Susan Pearlman

From:	Mary Power <maryeleanorpower@gmail.com>
Sent:	Monday, November 23, 2015 6:12 PM
To:	Ryan Coonerty; Zach Friend; Bruce McPherson; Greg Caput; John Leopold; SCC4 Information; drubin@ucsc.edu
Subject:	Support for Bonny Doon Association recommendations on cannabis cultivation
Attachments:	PLoS ONE 2015 Bauer.pdf; BioScience 2015 Carah.pdf; Copeia 2015 Power.pdf

Dear Members of the Santa Cruz County Board of Supervisors and the Cannabis Cultivation Choices Committee:

I write in strong support for the regulations on commercial cannabis cultivation proposed by the Rural Bonny Doon Association for their home watersheds. I am a river ecologist and a Professor at UC Berkeley, although I write here to express my personal views. I have studied river food webs along the California North Coast for over the last 28 years, mainly in the upper South Fork of the Eel River in Mendocino Co. Over the last fifteen years, we have seen great degradation of the environment along the California North Coast due to burgeoning marijuana cultivation. Fertilizer and pesticide contamination of waterways and food webs supporting fish and wildlife are documented effects of uncontrolled cannabis cultivation: (https://www.nationalforests.org/blog/pay-no-attention-to-the-crime-behind-the-emerald-curtain; https://www.nationalforests.org/blog/looking-behind-the-curtain). In the Eel, poorly built roads and excavated water retention ponds have re-initiated erosion and delivery of fine sediments to river channels, reversing the incipient recovery of the Eel from the poor logging practices of the last century. The worst immediate impacts of cannabis cultivation, however, are summer water withdrawals that exacerbate effects on the ongoing drought.

When summer base flows of rivers of the North Coast drop to critically low levels, edible algae like diatoms and filamentous green taxa become overgrown with cyanobacteria that thrive in warmer, stagnant water. Some of these cyanobacteria in the Eel and Russian Rivers are neurotoxic, causing dog deaths that have rightly concerned the public and have received considerable media attention. I attach a paper (Power et al. 2015) that presents our view of changes over the last 15 years, do in particular to impacts of burgeoning marijuana cultivation, that may tilt the Eel River summer food web from salmon supporting to degraded state in which cyanobacteria blooms become a public health concern.

David Rubin and others in the Rural Bonny Doon watershed association have written a powerful and prescient statement about the potential impacts of commercial marijuana cultivation in their home watersheds in rural Santa Cruz.

Their primary policy recommendations are:

1) to confine cannabis cultivation to lands zoned for agriculture, and prohibit cultivation on timber lands and sensitive areas, including watersheds that support salmonids and other sensitive wildlife;

2) to require organic cultivation in order to avoid introduction of fertilizers, herbicides, insecticides, and rodenticides into surface and ground waters;

3) to prohibit commercial cultivation from residential areas, where home owners would be disturbed by odor, traffic, land surface conversion, and other disruption.

In my opinion, these policies are both wise and comprehensive. I believe that their proposed plan for regulating commercial cannabis cultivation would be a very useful model for other groups seeking to protect people and watersheds against a surge in marijuana cultivation that may follow legalization, and against the grey or black markets that will persist if strong environmental regulations are not sufficiently enforced. I want to convey to you my strong support for this proposed plan, and my concern that if commercial marijuana cultivation is not subject to strong environmental oversight and regulation, great harm to natural environments and public health will persist and spread.

Sincerely,

Mary E. Power

455 Vermont Avenue

Berkeley, CA. 94707

PLOS | ONE

RESEARCH ARTICLE

Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds

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Data Availability Statement: Most data used are available via public sources (USGS gage data, EWRIMS, and Google Earth), but specific spatial locations of marijuana grows cannot be shared due to legal and privacy concerns. Summary data and all methods/information needed to replicate the study are included in the manuscript. Plant counts and greenhouse counts and measurements for all watersheds are included as Supporting Information (excel spreadsheets).

