

Introduction

RYAN MATHIS, *Environmental Program Manager, Cannabis Permitting Program, Habitat Conservation Planning Branch, California Department of Fish and Wildlife*

When I moved to Fieldbrook, California in the winter of 1995 to study wildlife management at Humboldt State University, I inadvertently rented a room from someone that “grew” with friends on a property in southern Humboldt County (one of the three counties collectively known as “the Emerald Triangle”). Keep in mind that the Compassionate Use Act that would ultimately lead to what we know as Proposition 215 would not be on the ballot until November of 1996. Cannabis was not the sole source of income for the landowners, and their gardens were small, temporary, easily moved, and more importantly out of sight of helicopters. It is probably fair to assume that federal and state prohibitions guided those cultivation practices. Therefore, my first impression of cannabis cultivation was a secretive and low-impact practice carried out by conservation-minded individuals.

This secluded, low-impact cultivation trend had been the norm among cannabis growers in Humboldt County since it became the nation’s most prominent center for production of the crop in the mid-1970s. This was a result of the “Back-to-the-Land” movement that began in the 1960s with many young people leaving urban cities like San Francisco to live in more rural areas. About the same time that growing cannabis was becoming popular in Humboldt and the surrounding counties of Mendocino and Trinity (the Emerald Triangle), the U.S. government unintentionally aided in creating a market for the crop by supporting Mexico’s government in using a toxic herbicide on Mexican cannabis¹—up until this time, most of the cannabis used in the U.S. came from across the border. This combined with the increased demand for cocaine trafficking²—a much more profitable export compared to cannabis—from Mexico in the late-1970s led to the Emerald Triangle becoming the mecca for cannabis production. The popularity of cocaine use in the U.S. in the 1980s most likely created a niche for the Emerald Triangle to fill the void of the mass produced cannabis from Mexico (e.g., seeds adapted to growing in the tropics) with a higher quality product (e.g., seeds adapted to growing at similar latitudes) from the Emerald Triangle.

Fast forward to 2002-2007, and gardening supply shops were popping up around Eureka (the largest city in Humboldt County), and mega grows started showing up on the landscape. Simultaneously, financing was readily available to anyone, regardless of their financial stability, who wanted to buy real estate. Those lending practices eventually led us to an economic crisis in 2008. Banks were failing, businesses were closing, and the federal government was forced to bail out lenders and auto manufacturers. While the economy was collapsing around, some growers flourished as it appeared nothing was being regulated (e.g., land grading, timber harvest and forest clearing, water diversion, water storage) in areas of Humboldt County that some would say were finally starting to recover from the logging practices of the 1950s and 60s. By 2010, it was estimated that nearly 80% of the nation’s cannabis came from California (and most of that from the Emerald Triangle). Cannabis is now a multibillion-dollar industry in California with at least 50,000 farms in the state (both illegal and legal).

The California Department of Fish and Wildlife (CDFW) took the lead on assessing environmental damage from unregulated cannabis cultivation, and began laying the foundation for a team of scientists and wildlife officers that would be dedicated to reducing impacts to fish and wildlife resources resulting from cannabis cultivation. CDFW scientific and enforcement staff began noticing large cannabis farms in the forests of the Emerald Triangle, with bulldozed redwoods forests cleared to make room for the crop. This eventually led to the creation of the Watershed Enforcement Program—a team of scientists, law enforcement officers, and attorneys charged with reducing the environmental damage caused by cannabis cultivation on public and private lands in California. Between 2013 and early 2018, more than 700 inspections resulted in 399 tons of trash removed from public and private lands including: 2.4 million feet of irrigation pipe, 50 tons of fertilizer, and 465 gallons of chemicals (many illegal in the U.S.). In addition, the removal of 709 illegal dams and water diversions resulted in restoration of 800 million gallons of water back into local watersheds.

In 2015, the Governor approved the Medical Cannabis Regulation and Safety Act and by November 8, 2016, the voters of California passed Proposition 64 or the Medicinal and Adult-Use Cannabis Regulation and Safety Act (MAUCRSA). As a result, any person wishing to commercially cultivate cannabis lawfully in California and obtain a license from the California Department of Food and Agriculture must notify CDFW, and we now have staff in six Regions assigned to process those notifications.

CDFW has a unique role in regulating today's commercial cannabis cultivation, in that we have the opportunity to recommend measures designed to avoid and/or minimize impacts to fish and wildlife for every licensed cultivation site. As we progress beyond the first few years since MAUCRSA, we are likely to see changes to the way we regulate cannabis cultivation. Should future regulatory or legislative proposals consider weakening protections for fish and wildlife, we can consider the findings from the great work published here in this issue to make informed decisions and responses.

What does the future of regulating cannabis look like? I would like to explore more opportunities to collaborate with the cultivation community for voluntary restoration projects. We may have an opportunity to discuss safe harbor agreements or watershed-level restoration projects, and I look forward to that discussion.

¹ Johnson, N. 2019. American weed: a history of cannabis cultivation in the United States. *EchoGéo* 48. Available from: <http://journals.openedition.org/echogeo/17650>

² Brouwer, K. C., P. Case, R. Ramos, C. Magis-Rodriguez, J. Bucardo, T. L. Patterson, and S. A. Strathdee. 2006. Trends in Production, Trafficking and Consumption of Methamphetamine and Cocaine in Mexico. *Substance Use & Misuse* 41:707–727.

