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Chancellor and Koshland Pastures' 3-year Management Plan Proposal

GOALS

Under the Chancellor's commission and desire for the Chancellor and Koshland pastures, this management plan has three main goals. The first goal is to have grazing livestock on the pastures for Berkeley students to see and learn more about these domestic grazing animals. The second goal is to decrease the encroachment of undesired plant species – trees and shrubs – and invasive species (star thistle). The third and last main goal is to decrease the fire risk in the pastures. Like the way goals are determined in other rangelands, the goals for these pastures were decided by some motive or desire. In this case, the Chancellor's desire of getting rid of stickers produced by starthistle and concerns about fire and invasive species set the goals for the rangeland management plan.

To accomplish these desired rangeland goals, it is necessary to have both a grazing and burning program. While both the grazing and burning programs have overlapping effects such as decreasing forage and fire risk, the grazing program will be focused on preventing the encroachment of trees and shrubs as well as teaching Berkeley students about domestic livestock; And, the burning program's main goal is to get rid of star thistle seed bank and woody species such as the planted conifers and juniper samplings. Because of the UC Berkeley campus' policy of preventing herbicide use, to manage the Chancellor and Koshland pastures, relying on burning and grazing are necessary for reducing invasions from woody species or star thistle and

fire hazards, in other words, having a grazing and burning plan is necessary to achieve the goals of the management plan. The strategies for the grazing and burning programs will be explained more in detail in their corresponding section.

SITE DESCRIPTION

Before we dive deep into the proposed grazing and burning prescription plans, it is important to have a good understanding of the site at hand as it will also be necessary for deciding strategies for our plans and measuring their effectiveness. The Chancellor and Koshland pastures are located on the North East side of the UC Berkeley campus, surrounded by both busy streets, divided by cement sidewalks, shaded by buildings, and blocked off by fences. While it is now a grassland pasture, it was not always that way. Before its current state, the pasture used to be the place of a building called the Tolman Hall which was demolished in 2020. According to the Daily Californian, the Tolman Hall demolition plan was broken into two phases: “the first phase of interior demolition work is slated to begin in late 2018 or early 2019, with the overall project to conclude by the following school year of 2019-20” (Chou). Due to this recent demolition plan, the grassland of the Chancellor and Koshland pastures have faced recent abiotic disturbances which is why there are not many native plants such as stipa pulpra growing there.

The Chancellor and Koshland pastures are also mainly made up of grassland vegetation and trees such as live oak trees. The Chancellor and Koshland pastures are not composed of any body of water such as streams and vernal pools. However, since it lies on the Berkeley campus, whatever amount of water runoff forms runs into the sewage ways on campus. With Chancellor pasture being 1.5 acres and the Koshland pasture being .7 acres big, there is an AUM average of about 1000lbs dry weight. The Chancellor and Koshland pastures also both face a 10% slope with the ground levels rising from the Koshland side to the Chancellor side. Additionally, based

on the data gathered from the web soil survey, both the Chancellor and Koshland pastures are mainly composed of urban land with 95% of the land being urban land (Web). Urban land is land used or expected to be used for urban activities with attributes including location, space, property, clustering, heterogeneity and immobility and indestructibility (Qadeer). The Chancellor and Koshland pastures are also nonirrigated and classified as class 8 soil which are soils that have limitations that preclude commercial plant production and that restrict their use for recreational purposes, wildlife habitat, watershed, or esthetic purposes (Web). Because of this soil classification and limited size, the Chancellor and Koshland pastures cannot be used for agricultural crop production and are focused on preserving native plants and biodiversity.

In addition to the information provided by the web soil survey, further information about the Chancellor pasture can be given from the collected field data. According to the field data, most of the forage found in the Chancellor pasture are trifoliate plants such as melilotus, medicago, and clover making up more than 70% of land coverage with the remaining coverage being either litter/RDM or bareground. There are also some lupine patches (making up 1% of land coverage) which is not a significant amount, but something to keep an eye for as lupine is toxic and can cause birth defects. With most of the land coverage being clover plants, the Chancellor pastures are rich in plants with high nutritional value. While these plants are high in nutrition, the field data also discovered that these plants also have high water content with an average moisture percentage of 78%. This high water content will be a key influence in the way and time of burnings as high water content will lead to slower and more intensive burns that will get rid of seed banks while burning biomass with low water content would burn faster. The field data also calculated that the pasture had an average of 3100lbs/acre of dry forage that can be used to feed the domestic grazing livestock.

According to the Chancellor, the Chancellor and Koshland partures are also faced with concerns of possible encroachment of trees or shrubs as every year the groundskeepers continue to plant conifer and juniper saplings which create shade for the grassland and increase risk of fire by increasing both biomass and density of biomass. As this happens, there is also a star thistle invasion beginning to form in a part of the pasture. With all of this, there is a great concern of invasion from both star thistle and woody vegetation.

While these are the site conditions and current plant communities, which are important factors in formulating a management plan, it is also important to take note of the climate and weather conditions that these pastures face as temperature and precipitation are *the* major influencers on plant growth. The Chancellor and Koshland pastures experience a Mediterranean climate with hot, dry summers and mildly cold, wet winters. On average, the coldest times are during December and January when the average high and lows are 56 degrees and 44 degrees respectively. While the hottest times of the year are during late summer/early fall (August and September) when the average high and lows are 75 degrees and 57 degrees in Berkeley. With this seasonal temperature change from hot summers to cold winters, there is also precipitation change from little rain to more rain. While there is some precipitation before October, the first rain, aka the first break of season, is usually sometime in October with only increasing rainfall from then till March when it starts dwindling. By the time of May, there is usually barely any rainfall which leads to lots of drying of the leftover biomass and vegetation forming RDM (Berkeley). Thus, with these conditions, most grassland vegetation will start growing in the break of season until May when they start to dry out and produce seeds. As for the trees and shrubs, they will continue to grow year-round due to their resilience and deep taproot.