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Abstract

Marijuana (*Cannabis sativa* L.) cultivation has proliferated in northwestern California since at least the mid-1990s. The environmental impacts associated with marijuana cultivation appear substantial, yet have been difficult to quantify, in part because cultivation is clandestine and often occurs on private property. To evaluate the impacts of water diversions at a watershed scale, we interpreted high-resolution aerial imagery to estimate the number of marijuana plants being cultivated in four watersheds in northwestern California, USA. Low-altitude aircraft flights and search warrants executed with law enforcement at cultivation sites in the region helped to validate assumptions used in aerial imagery interpretation. We estimated the water demand of marijuana irrigation and the potential effects water diversions could have on stream flow in the study watersheds. Our results indicate that water demand for marijuana cultivation has the potential to divert substantial portions of streamflow in the study watersheds, with an estimated flow reduction of up to 23% of the annual seven-day low flow in the least impacted of the study watersheds. Estimates from the other study watersheds indicate that water demand for marijuana cultivation exceeds streamflow during the low-flow period. In the most impacted study watersheds, diminished streamflow is likely to have lethal or sub-lethal effects on state-and federally-listed salmon and steelhead trout and to cause further decline of sensitive amphibian species.

Introduction

Marijuana has been cultivated in the backwoods and backyards of northern California at least since the countercultural movement of the 1960s with few documented environmental impacts [1]. Recent increases in the number and size of marijuana cultivation sites (MCSs) appear to be, in part, a response to ballot Proposition 215, the Compassionate Use Act (1996). This California law provides for the legal use and cultivation of medical marijuana. In 2003, legislation was passed in an attempt to limit the amount of medical marijuana a patient can possess or

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High Time for Conservation: Adding the Environment to the Debate on Marijuana Liberalization

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Key words:	agriculture production, Cannabis, biodiversity, policy/ethics, endangered species
Abstract:	Liberalization of marijuana policies, including legalization of medical and recreational marijuana, is sweeping the United States and other countries. Marijuana cultivation can have significant negative collateral effects on the environment that are often unknown or overlooked. Focusing on the state of California, where by some estimates 60-70% of the marijuana consumed in the United States is grown, we argue that (1) the environmental harm caused by marijuana cultivation merits a direct policy response, (2) current approaches to governing the environmental effects are inadequate, and (3) neglecting discussion of the environmental impacts of cultivation when shaping future marijuana use and possession policies represents a missed opportunity to reduce, regulate, and mitigate environmental harm.

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Abstract: Liberalization of marijuana policies, including legalization of medical and recreational marijuana, is sweeping the United States and other countries. Marijuana cultivation can have significant negative collateral effects on the environment that are often unknown or overlooked. Focusing on the state of California, where by some estimates 60-70% of the marijuana consumed in the United States is grown, we argue that (1) the environmental harm caused by marijuana cultivation merits a direct policy response, (2) current approaches to governing the environmental effects are inadequate, and (3) neglecting discussion of the environmental impacts of cultivation when shaping future marijuana use and possession policies represents a missed opportunity to reduce, regulate, and mitigate environmental harm.

Keywords: agriculture production, Cannabis, biodiversity, policy/ethics, endangered species

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The Thirsty Eel: Summer and Winter Flow Thresholds that Tilt the Eel River of Northwestern California from Salmon-Supporting to Cyanobacterially Degraded States

Author(s): Mary E. Power, Keith Bouma-Gregson, Patrick Higgins, and Stephanie M. Carlson
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The Thirsty Eel: Summer and Winter Flow Thresholds that Tilt the Eel River of Northwestern California from Salmon-Supporting to Cyanobacterially Degraded States

Mary E. Power[1], Keith Bouma-Gregson[1,2], Patrick Higgins[2], and Stephanie M. Carlson[3]

