function, among other things. Tomatoes are also the main source of the antioxidant lycopene, which has been found to protect important biomolecules from damage and degradation and promotes cell communication (Bjarnadottir 2019). Recent studies have found that lycopene plays a big role against Alzheimer’s and cardiovascular diseases, and also shows some anticancer activity (Kumar et al. 2017).

While there are biennial and perennial tomatoes, *S. lycopersicum* is typically grown as an annual crop (OECD 2017). Its growth and ripening following flower fertilization are typically accompanied by a color change from green to red fruit, but color variations of tomatoes exist within different cultivars. Ripening of tomato fruit is regulated through ethylene production, which has recently been manipulated to de-green tomatoes that are harvested too early (Quinet et al. 2019). Other relatively new tomato-related technologies include the use of artificial intelligence to manage greenhouse conditions, the breeding of tomatoes to increase pest resistance, and the use of plant growth-promoting rhizobacteria to promote stress tolerance and crop yield (Nyaku and Danquah 2019).

China is the leading producer of fresh tomatoes, followed by India, Turkey, and then the United States; these four countries accounted for around 60% of worldwide tomato production in 2017, totaling over 170 million tons worth tens of billions of
dollars (Nag 2020). In 2020, world tomato production exceeded 180 million tons, with China producing about 35% of the fresh fruit (Branthome 2022). Within the United States, California is the leader in processing tomato production, while Florida is the leader in fresh tomato production; the U.S. produces over $2 billion worth of commercial tomatoes annually (Reimers and Keast 2019).

Tomatoes have an unmistakable influence on cuisines all around the world. With its acidic, sweet, and umami flavors, we can observe the use of tomatoes in the grilled kebabs of the Middle East and simple egg and tomato stir-frys in Southeast Asia. Despite their early misclassification as poisonous in Europe, we also see tomatoes in Italian pasta and pizza sauces, French dishes like ratatouille, and refreshing Greek salads (Smith 2013). Spaniards, who are credited with introducing tomatoes to Europe, use tomatoes in dishes like paella. Following British colonization, Indian recipes began including tomatoes, leading to dishes like butter chicken and other curries (Authentica World Cuisine, Kanjilal 2021). And long before the cultivation of the modern tomatoes we are familiar with, the Aztecs prepared a salsa-like mixture of tomatoes, chilies, and squash seeds (Cutler 1998).

Tomatoes have recently been employed as a focus for genetic, fruit development, pest and disease resistance, and evolution research. It is regarded as the cornerstone for genetic research on all crops within the Solanaceae family, and acts as a model for fleshy fruit development and biology (Lin et al 2014). However, human breeding of tomatoes has affected the ability of researchers to trace the genetic history of tomatoes. Crosses with distantly related relatives during tomato domestication have led to introgressions that can mask the true genetic identity of the crop (Razifard et al 2020). This unintended side effect of tomato domestication means researchers cannot dismiss other forms of evidence in order to better understand the tomato’s origins.
Results and Discussion

This composition will analyze three types of evidence—historical, linguistic, and botanical—to trace the history of tomato domestication and evolution. A literature review of current knowledge regarding the tomato will allow us to better understand its origins.

Historical Evidence

European herbalists began to take note of the tomato in their writings in the 1500s when the tomato was introduced to Europe. Despite the common agreement that tomatoes were introduced to Europe by the Spaniards, the timing of Spanish conquests makes it difficult to pinpoint where the Spaniards obtained the fruits. Between the capture of Mexico City in 1521 and the Peruvian conquest in 1531, either location could have been the Spaniards’ source of tomatoes (Labate et al. 2007). While previous names such as “Mala peruviana” and “Pomi del Peru” suggested a Peruvian origin, other scientists such as Alexander von Humboldt believed cultivation began in Mexico (Jenkins 1948). Pietro Andrea Matthioli, the first Italian to write about the tomato in 1544, described it as another species within the mandrake family, comparing the fruit to an apple and its preparation to an eggplant (Jenkins 1948). He explained that, in Italy, the tomato was prepared with salt and pepper, and fried in oil (OECD 2017, Jenkins 1948).

John Gerard was the first botanist to write about the tomato in England (OECD 2017). He explained that this plant grows in hot environments like Italy and Spain, where he was able to retrieve some seeds for his own garden. In his herbal, Gerard describes both yellow and red fruit. Curiously, one particular excerpt from his writing stands out: “… I have in the hottest time of Summer cut away the superfluous branches from the mother root, and cast them carelessly in the allies of my Garden, the which (notwithstanding the extreme heate of the Sun, the hardnesse of the trodden allies, and at that time when no rain at all did fal) have growne as fresh.
where I cast them, as before I did cut them off…” (Gerard 1636, pp. 346). This line seems to speak about the adaptability of the tomato and bears a striking resemblance to the Dump Heap theory posited much later on by Edgar Anderson in 1952. Anderson posits that the disposal of food waste could have supported the survival of plants that grow to be adapted to highly disturbed areas; these dump heaps could have been the origin of domestication for some plants (Anderson 1952). Perhaps the “weedy” abilities of Gerard’s tomatoes offer a connection to wild ancestors, like early *S. lycopersicum* varieties in Mexico that regressed wild traits and weed-like capabilities in order to better adapt to new environments (which will be detailed in *Botanical Evidence*).

Subsequent evidence of tomatoes in the 17th and 18th centuries suggests that they were domesticated as ornamentals (OECD 2017). Strangely, despite the previous understanding that tomatoes could be eaten, they were widely feared by the public and believed for a period of time to be poisonous. In the late 18th century, the tomato was nicknamed the “poison apple”; they were considered exotic fruits and mostly eaten by upper-class Europeans, who could afford pewter tableware (Smith 2013). Unfortunately, the acidity of the tomatoes leached lead from pewter plates, causing an increase in deaths due to lead poisoning (Crang et al 2018). As a result, the tomato was blamed for the deaths.