Introduction—continued

MOURAD W. GABRIEL, *United States Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, CA; University of California Davis, One Health Institute, Karen C. Drayer Wildlife Health Center, Davis, CA*

GRETA M. WENGERT, *Executive Director, Integral Ecology Research Center, Blue Lake, CA*

It is rewarding and galvanizing for us to contribute towards the Introduction of this journal's special issue focusing on cannabis cultivation in California. It is equally lifting to see the several innovative research papers that make up this issue coming on the heels of an unprecedented cannabis cultivation season where both unpermitted private as well as trespass public land cultivation appear to be unbridled in plant production and environmental damage. This is our ninth season of data collection on the vast environmental impacts of this activity, and collectively, we have documented over 650 cannabis cultivation sites. Nevertheless, this season is proving to be on par with our first data collection season in 2012 in terms of impacts to California's natural resources.

California is a truly unique landscape home to a rich and diverse amount of flora and fauna, combined with the highest number of endemic species in North America. Yet neither California's plants nor wildlife is immune to deleterious anthropogenic influences, making this state also home to the second-highest number of plant and wildlife species protected federally. We understand that not all 102 state-listed or 132 federally-listed wildlife species in California are in direct conflict with or impacted by the cultivation of cannabis. However, the question now faced by today's natural resource managers and conservationists in California is if and how the vast expansion of cannabis cultivation within the many ecoregions in the state will impact our sensitive wildlife species and their essential habitats.

What we do know is that several sensitive species in California are at risk of contamination or poisoning from the many types of toxicants used at cannabis cultivation sites in attempt to mitigate herbivory of cannabis plants by wildlife, curtail pilfering of food stores at trespass cultivation site camps, and reduce damage to cultivation infrastructure by wildlife (Gabriel et al. 2012, Franklin et al. 2019). We know that the consumption of water for permitted and illegal cultivation is immense and often exceeds what would be considered sustainable for many of the watersheds that support threatened and endangered salmonid populations and other sensitive aquatic species (Bauer et al. 2015). From a landscape perspective, it is also evident that the fragmentation caused by both permitted and illegal cultivation cumulatively results in significant habitat impacts associated with substantial increases in edge and deforestation (Wang et al. 2017). Yet the list of scarcely explored and unexplored effects of all aspects of cannabis cultivation remains substantial, and the field of study veritably remains "wide open" for those researchers willing to venture into this largely unknown, and sometimes dangerous realm.

This volume and the collection of papers within represent the current state of the science in the investigation of the environmental impacts of both legal and illicit cannabis cultivation in California. Though individual studies exploring the first documented effects of these sites on wildlife took place almost a decade ago, since then studies on this topic

have been few and far between and only by a limited number of dedicated scientists. The clandestine nature of the black market component of the industry, the risks of working in often dangerous and uncertain conditions, and the unconditional need to work closely with other disciplines, most notably law enforcement agencies, make embarking on these studies precarious and often unclear. However, with the raised local, regional and national awareness on this issue gained in recent years, notably with the legalization of cannabis cultivation in 2018, came more interest, support, and the recognized need for understanding the full array of impacts that cultivation might have on California's ecosystems. The several papers within this journal not only provide primary research, but reviews and meta-analyses to continue the discussion on the environmental ramifications, best management practices, and creative approaches towards the conservation and sustainability of California's natural resources within this rapidly emerging issue.

Nevermore than now exists the need for scientists and researchers to intensify the collection of empirical data on this topic to develop the foundation for management and policy guidance. We must reflect on where we currently stand in comparison to just a few years ago. From the research published in 2012 (Gabriel et al. 2012) focusing on rodenticide impacts from public land cannabis cultivation to Bauer et al. (2015) highlighting cannabis proliferation and associated water use on private lands, these foundational papers set a precedent that scientific evidence, rather than anecdotal inference, should guide policy. This current set of research articles extends that scientific foundation supporting the development of strategies in these novel and ever-changing times in California cannabis policy.

¹ California Department of Fish and Game (CDFG). "Atlas of the Biodiversity of California." California Department of Fish and Game, Sacramento (2003). United States Fish and Wildlife Service (USFWS). "Environmental Conservation Online System (ECOS)" <https://ecos.fws.gov/>, Accessed August 20, 2020

² Gabriel, M. W., L. W. Woods, R. Poppenga, R. A. Sweitzer, C. Thompson, S. M. Matthews, J. M. Higley, S. M. Keller, K. Purcell, R. H. Barrett, G. M. Wengert, B. N. Sacks, and de ana L. Clifford. 2012. Anticoagulant rodenticides on our public and community lands: Spatial distribution of exposure and poisoning of a rare forest carnivore. *PLoS ONE* 7:e40163.

³ Franklin, A. B., P. C. Carlson, A. Rex, J. T. Rockweit, D. Garza, E. Culhane, S. F. Volker, R. J. Dusek, V. I. Shearn-Bochsler, M. W. Gabriel, and K. E. Horak. 2018. Grass is not always greener: rodenticide exposure of a threatened species near marijuana growing operations. *BMC Research Notes* 11:1–8.

⁴ Bauer, S., J. Olson, A. Cockrill, M. Van Hattem, L. Miller, M. Tauzer, and G. Leppig. 2015. Impacts of surface water diversions for marijuana cultivation on aquatic habitat in four northwestern California watersheds. *PLoS ONE* 10:e0120016.

⁵ Wang, I. J., J. C. Brenner, and V. Butsic. 2017. Cannabis, an emerging agricultural crop, leads to deforestation and fragmentation. *Frontiers in Ecology and the Environment* 15:495–501.