Although it flows through regions of northwestern California that are thought to be relatively well watered, the Eel River is increasingly stressed by drought and water withdrawals. We discuss how critical threshold changes in summer discharge can potentially tilt the Eel from a recovering salmon-supporting ecosystem toward a cyanobacterially degraded one. To maintain food webs and habitats that support salmonids and suppress harmful cyanobacteria, summer discharge must be sufficient to connect mainstem pools hydrologically with gently moving, cool base flow. Rearing salmon and steelhead can survive even in pools that become isolated during summer low flows if hyporheic exchange is sufficient. But if the ground water discharge that sustains river flow during summer drought drops below critical levels, warm stagnant conditions will kill salmonids, and cyanobacteria will thrive. Challenges and opportunities for restoring the Eel and increasing its resilience to climate extremes, water diversions, and excessive loading of fine sediments point toward exploring how land use and terrestrial vegetation affect delivery from uplands of water, heat, sediments, solutes, organic matter, and organisms—in ways that either heal or damage rivers.

HYDROLOGIC extremes—droughts and deluges—are predicted to intensify under climate change, particularly in arid and semi-arid regions (IPCC, 2014). These trends are already apparent in the western US (Hayhoe et al., 2004; Kadir et al., 2013). Although shifts or anomalies in annual averages still dominate climate change projections, flow variability (maxima and minima) matters more to aquatic ecosystems (Poff et al., 1997; Stafford Smith and Cribb, 2010). The timing and duration of significant highs and lows in discharge are important as well, particularly in river ecosystems like the Northern California's Eel River, where native biota are adapted to Mediterranean seasonality (Kupferberg et al., 2012; Power et al., in press).

Regions under Mediterranean seasonality, including California, have cool rainy winters and hot, dry summers. In the Eel River of northwestern California, most precipitation falls from October through March, followed by summer droughts with little or no rainfall. Despite somewhat predictable seasonality, Mediterranean rivers experience large year-to-year variation in precipitation and flow patterns, with many implications for the river biota (Gasith and Resh, 1999; Power et al., 2008). The responses of river organisms to hydrologic disturbances will depend on the timing of flood or drought events relative to the timing of organismal life history events. Winters can be relatively dry or wet, and either of these may be followed by summers with relatively high, sustained base flows, or base flows lowered by drought or human water extraction. Native riverine biota of western North America have many morphological, physiological, and behavioral adaptations to the "deluge or drought" conditions typical of this region, such as behavioral adaptations for seeking refugia during disturbances (Meffe et al., 1983; Meffe and Minckley, 1987; Lytle and Poff, 2004). However, the limits of these adaptations will be tested under climate change and water extraction that increase the duration of the drought season and decrease the magnitude of summer low flows.

Here we propose that the best scenario for summer salmonid production occurs when scouring winter floods (which release large algal proliferations during the following summer) are followed by summers with relatively high base flows, under which nutritious epilithic and epiphytic diatoms dominate. These high flows also stimulate up-river migrations of anadromous salmon and allow them access to upstream breeding grounds in tributaries. The worst case appears to be when bed-scouring winter floods are followed by extreme low-flow summers, because then the algae that bloom early in the summer rot later, fueling overgrowths of cyanobacteria, some toxic, that proliferate as channel pools warm and stagnate. The basis for this prediction is the hydrologic mediation of the length of functionally significant food chains—those through which predators, by suppressing prey or predators of prey, can either control or suppress algal biomass—in the largely algal based food webs of the Eel.

WATERSHED CONTEXT AND HISTORY

Location, vegetation, and climate.—The Eel River is the third largest river flowing entirely within California (the Sacramento and the San Joaquin are larger), draining 9546 km^2 watershed (Fig. 1). It flows northward through tectonically uplifted terrain covered by conifer forests, oak savannahs, and grasslands. The headwaters of the mainstem Eel River originate near Bald Mountain in Mendocino County. The Mainstem Eel River is joined from the west by the South Fork, and from the east by three other major tributaries: the Middle and North Forks and the Van Duzen River (Fig. 1). Forestry has been the principal land-use since European settlement, with dairy and small-scale agriculture near the estuary.

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