Also in the 18th century, the tomato made its way (back) to North America. William Salmon reported the tomato as an ornamental plant in 1710 as it arrived in commercial harbors on the East Coast, but it continued to take on a notorious reputation. Due to its classification within the *Solanaceae* family, also known as the nightshade family, tomatoes were believed to carry the same toxins as deadly nightshades. These myths were finally debunked in the 1800s when a New Jersey resident ate a tomato on the Salem courthouse steps (Rick 1978). Subsequent Italian cultivars of tomatoes began to make their way to the United States, followed by the breeding of new varieties for commercial sale and an increase in knowledge regarding the incredible nutritional value of tomatoes.
Despite its tropical origins, the tomato is now widely grown across the globe, mostly in temperate regions (OECD 2017).

Linguistic Evidence

In 1532, following Spanish colonization in the New World, Bernardo de Sahagun wrote about the tomato and its origin in Nahuatl language. The Aztecs referred to the fruit as “tomatl,” which comes from the roots “tom,” meaning plump or swollen, and “atl,” meaning water (Davis 2015, Veschi 2020). When the Spanish brought the New World tomato to the Old World, they referred to the fruit as “tomate”. It is important to mention that there has been no discovery of any South American Indian word for tomato, which points towards Central or North American origins (Jenkins 1948).

When tomatoes arrived in Europe, the Italian naturalist Pietro Matthioli referred to the tomato as “Pomi d’oro” which is still used as the common Italian word for tomato today, pomodoro. In Matthioli’s original reference, the tomato is described to be yellow, which likely inspired the name “Pomi d’oro,” or “apple of gold” (Jenkins 1948). The Flemish botanist Rembert Dodoens wrote in his herbal, Cruijdeboeck, in 1554 several names referring to the tomato, including “Apples of love” and its French equivalent, “Pommes d’amours”- inspired by Matthioli’s Italian name for the plant (Davis 2015).

In 1561, Italian botanist Luigi Anguillara’s Semplici suggested that “Lycopersico” and “Pomi d’oro” were synonymous for the tomato. One significant record refers to the tomato as “tomato from Themistitan,” which refers to Tenochtitlan- the Aztec capital in ancient Mexico (Jenkins 1948). An account from 1590 by José de Acosta, a Spanish Jesuit missionary, in his Historia natural y moral de las Indias (Natural and Moral History of the Indies), describes Lycopersicon esculentum as a round and juicy berry, good for eating on its own or as a sauce (Acosta and Mignolo 2002).
During the 17th and 18th centuries, various scientists posited a variety of names for the tomato, including “Pomum de oro” and “Solanum pomiferum” (Jenkins 1948). However, in 1753, Linnaeus formally named the tomato *Solanum lycopersicum*. Around the same time, other botanists like Phillip Miller placed the tomato in its own genus, *Lycopersicon* (from Greek “wolf-peach”), calling the tomato *Lycopersicum esculentum* (Labate et al 2007). Despite these arguments, *S. lycopersicum* remains the most used scientific name today (Labate et al 2007).

**Botanical Evidence**

Based on the variety of wild tomato fruit sizes found, it was once believed that the original tomatoes featured a small, blueberry-sized fruit. These ancestral tomatoes were bred roughly 7,000 years ago to produce a medium, cherry-sized fruit, then bred to the larger tomatoes we consume today (Pankau 2020). Typically—and certainly in the case of the tomato—an increase in fruit size is a desired trait, and therefore the evolutionary growth from a small blueberry-sized tomato to a medium cherry-sized tomato to a modern tomato is reasonable. Even in more recent journal articles from 2008, 2012, and 2014, it was posited that the ancestor of our modern tomato is *Solanum pimpinellifolium* (SP), which bred into intermediate-sized *S. lycopersicum* var. *cerasiforme* (SLC), before reaching cultivated *S. lycopersicum* var. *lycopersicum* (SLL) (Ranc et al 2008, Blanca et al 2012, Lin et al 2014).

However, in a 2020 journal article, a research team utilized genomic evidence to trace the domestication history of the tomato. Razifard *et al* discovered that the pathway of domestication to our modern tomato was not as linear as previously perceived, and instead likely featured a regression of domesticated traits before the re-domestication to the tomato cultivars we see today. In particular, the journal article pinpoints the origins of SP to be in South America. They hypothesized a divergence of SLC from the South American SP around 78,000 years ago in nearby locations.
such as Peru, Ecuador, and San Martin, as well as locations further north such as Mexico, Central America, and Northern South America. Interestingly, we see that the South American SLC has many of the favorable traits observed in the tomato domestication syndrome: thicker pericarps, lower dry weight, and lower levels of soluble solids and citric acid, among other characteristics. On the other hand, these traits were diminished in northern SLC groups, with smaller fruits, thinner pericarps, and higher levels of citric acid (Razifard et al. 2020).

There appears to be an increasing consensus that SP originated in western South America and an expanding acceptance of theories similar to those of Razifard et al. (OECD 2017, Pankau 2020). These blueberry-sized tomatoes were possibly never domesticated by humans, and modern tomatoes come from naturally diverged SLC groups (Razifard et al. 2020). In having to adapt to different stresses as they spread northwards, these SLC groups lost some traits of the tomato domestication syndrome (Razifard and Caicedo 2020). The weedy nature of the crop comes into mind when we consider the different environments SLC had to grow into as it migrated, possibly along human migration routes or natural routes like birds or other animals (Pankau 2020). SLL groups, which are most closely related to northern SLC groups, were domesticated by residents of Central America and Southern Mexico—like the Aztecs—and subsequently carried over to Europe following the conquest of Mexico City (Estabrook 2015, Razifard and Caicedo 2020).

