



With two units totaling 345 acres, this burn in Humboldt County was the largest NRCS-funded burn in California history. Humboldt County Prescribed Burn Association, Fall 2018.

Burning by the Day: Why cost/acre is not a good metric for prescribed fire

by Lenya Quinn-Davidson¹ and Jeffery Stackhouse² Photos courtesy Lenya Quinn-Davidson

As California's fire problem grows, so too does the interest in and social license for prescribed fire. There is now widely shared recognition by federal and state agencies, private landowners, and the public that more prescribed fire is needed to curb severe wildfires and restore and maintain California's diverse fire-adapted habitats, including grasslands and prairies in which prescribed fire can be an effective tool for invasive species control. However, with this interest and support have come important questions about the cost of prescribed fire projects, and how prescribed fire costs compare with other types of treatments. This article summarizes the costs of

prescribed fire projects implemented by the Humboldt County Prescribed Burn Association—a landowner-led cooperative in California's North Coast that is forging a new path for prescribed fire on private lands in California. These examples from Humboldt County demonstrate the limited utility of cost/acre as a metric for understanding prescribed fire costs, and point to cost/season and cost/day as more helpful approaches to planning and budgeting for prescribed fire.

Prescribed Fire Costs

The Humboldt County Prescribed Burn Association (HCPBA) officially formed in March 2018 and is modeled after prescribed burn associations in other parts of the country, where community members pool labor, equipment, and expertise to implement burns on private lands (Toledo et al. 2014). Burns in Humboldt County have focused on a variety of objectives, including restoration and maintenance of grasslands through control of invasive species and woody encroachment. Unlike federal- and state-prescribed fire programs,

University of California Cooperative Extension, 5630 South Broadway, Eureka, CA 95503: ¹Area Fire Advisor, Lenya has a background in fire ecology and restoration, and the bulk of her program is focused on empowering and training landowners and land managers to use prescribed fire. ²Livestock and Natural Resources Advisor, Jeffery is a wildlife biologist and range ecologist with research experience in a wide variety of habitats, from North Dakota to California. Prescribed fire has become an important part of Jeff's range management toolbox.

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which rely on paid staff and agency resources, PBAs are mostly volunteer and based on a system of mutual benefit and reciprocity—a true neighbors-helping-neighbors approach (Diaz et al. 2016). Costs for PBA burns vary depending on where they are located, but in Humboldt County, the primary costs include air quality permit fees, contractor fees for burn planning and burn bossing, and volunteer fire department stipends, which the HCPBA recommends for in-season burns with permits that necessitate fire department resources. Most of these costs are one-time expenses that relate loosely, if at all, to project size.

Air Quality permit fees

In Humboldt County, air quality permits are the one project cost that relate directly to project size. The North Coast Unified Air Quality Management District (NCUAQMD) has a graduated permit fee structure (Figure 1) based on the acreage of the project, plus set fees for smoke management plans and no-burn day permits (i.e., variances). The NCUAQMD is the most expensive air district in northern California (Stackhouse, personal communication, May 1, 2019), with costs ranging from \$80 for a project less than 10 acres to \$1250 for a project of 300 acres or more, plus \$65 for a smoke management plan and an additional \$65 for a no-burn day permit (NCUAQMD website 2019). Other northern California air districts have minimal or no permit fees.

Burn planning and burn bossing

For complex or in-season burns, the HCPBA has worked with private contractors to develop burn plans and provide leadership on the day of burn. Burn plans describe project objectives, outline the

Figure 1: Air quality permit fees for prescribed fire in the North Coast Unified Air Quality Management District (Humboldt, Trinity, and Del Norte counties). Note: changes were made to the fee structure in spring 2018, so projects in 2017 were subject to a different fee structure.

Permit	Cost	Lifespan
1-10 acres	\$80	1 calendar year, expires Dec. 31
10-100 acres	\$250	1 calendar year, expires Dec. 31
100-300 acres	\$500	1 calendar year, expires Dec. 31
300+ acres	\$1250	1 calendar year, expires Dec. 31
Smoke management plan (SMP) (required for projects larger than 1 acre) from date of execution	\$65	2 years
No-burn day permit (one-day variance to burn on a no-burn day; applicants with SMPs may apply)	\$65	Day of burn

prescription necessary to meet those objectives, and provide guidance on unit preparation and resources needed to implement the project safely and effectively. Burn plan development generally requires site visits, conversations with the landowner, mapping, and clear synthesis of information in a written plan. Costs for burn planning generally range from \$500-\$1,000, depending on the complexity of the project.

In California, there are several private burn bosses who can provide leadership on the day of the burn. These private burn bosses typically have decades of fire experience and meet the federal (National Wildfire Coordinating Group) standard as a Type 2 Burn Boss. Private burn bosses usually bring some level of insurance with them, providing an additional buffer for the landowner. During declared fire season, when Cal Fire permits are required, burn bosses lend credibility and

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California Native Grasslands Association

PO Box 485
Davis, CA 95617-0485

(530) 902-6009

www.cnga.org

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expertise to prescribed fire operations, often easing the permit process. However, private burn bosses are in short supply, and private contractors are hesitant to provide burn boss services unless they have trusting relationships with burn organizers and adequate resources to implement the burn safely. Prescribed fire leadership will continue to be a bottleneck in California in the absence of programs and resources that build new capacity outside of state and federal fire management agencies. Day-of-burn leadership by a private Type 2 Burn Boss typically costs \$1,000-\$1,500.