**Recommended Lines of Future Research**

Notably, there is a distinct lack of archaeological evidence regarding the tomato and its origins. Alphonse de Candolle discussed the tomato in his *Origin of Cultivated Plants* and its missing puzzle piece in his four types of evidence towards crop origins (Jenkins 1948). This is not to say archaeological evidence does not exist. Claims of tomato-like carvings on ceramic spindle
whorls have been made, although the florets depicted could also be in reference to other species such as the potato (Denham 2014). Future research may include finding ways to fill in this gap in knowledge, potentially through further excavations of Aztec sites to find remains that point to the possible domestication of the tomato.

Future research may also include a better understanding of how *S. lycopersicum* var. *cerasiforme* made its way north from the west coast of South America to Mexico and Central America. Similarly, it may be beneficial to understand the circumstances that lead to the regression of traits that differentiates SLC groups in South America and those in Mexico, Central America, and Northern South America (Razifard and Caicedo 2020). Another question that remains unanswered is why SLC diverged from *S. pimpinellifolium* in the first place. The emergence of traits similar to the modern domestication syndrome seems too coincidental to not be driven by human selection, but we must recall that SLC divergence seemingly occurred before human presence in the area. One possible explanation could be animal-driven selection, but overall the overlap of SLC traits with human preference remains a mysterious phenomenon (Razifard *et al* 2020)

An improved understanding of the domestication and evolutionary history of the tomato provides insight into the development of new varieties that can adapt to a changing world. As the viability and amount of agricultural land decreases, knowledge of origins and diversity becomes increasingly more valuable in order to cultivate sustainable crops. By piecing together the puzzle that is tomato evolution, we make connections between species and varieties that allow us to breed a more resilient and high-yield plant.
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Prized Writing 2021–2022


The Effects of Climate Change on Mangrove Ecosystem Services and Their Dependent Communities

Adrienne Blythe

Writer’s Comment: I am keenly aware that I am part of the climate change generation who will spend the rest of our lives paying the price for human mistreatment of the planet. As such, it is necessary for us to understand how the ecosystems we depend on to survive will be impacted. Mangroves in particular play a fascinating role in the natural world, and offer humans both a living and potential solution to the snowballing effects of climate change. My goal for this paper was to describe the complex interactions between mangrove systems and climate change, but present it in a light that would prompt even someone who knows nothing of the subject to care. Not everyone believes in the intrinsic value of ecosystems, but many can be persuaded of their worth when considering how ecosystem services benefit people. Papers like this are one of many ways I want to contribute to saving our planet.

Instructor’s Comment: Taking an upper division writing course over the summer, virtually, during a global pandemic is a challenge. Full stop. In the summer of 2021 Adrienne was a student in my course and her exemplary work shows that even during times of great difficulty, the need for clear, concise and compelling science communication persists. In this Literature Review, Adrienne tells us about the significant ecosystem services coastal mangrove forests provide. We learn about their contributions to coastal communities, how they mitigate impacts from a changing climate and what is being done to help protect them.
from loss. Her writing is accessible to general audiences, and provides them with insight gleaned from her careful study of the current research in this field. She also does the important work of situating the urgent need for this research by helping us understand what is at stake if these, and other keystone species continue to decline.

—Russ Carpenter, University Writing Program

Abstract

Mangroves are a saline-tolerant species of tree that grow in coastal regions of the world, primarily between the Tropics of Cancer and Capricorn. Their attributes make them a critical habitat for many species and an indispensable source of ecosystem services, including defense against hurricanes and floods, prevention of eroding shorelines, a source of food and raw materials, water filtration, and carbon storage. However, climate change and land development have been major perpetrators of their decline, especially driven by violent storms, rising sea levels, pollution, deforestation, and intensive aquaculture. Mangroves are struggling to survive under these poor conditions, and even if left to regenerate on their own, will still need human support to make a full comeback. Restoration attempts thus far have seen mixed results, with manual plantings finding little success and mound plantation programs achieving more promising results. Management will require an interdisciplinary approach spanning all aspects of life from government bodies to average people. Local governments will need to push policies protecting mangrove forests while making sure local communities understand why they are so important, assessing location, ecosystem services, and economic aspects before any decisions are made. More research, outreach, and management experimentation must be undertaken to fully understand how humans can better care for these ecosystems. Sourced from a variety of studies chosen for their analyses of management, valuation, and ecology, this review will illustrate
how climate change is affecting the ecosystem services that mangroves impart and how these effects impact human communities.

**Keywords:** Mangroves, Ecosystem Services, Climate Change

**Introduction**

Life on the tropical coasts depends on mangroves for survival. For thousands of years, they have provided humans with services that sustain our populations, including hurricane and flood protection, fishing nurseries, water filtration, and recently more important, carbon storage (Akbar et al. 2021). Despite their importance, they are a prime target of unsustainable deforestation, agriculture, and pollution, currently resulting in a 35 percent loss of mangrove coverage across the globe (Mehvar 2018). Climate change exacerbates these problems even further, resulting in a global decline of mangrove forests and, by extension, their ecosystem services. If humans wish to save mangroves and the boons they provide, a global restoration effort must be undertaken to reverse the aforementioned predicaments.

At the moment, there is no particular consensus on how to manage mangrove forests. Using current restoration strategies, the mortality of planted seedlings is still quite high (Akbar et al. 2021). There have been several theories suggesting interdisciplinary approaches involving collaboration between local communities, various stakeholders, and the government; but according to Carrasco De La Cruz (2021), ecosystem services must be appraised for their monetary values before proper management practices can be carried out. This review describes the current state of mangrove management, how their ecosystem services are affected by climate change, and elucidates the next steps that need to be taken to improve present circumstances.

**Mangroves and Ecosystem Services**

The exact definition of an ecosystem service is disputed, but the general consensus states that the services must benefit
people, be a specific part of the ecosystem outside of its natural processes, be measured discreetly, and have no human role in the service’s existence (Carrasco De La Cruz 2021). There is immense variety in what this encompasses, but in the case of mangroves, their ecosystem services include protection from hurricanes and rising sea levels, sediment stabilization, erosion protection, marine fishing nurseries, carbon storage, water filtration, and biodiversity (Powell et al. 2019).

The ability of mangrove forests to simultaneously perform all these feats comes from their species characteristics: by growing in thick, dense forests, they trap water and sediment that can cause floods and erosion (Rahman et al. 2019). This not only filters the water from contaminants, but also creates a defensive barrier to storms that would otherwise buffet or destroy communities on the shoreline (Mehvar 2018). Because of their chaotic growth, the trees generate significant biomass, making them five times as effective at absorbing atmospheric carbon than other trees (Akbar et al. 2021). Due to all these factors, mangroves are the ideal habitat for many species, making them a biodiversity hotspot and critical nurseries for fish (Powell et al. 2019).

How much an ecosystem service is valued is typically calculated in monetary terms and varies by country. In India, ecosystem services provided by mangroves ranged around 200 dollars per hectare not accounting for inflation after the early 2000s, paling in comparison to the staggering 10,000-12,000 dollars per hectare in Thailand (Mehvar 2018). One must take into account which ecosystem services are being valued; in this case, India is only valuing storm protection and nutrient retention, while Thailand is valuing general coastal protection, wood from logging, and habitats for fisheries. It was also noted in this study that fisheries and storm protection were the most valued services overall. Thus, it is safe to assume that the more ecosystem services a community utilizes, the greater the monetary value of the mangroves in that region. Though not an ecosystem service, mangroves also provide a source of income for local communities through tourism. Together with
coral reefs, they reign in an estimated value of 150-196 million dollars every year in the Caribbean Islands alone (Mehvar 2018).

**Climate Change and Other Threats**

Mangroves are fragile ecosystems that are considerably threatened by climate change (Win et al. 2020). Climate change affects them in a variety of ways by driving increasingly intense hurricanes, storms, and floods that cause rising sea levels, the intrusion of saltwater into freshwater, and fluctuating erosion and accretion of sediment in coastal zones (Rahman et al. 2019). While mangroves serve as strong protection in storms, they are not indestructible—in Myanmar in 2008, 80 percent of mangroves in the Ayeyarwaddy Delta were seriously damaged by cyclone Nargis (Win et al. 2020). Storms like this wreak havoc on human communities, as their increasing frequency and intensity leads to less and less mangroves, which causes higher human mortality rates and loss of livelihood (Rahman et al. 2019). Though mangrove forests are able to bounce back and somewhat regenerate on their own in the right circumstances, protection and restoration efforts may not be enough to save them if climate change driven storms continue to devastate global populations on a yearly basis. Combined with rising sea levels and erosion-accretion avulsion, mangroves have been on a declining trend and consistently pressed to the limits of their adaptive capacity (Win et al. 2020).

There is still very limited information as to how climate change specifically affects the value of ecosystem services. As a baseline, it is obvious to state that if climate change negatively affects mangroves and contributes to their decline, there is a high probability that it also causes ecosystem services to function less effectively, or not at all, when their ecosystem vanishes entirely. Biodiversity and carbon storage in particular are extremely threatened. While mangroves are fragile ecosystems, islands are even more so, putting island mangrove ecosystems in an exceptionally precarious position with all of their biodiversity hotspots following
suit (Mishra 2020). Currently, climate change’s positive feedback loop is spiraling too quickly for species to adapt and survive (Watson et al. 2020). With between 22-50 percent of all ecosystem services in, or going to be in, a climate class transition, it is highly likely that the systems people have depended on for generations are going to change significantly in the coming years (Watson et al. 2020). It is possible that in some ways climate change can actually benefit mangroves by increasing global temperatures and allowing them to expand their range, but we do not have enough information to know how much of a difference this will make when considering human interference, decreases in water quality, and frequent, harmful hurricanes (Powell et al. 2019). Though current studies have not yet conjectured on the financial effects of changes to ecosystem services, by looking at the avoided damage costs in the data from Mehvar (2018), one can surmise that losing these services is going to potentially cost millions for both local communities and the rest of the world depending on them.

On top of climate change, human interference with mangrove forests is another major contributor to their global decline. Land development and pollution are typically the main drivers for loss, including logging, mining, aquaculture, and tourism for the former; and industry, agriculture, and oil spills for the latter (Akbar et al. 2021). Shrimp aquaculture in particular is highly damaging in relation to pollution, making up 80 percent of the total (Akbar et al. 2021), but it is also valued at 6.12 million international dollars, making the industry a tempting, lucrative one (Watson et al. 2020). Overfishing does not directly affect the forests but it contributes to the deterioration of marine nurseries as an ecosystem service they would provide (Mishra 2020). These forests are vital to coastal populations for food and raw materials, even supporting entire economies, but a sustainable balance of give and take has yet to be reached (Akbar et al. 2021).
Management and Restoration