Other costs

Burns organized by the HCPBA may include other costs, including volunteer fire department stipends and lunch. Landowners are also encouraged to make a donation to the HCPBA for equipment maintenance and project coordination. The landowner is also expected to prepare units for burning, which can include brush work, tree thinning, and installing firelines. In Humboldt County, those costs have in some cases been offset through landowner contracts with the Natural Resources Conservation Service (NRCS) or with other grant funding secured by the HCPBA.

Comparing Project Costs

As demonstrated in Figure 2, per acre costs have varied substantially on burns implemented by the Humboldt County Prescribed Burn Association. Costs have ranged from \$3/acre on a winter oak woodland restoration burn to almost \$1,100/acre on an in-season understory fuels reduction burn. Costs are heavily influenced by seasonality, because the HCPBA has contracted private burn bosses for almost all projects that occurred during declared fire season (typically May 1 – late October/early November). Thus, for in-season burns more than an acre in size, costs averaged \$2,481 (\pm \$446) per day with project sizes ranging from 3 to 215 acres, whereas out-of-season burns averaged \$439 (\pm \$665) per day with project sizes ranging from 2 to 163 acres. On any of those days, a smaller or larger project on the same property would have cost roughly the same amount. During both seasons, the cheapest per acre costs were realized on the largest burns, because costs accrue by day—not by acre. For example, in Humboldt County, the only cost difference between a 20-acre and 200-acre medusahead (*Elymus caput-medusae*) or starthistle (*Centaurea solstitialis*) burn in early summer would be the air quality

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Figure 2: Actual day-of-burn costs of burns conducted by the Humboldt County Prescribed Burn Association, June 2017 – April 2019. Italicized objectives indicate burns that occurred during Cal Fire's declared fire season. Table does not include unit preparation, hospitality costs (e.g., lunch), or donations to the HCPBA. Note: * indicates when an existing burn plan or air quality permit was used, meaning no additional costs were accrued.

Year	Objective	Acres	Burn plan	Burn Boss	VFD stipend	Air quality	Crew size	Total cost	Cost/acre
2017	<i>Medusahead control/training</i>	18	\$500	\$1,500	\$600	\$100	30	\$2,700	\$152
2017	<i>Coyote brush control/training</i>	140	\$500	\$1,000	\$600	\$200	25	\$2,300	\$17
2017	Oak woodland restoration/training	20	N/A	N/A	\$0	\$100	12	\$100	\$6
2017	Oak woodland restoration	15	N/A	N/A	N/A	\$100	3	\$100	\$7
2017	Oak woodland restoration	13	N/A	N/A	N/A	\$0 *	6	\$0	\$0
2018	Blackberry control	5	\$500	\$1,500	N/A	\$145	10	\$2,145	\$431
2018	<i>Grasshopper control/medusahead control/training</i>	6	\$0	\$1,500	\$600	\$145	25	\$2,245	\$378
2018	<i>Coyote brush control/training</i>	215	\$500	\$1,000	\$750	\$565	35	\$2,815	\$13
2018	<i>Coyote brush control/training</i>	145	\$0 *	\$1,000	\$750	\$565	30	\$2,315	\$16
2018	<i>Native grass seeding trial</i>	0.25	N/A	N/A	N/A	\$145	3	\$145	\$592
2018	<i>Coyote brush control/training</i>	130	\$0 *	\$1,000	\$750	\$0 *	30	\$1,750	\$14
2018	<i>Understory fuels reduction/training</i>	3	\$1,000	\$1,500	\$600	\$145	25	\$3,245	\$1,090
2019	Oak woodland restoration	163	N/A	N/A	N/A	\$565	2	\$565	\$3
2019	Oak woodland restoration	22	N/A	N/A	N/A	\$315	9	\$315	\$15
2019	Blackberry control	2	N/A	N/A	N/A	\$145	3	\$145	\$74
2019	Understory fuels reduction/training	5	\$0	\$0	\$0	\$145	20	\$145	\$33



Prescribed fire can be used to halt woody encroachment and maintain grasslands. Humboldt County, CA, just after a Fall 2018 burn (left), and seven months later in Spring 2019 (right).

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permit fee. Either unit would be achievable in one day. The burn plan and burn boss fees would be the same, as would the resource (fire engine, crews, and water) requirements outlined in the Cal Fire permit (and reflected in the VFD stipend). In this example, the landowner could accomplish 180 more acres of invasive plant control for a cost difference of \$420 (and some neighboring air districts would have no difference in cost.) Likewise, preparation of the units becomes significantly more efficient as the units grow in size. As a simple example, a square one-acre grassland unit would require 836 ft of perimeter fireline (836 ft/acre of treatment), a five-acre unit would require 1,867 ft of fireline (373 ft/acre of treatment), and a 100-acre unit would require 8,348 ft of fireline (83.5 ft/acre of treatment). These examples show that prescribed fire costs do not have a linear relationship to project size in the same way that other treatments (e.g., mastication, thinning) might.

Conclusion

This paper demonstrates that cost per acre is not a useful metric for considering prescribed fire implementation costs. Rather, private landowners in California should be considering costs by season and by day. In-season burns are naturally more complex, and will usually require additional resources, crew members, and expertise. For many landowners, those additional costs are justified by their specific burn objectives, which may only be achievable during certain times of year (e.g., medusahead and starthistle control) or may require drier weather. Likewise, some fuel types (e.g., forested areas) may add complexity and require additional resources and post-fire patrolling. For other landowners whose objectives can be met during cooler times of year and with fewer resources, costs will be lower. For all landowners, there is clear incentive to maximize project area when planning prescribed burns, as most implementation costs accrue by the day, and the cost efficiency of preparation, permitting, and implementation greatly increases with project size.



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