Many management ideas such as criminalizing deforestation or mass planting young mangroves have been thrown around, but few plans or new techniques have been successful. Managing forests is already difficult while trying to stamp out unsustainable development and illegal activities within them, but restoring them is even more challenging. Mangroves have a very low rate of recruitment, meaning that most of the time, only 25-30 percent of seedlings will reach adulthood (Rahman et al. 2019). This makes afforestation difficult and slow, and though manual planting has such a high risk of failure, it is currently still the most used method to restore mangrove forests (Akbar et al. 2021). Bangladesh is opting to create mangrove mound plantations instead as a way to simultaneously protect and restore forests while creating alternative livelihoods for vulnerable communities. Their plan calls for bestowing families with an acre of land for mangrove plantation and rice cultivation; allowing these families to make decent money, have a backup plan if the rice crop fails, and increase their own knowledge and interest in the subject of mangrove restoration (Rahman et al. 2019). Conversely, in Myanmar, plantations are established in agricultural zones where the previous owner dies or leaves, which resulted in a 26.75 percent increase in mangrove area in the seven year period after cyclone Nargis (Win et al. 2020). Despite this seemingly large increase, the authors of this study have reason to believe that natural regeneration is the main source of the 2,265.6 hectare per year upswing, signifying that improving living conditions for mangroves is actually more beneficial to their recovery process than human intervention.

Given the fact that mangrove forests are difficult to restore in less-than-ideal conditions caused by pollution and climate change, management must be thoroughly researched and planned. Carrasco De La Cruz (2021) affirms that it is absolutely imperative for four main pathways to be carried out in order for management to be successful: continue publishing research, facilitating outreach
to communities, writing policy based on these foundations, and producing results from all three together. In theory, an integrated approach with interplay between local governments, communities, and stakeholders would be the most effective at promoting interest, knowledge, and overall willingness to comply (Akbar et al. 2021). Powell et al. (2019) have stated that using mangroves as coastal infrastructure could offer an effective compromise between ecological and socioeconomic stability. Christened as natural infrastructure, research is still lacking in determining to what extent mangroves can provide ecosystem services, or where they would be more effective than gray infrastructure such as seawalls, dikes, and levees. However, according to this study, mangroves require relatively little investment and have the potential to provide any or all of their profitable ecosystem services. Alternately, using mangroves in conjunction with some gray infrastructure as a hybrid approach can double their success while remaining cost-effective. The main limitations of mangrove infrastructure are related to a lack of outreach and research, which could be alleviated by following the aforementioned four pathways and subsequently implementing the integrated approach.

Conclusion

Mangroves are vital to human life for their ecosystem services that support coastal communities by acting as storm barriers, sources of food and raw materials, and hubs of biodiversity. Economically, the location of a mangrove forest and the number of ecosystem services it provides dictates how much of a direct monetary value it has for humans. As climate change progressively gets worse, mangroves’ capacity for carbon storage becomes more and more invaluable, yet, ironically, they are declining from anthropogenic activities. More intense and frequent hurricanes, as well as rising sea levels, are putting a great strain on mangrove forests, reducing their numbers and ability to regenerate. Changes in climatic conditions and unsustainable human development are
reducing them even further before we have refined an action plan to tackle management or restoration. There are different ways to address the question of management, but so far there is a distinct lack of examples carried out at a large scale, with most being left to theoretical conjecture. More research must be conducted to discover the fiscal impacts of climate change on ecosystem services, more outreach must be done to educate communities on the importance of mangrove restoration, and more management experiments must be undertaken to find the best way forward. With this in mind, action should be taken wherever relevant to mitigate current mangrove loss and incorporate all parties in the endeavor.

(1,944 words + 243 abstract)
Works Cited


Plant, Pollinator... Predator? Ecologies of Tritrophic Interactions, and the Proposed Effects of Flower-Dwelling Thomisids on Host-Plant Fitness

Shannon Reilly

Writer’s Comment: In EVE 149, “Evolution of Ecological Systems,” our term paper prompt was to write about a topic relating to community ecology and/or evolution. Ecosystem structuring and symbioses in particular are sustained interests of mine, and thus my project became an exciting opportunity to delve deeper into how we study, classify, and communicate about these fundamentally dynamic aspects of nature. Specifically, I opted to review research regarding the impacts of crab spiders on their host plants’ fitness, within the framework of relationships between flowering plants and their associated pollinators. Sit-and-wait arachnid predators can benefit plants by preying on herbivores or nectar thieves, for example, but may also interfere with plant reproduction by consuming or otherwise deterring potentially beneficial floral visitors. Highlights of current literature on these multitrophic interactions (plant-pollinator-predator) include not only nuances of specific triads’ developmental patterns and net fitness outcomes, but also emphasis on the importance of considering context dependency—such as spatiotemporal variation of participant species’ richness, abundances, and behaviours—in analysis of ecological networks more broadly.

Instructor’s Comment: Remote instruction during the Covid-19 pandemic created problems for everyone. My comment on Shannon Reilly’s “Prized Writing” essay will be very brief because, unlike under
normal circumstances, I didn’t really get to know my remote students very well. Shannon took my course EVE 149, “Evolution of Ecological Systems,” in fall 2021. This is an advanced course on the community concept in ecology, viewed from an evolutionary standpoint. It demands a great deal of reading ranging across several fields, from philosophy of science to physiological ecology to paleobiology. The final grade is based on three items, equally weighted: a midterm exam and a final, both long-essay, and a term paper. The term paper must be on a topic chosen by the student and approved by me, dealing with some aspect of interspecific interaction or synecology. It is normally a literature review, with emphasis on the primary literature. Shannon received A+ grades on both exams and an A for this paper. (She didn’t get an A+ because she missed a critical reference. To coin a cliché, I was shocked, shocked, shocked given her outstanding overall performance!) Several term papers from this course have won a place in “Prized Writing” and a few have been published. I would not be surprised if Shannon joins the latter, highly exclusive, club.

—Arthur M. Shapiro, Department of Evolution and Ecology

Abstract

Contemporary flowering-plants’ immense diversity is commonly associated with millions of years of hypothesized coevolution with a variety of pollinating animals, particularly flying insects. It is thus unsurprising that much of modern ecological study regarding angiosperm-animal interactions is centered on the various relationships of these taxa and their associated pollinators. Nonetheless, such interactions do not exist in an ecological vacuum, and are naturally subject to several spectra of abiotic and biotic influences which themselves play a role in those plants’ fitness determinations and evolution more generally. In this regard, one notable area of ongoing research interest is in the ecological roles of flower-dwelling predators within plant-pollinator associations. This literature review will describe the structures and
implications of such tritrophic interactions, primarily focused on the ecological roles of crab spiders (Thomisidae) relative to their host plants and those floras’ own insect visitors. In addition, relevant contextual research on extended ecological webs—such as around herbivore consumption, volatile plant signals, and spider crypsis—will also be discussed and evaluated. Examination of the development and consequences of multi-trophic systems like the above-described triads may reveal themes potentially applicable to community ecology and evolution more broadly, such as the context-dependency of categorizing symbiotic relationships (i.e., commensalism versus mutualism or antagonism) or the potentiality of frequency-dependent selection on predators by their prey (in opposition to the perhaps classic model).

**Keywords:** Thomisidae, plant-pollinator, tritrophic interactions, fitness, selection, symbiosis

**Introduction**

Plant-pollinator associations frequently function as keystone mutualisms in natural ecosystems, as well as in humans’ agricultural systems and broader economies (Benoit & Kalisz 2020). In fact, these often-charismatic examples of interspecific interactions can be critical for the persistence of those relationships’ involved species and/or the stability of their surrounding ecological communities (Fründ et al. 2010). As collections of autotrophic producers, terrestrial vegetations form a base layer of productivity and structure for many different organic systems, at a variety of scales; the presence and formations of these organisms in an environment shape much of how other macrobiota move through and interact with that space, over time. And in turn, the respective members of each subsequent layer of herbivore, meso-consumer, or other trophic classes influence the development and composition of the vegetation, as well as each other, both directly and indirectly. Such cascades of interacting effects can profoundly impact the growth and persistence of a species; for flowering plants, these interactions are now being increasingly examined at the scale
of primary and secondary associations (Benoit and Kalisz 2020)—
exploring how not just pollinator traits, but also factors like herbivory
and arthropod predation on floral visitors, play into positive and negative
fitness determinations.

As typically generalist predators, spiders are commonly
considered important meso-consumers in their respective ecosystems
(Silva et al. 2020). Sit-and-wait crab spiders (Thomisidae), as well
as actively-hunting lynx spiders (Oxyopidae) are two cosmopolitan
arachnid clades notably associated with floral-dwelling and the
consumption of plant-associated invertebrates (Kersch-Becker et
al. 2018, Romero et al. 2008), though there is also some emerging
research on arboreal tarantulas (Theraphosidae) opportunistically
attacking tropical hummingbirds that visit flowers (Alcantara Viana
et al. 2021). Thomisids are popular study subjects for examining the
effects of predation on pollinators and host plants because of their
broad geographic distribution, generalist foraging (typically from
a plant-associated hideout), and curious capabilities for crypsis or
aggressive mimicry (in some genera) (Knauer et al. 2018).

Yet within this growing subfield of community ecology and
evolution research, one major point of contention centers around
how these flower-dwelling spiders, through their direct influence
on pollinator and herbivore traits and behaviors, may indirectly
benefit or detract from the survival and fecundity of their host
plants. Some authors take a firm stance arguing for either net
positive or negative fitness effects (e.g., Cuny et al. 2020, Antiquiera
and Romero 2016), while others claim a more nuanced position
focused on context-dependency and the dynamicity of biological
communities (e.g., Telles et al. 2018, Gavini et al. 2019a, Benoit
and Kalisz 2020). This paper will review and synthesize relevant
literature attempting to conceptualize and evaluate the tritrophic
interactions of spiders, plants, and pollinators, with an emphasis
on the ecological role of thomisids relative to their host plants
and associated floral visitors, and a secondary focus on contextual
concepts including hymenopteran behaviour and crab spiders’
evolution and exploitation of both visual and olfactory signals.
Baseline: plant-pollinator interactions

Plant-pollinator associations are commonly understood to be products of millennia of coevolution, by which stationary plants have developed strategies to increase outcrossing sexual reproduction through attraction and sometimes exploitation of mobile floral visitors, and animals such as birds, bats, small mammals, or especially insects have in turn taken advantage of floral provisions including foodstuffs and sheltering architecture. Direct selection pressures exerted by these symbiotes on one another has contributed to expansive taxonomic radiations over time; angiosperms serviced by biotic pollen vectors, versus wind, are estimated to account for ~87.5 percent of assumed species-level diversity in the flowering plant clade (Ollerton et al. 2011).

Evolution is not a directed process, however, and neither are all plant-pollinator relationships as simple or entirely mutualistic as popular audiences may frequently imagine them to be. For instance, a plethora of descriptions of mimicry or other bargain-breaking acts on the part of one participant or another exist throughout the literature—from rewardless orchids producing attractive olfactory signals (Schiestl 2005), to nectar-robbing bumblebees (floral larcenists) that feed on floral resources without significantly contributing to pollination (Irwin et al. 2010).

Plants and their pollinators do not set out to somehow assist one another intentionally, yet pollination is closely intertwined with angiosperm reproduction. Thus, a multitude of selection factors acting on these organisms both individually and in combination can lead to complex and sometimes contradictory trait evolution.

Branching out: spider-plant interactions

Although it is not entirely clear how and why spiders choose their respective host plants and develop fidelity behaviors to them, there are a number of current hypotheses. First, as reviewed by Gavini et al. (2019a), spider presence is commonly associated with plant traits including flower color, rosette leaf arrangement, overall
size, inflorescence height, and the presence and length of glandular trichomes. These mainly morphological characteristics can be evaluated by a discerning arachnid seeking a specific microhabitat; exact trends or values for relevant traits vary between study systems (Gavini et al. 2019a), as well as across life stages within some spider species (Su et al. 2020). In addition to aspects of plant architecture, more transient, often induced signals in the form of volatile chemicals have also been shown to attract spiders to certain plants. A 2018 study by Knauer et al., for example, described local adaptation of *Biscutella laevigata* (Brassicaceae) to the presence of the crab spider *Thomisus onustus* via emission of the attractive floral monoterpene β-ocimene as a consequence of florivore infestation. The authors additionally noted that β-ocimene is found across a multitude of other plant species, as an herbivory-induced compound in leaves as well as flowers, and so may influence plant-spider interactions in other systems besides that covered by their paper.

In studies on mechanisms of specifically spider-plant relationships (less directly focused on pollinator elements), symbioses are often classified in relation to the consequences of spiders’ predation on herbivores. Such consumption can function as an indirect defense for an associated host plant, as seen in the above example of florivory-induced olfactory signals attracting *T. onustus* to threatened plant individuals. At the same time, however, spiders’ generalist predation habits do not only cover herbivores, but also extend to potentially beneficial floral visitors, including pollinators. Depending on the study system, and its own abundances and traits of predator and prey species, researchers have drawn variable conclusions about the ecological partnerships between spiders and plants.

Host-plant fitness was positively impacted by the presence of each spider type, as measured in herbivore suppression and increased ovary fertilization compared to spiderless controls, but the combined presence of the two taxa had an additive beneficial effect weaker than that of either spider taxon’s presence alone. In this case, spiders and plants were generally considered to be engaged in a mutualistic relationship.

On the other hand, the work of Gavini et al. (2019a) on the ecological role of *Misumenops pallidus* (Thomisidae) relative to its host *Anemone multifida* (Ranunculaceae) found more of a commensal spider-plant association. Specifically, the presence of spiders did not appear to affect pollinator visitation rate, florivory, or overall plant fitness. According to the authors, the asymmetrical benefit (favoring spiders) may result from a combination of factors weakening top-down effects on plant fitness, including the low-to-medium abundance of spiders observed, the generalist diet of *M. pallidus*, and the presence of ecologically redundant pollinators in the region. They also noted that upward variation in spider population density could further increase asymmetrical benefits attained from inhabiting *A. multifida* plants, likely causing a shift from commensalism to antagonism.

Overall, several authors have commented on how variation in abundance—of spiders and/or prey species—is known or hypothesized to affect fitness for plant individuals as well as populations. With respect to floral-dwelling spiders generally, Silva et al.’s (2020) study of *Peucetia flava* (Oxyopidae) and *Chamaecrista neesiana* (Leguminosae Caesalpinioideae) in the tropical savanna found that plant benefits from indirect herbivory defense were conditional on predator abundance over time, and highest during the rainy season (the period of peak abundance for *P. flava*). The aforementioned Kersch-Becker et al. (2018) work also indicated that suppression of herbivory may be more effective with higher abundance, rather than diversity, of predators. Regarding prey species, modeling by Higginson et al. (2010) suggests that plants’ net fitness effects are strongly influenced by the relative density
and effectiveness of pollinators, as well as strength of florivory, in a system. Moreover, Telles et al. (2018) found that when flower-dwelling predators have access to, and experience with, abundant non-pollinator prey, they may attack other species less frequently—and even indirectly benefit their host plants.

**Bringing it together: pollinator-spider interactions**

By consuming pollinators, as well as altering their behavior through a so-called “landscape of fear” (Cuny et al. 2020), flower-dwelling predators can disrupt plant-pollinator mutualisms to varying degrees, with a multitude of potential consequences for plant fitness. Focusing on interactions between spiders and floral visitors—specifically insect pollinators—there exists a complex interplay between the morphological, physiological, and behavioral traits of predators and prey. As described by Rodríguez-Morales et al. (2020), sit-and-wait predators such as crab spiders typically must use patient stillness (avoiding motion-detection cues in prey) and attain some form of crypsis or signal exploitation relative to the sensory system(s) of their targets, while prey use a blend of visual and olfactory information to identify ambush predators, and then potentially engage in behavioral strategies to avoid a novel or repeated attack.

**Crypsis, Signaling, and Sensory Perception**

Under selective pressure to avoid detection by potential prey, ambush-hunting thomisids have evolved a complex blend of camouflage strategies. For example, depending on the exact species—and sometimes instar—individuals may exhibit different degrees of preference for certain host-plant flower-colourations (Gavini et al. 2019a, Su et al. 2020), or even specific positions (such as on flower heads versus receptacles) on individual plants’ inflorescences (Rodríguez-Morales et al. 2018). Body colouration is also a variably employed strategy for evading notice; some species are known for their plasticity—altering their appearance over several
days to mimic the colouration of particular flowers—while others exhibit more permanent color-polymorphisms that may help them blend in with certain plant species or features of floral architecture (Ajuria Ibarra et al. 2018, Rodríguez-Morales et al. 2018).

Rather than attempting to escape detection by potential prey items, some thomisids have alternatively evolved to exploit plants’ visual and olfactory signals that are attractive to pollinators and other floral visitors. Manipulation or exploitation of a signal its prey is sensorily biased towards can increase a spider’s chances of foraging success (Heiling et al. 2004). The previously discussed floral volatile β-ocimene, for instance, serves as an attractive signal for not just crab spiders but also some pollinator species (Knauer et al. 2018). Further overlap in host-plant choice factors can also be found for Thomisus spectabilis and honeybees (Apis mellifera) in relation to Chrysanthemum frutescens (Asteraceae), in the contexts of olfactory cues and flower symmetry (Heiling et al. 2004, Wignall et al. 2006). Another way in which crab spiders take advantage of insect pollinators’ perception biases is through mimicry of visual cues; visual luring is a common strategy among sit-and-wait predators (White and Kemp 2020). For example, UV+-white colouration, functioning as a conspicuous and attractive visual lure, has recurrently evolved across several species of flower-dwelling thomisids in Australia (Gawryszewski et al. 2017), and UV-induced fluorescence has been proposed as an additional possible signal to draw in prey (Brandt and Masta 2017, Suetsugu and Morihisa 2020). A leaf-dwelling crab spider, Epicadus heterogaster has even been observed successfully attracting pollinators, via its own mimicry of flower shape and UV reflectance, in the absence of a nearby floral model (Vieira et al. 2017). Exploitation of existing signals can contribute to conflicting selection pressures on the plants exhibiting those traits, because they may suffer a decline in reproductive success if a greater proportion of would-be pollinators are consumed or otherwise deterred by predators-in-residence. Knauer et al. (2018) specifically call out floral-dwelling predators’
influences on floral trait evolution as a currently enigmatic and underexplored area of research.

Importantly, the relative effectiveness of a camouflage or attraction strategy is highly dependent on the sensory system(s) of whatever animals are potentially attempting to identify and interact (or not) with the organism engaged in passive deception. Factors such as visual acuity and color sensitivity are particularly crucial to consider, as are decision-trees and sense-prioritization, when attempting to evaluate the perception and responsiveness of an individual confronted with abiotic and biotic stimuli. Bees’ ability to see into the UV portion of the electromagnetic spectrum is one reason researchers have been exploring spider signaling through signals in that light range, and models of honeybee vision specifically have been used to check hypothetical conspicuousness of variously pigmented, distanced, and positioned, flower-dwelling spiders (Rodríguez-Morales 2018). With respect to decision-making and interpretation of sensory input, insect prey species have been shown to exhibit differential responses to color, morphology, and/or presence of ambush predators (Morse 2007, Gavini et al. 2018, Rodríguez-Morales et al. 2020). By keeping in mind the biases of human sensory perception (e.g., emphasis on color cues) relative to research on non-human organisms, researchers can hopefully construct more objective experimental conditions, and so also draw more useful conclusions.

Behavior and Learning by Prey

In a similar vein to predators’ exploitation of floral traits influencing foraging success and pollinator attraction, prey behavioral responses can observably affect ongoing selection on predators’ morphological traits. Ajuria Ibarra et al. (2018) explored a notable example of this phenomenon, examining how honeybees’ (*Apis mellifera*) learned experiences contribute to subsequent predator avoidance and so also selection on the colouration of *Synema globosum* (Thomisidae). Results indicated that based on
a prior, simulated attack, honeybees learn to avoid spider color morphs associated with that experience. This gives less-common morphs a fitness advantage (more opportunities to catch prey), and contributes to cyclical modulation of each discrete, heritable color-pattern’s frequency in the population over time. Thus, in contrast to the perhaps traditional model of predator-on-prey selection mechanisms, this study offers empirical evidence for negative frequency-dependent selection on predators’ conspicuous polymorphisms as a consequence of prey behavior—a concept which could have potentially significant implications for ecological and evolutionary study even beyond spider-pollinator systems.

Pollinators’ behavioral responses to predation risk, mediated by sensory perception and sometimes also learned experience, also more generally provide a link between direct dynamics of spider-pollinator interactions and cascading, indirect impacts of spiders on host-plant fitness. Not all species are equally capable of discerning the presence of a floral-dwelling predator while foraging, and not all species react the same way to such a potential threat even after it has been successfully identified (Brechbühl et al., 2009; Rodríguez-Gironés and Jiménez 2019). A significant portion of extant research on spider-pollinator interactions in this context has primarily focused on hymenopterans—and among those, mostly social bees (Howard 2021)—but some generally proposed influences affecting pollinator responses to perceived predation risk include ecological factors (bee size and sociality, abundance of available resources), as well as organisms’ previous experience with predators (Rodríguez-Gironés and Jiménez 2019). At least at the species level, bees that are larger and/or habituated to less frequent occurrences of spider attack are more likely to respond to perceived predator presence with indifference, while those that are smaller and/or have experienced a prior predation attempt (real or simulated) typically exhibit more avoidance behaviors (Gavini et al. 2018, Telles et al. 2018, Gavini et al. 2019b). In systems with generalist pollinators, especially in abundance, such a mix of behaviors combined with opportunities for ecological redundancy could impact the magnitude of negative
plant-fitness cascades resulting from arachnid-on-pollinator predation (Higginson et al. 2004). Moreover, considering these behavioral variations in complement to abundance effects on spider foraging patterns (Telles et al. 2018), it seems that the fitness effects of these tritrophic interactions are in yet another way highly context dependent.

### Conclusion

This review summarized and synthesized major themes of current literature regarding tritrophic interactions of spiders, plants, and pollinators—primarily focusing on how angiosperm fitness is impacted by thomisid predation, and additionally discussing contextual topics including florivory, sensory signals, and foraging behaviors. While some authors emphasize core subsets of the triad (e.g., spider-pollinator interactions) and argue a paradigm of majority-positive or negative fitness cascades, others offer a more nuanced, often system-specific analysis of net effects. In short, consideration of context dependency and spatiotemporal variation is critically important for exploration of multitrophic interactions’ inputs and outcomes. Developing research in this area has already provided, and will likely continue to contribute, significant insight about broader themes of biological communities’ structures, functions, and dynamism.
References


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