GRAZING PRESCRIPTION

With our grazing prescription, our main goals are to prevent encroachment of trees and shrubs and to expose Berkeley students to domestic grazing livestock. To do this, we need to employ the four principles of range management: kind and class of livestock, spatial distribution of livestock, temporal distribution of livestock, and number of animals. The four principles of range management are the key components in formulating a grazing plan as different animals have different diet selectivity as well as many other factors that affect the amount of grazing/types of plants we want to graze. Using the four principles of range management, a possible 3-yr grazing plan would be having goats graze the Chancellor and Koshland pastures during the summer and fall and, in the winter and spring, have an intermediate amount of grazing of cattle every other year. This kind of grazing strategy is also known as a grazing system where one year there is grazing and the following year there is a deferment of grazing. With this grazing system, we will be able to reduce tree and shrub encroachment, decrease fuel load, and display a variety of grazing animals to Berkeley students. In the following paragraphs, we will dive more in-depth into the reasoning and details of this grazing system.

During the summer and fall, the grazing system will utilize goat grazing. Goats have a preference for brush, forb, and woody vegetation which is preferable during the summer as there is not a lot of new grass vegetation (Huntsinger). The goats then would be focused on eating all the shrubby and woody vegetation such as the conifer and juniper saplings, eliminating invasions of woody species and preventing their further encroachment. Furthermore, the goat's grazing of woody vegetation would also lead to a reduction of fire risk as there is a reduction of biofuel. Goats are also tolerant to low water which makes them a good grazing animal to use during the summer as they can tolerate the dry conditions which other livestock such as cattle cannot handle without provided water resources. Goats are also tolerant to toxic plants such as lupine, getting

rid of them before cattle come around to graze in the winter/spring. By having goats get rid of shrubby vegetation in the fall, native grasses would be able to take their space (Bartolome). Additionally, in a lecture, it mentioned that goats like eating star thistle during its early stages of growth which would take place during the fall, after the break of season, adding on another reason of why goats would be a great grazing animal to use during the summer and fall as it will delay invasion of star thistle. Thus, during the first and third year of the three-year management plan, goats will graze to eliminate woody species and reduce biofuel. During the second, we will have a break from grazing to improve perennial plant vigor, nurture rangeland health, and maintain a good RDM level of about 500 lbs of RDM per acre to have a 0-25% woody coverage in the 10% slope condition of the Chancellor and Koshland pastures (based on UC RDM standard).

During the winter and spring, the grazing system will utilize intermediate cattle grazing. Unlike goats who are picky eaters, cattle are considered the vacuum cleaner of domestic grazing livestock. Thus, they will eat anything depending on the selectivity and food competitiveness of the rangeland condition. By having cattle graze in the winter and spring we will be able to maintain a certain level of grass biomass and, therefore, RDM levels. In addition, during the winter and spring, grass vegetation is the most nutritious without having too high fiber content making them the preferred forage for cattle who will then eat the most during this time. For cattle grazing, we would also like an intermediate level of grazing because it improves native perennial grass seedling establishment, pushing out the establishment and invasion of star thistle (Hatch). With intensive cattle grazing or no grazing, invasive annual plants like starthistle will be more likely to dominate as native grasses are sensitive to intense grazing. According to a scientific journal called “Effects of Burning and Grazing on a Coastal California Grassland,” moderate

level of trampling from intermediate grazing can prevent encroachment of shrubs. Thus, intermediate levels of cattle grazing are best in reducing biofuel, decreasing encroachment of shrubs, and preventing invasion of star thistle.

By having this grazing system where we have goats and cattle grazing at different periods of the year, not only will we expose a variety of domestic livestock to Berkeley students, decrease encroachment of trees and shrubs, and reduce biofuel, but we will also maintain a level of RDM that will prevent soil erosion and water runoff that could pollute UC Berkeley's water. To reach these goals without causing damage to the rangeland resources, we must calculate the grazing capacity and stocking rate to determine how many of a type of animal we want on the rangeland to reach our goals. With the Chancellor and Koshland pastures being a total of 2.2 acres big and an average of 3100 lbs of dry forage per acre, there is a stocking rate of 3 mature cattle or 15 goats (.2 AUM cows = 1 AUM cattle) per acre for a month. Thus, during the years of grazing, we can have 15 goats during the summer and fall, and 2 cattle during the winter and spring to have intermediate grazing.

BURNING PRESCRIPTION

In addition to the grazing prescription, it is also necessary to have a burning prescription that will be used to eliminate star thistle seed banks and woody species such as the planted conifers and juniper samplings. To eliminate starthistle seed bank and woody vegetation, this burning plan proposes to do burnings every year for the next three-year during the late spring. By burning every year during the late spring, we would be able to eliminate all the star thistle that was too fibrous to be grazed as well as their seed banks by burning before the plant can produce more seeds. Spring burning also prevents the fire from growing too large too fast as there is still a decent amount of water content in the plants. Thus, by the last year, the burning will not only

exterminate the star thistle invasion, but also all of the star thistle seed bank that would produce star thistle another year.

Because the star thistle is located on the hillside, aka the top of the pastures hill, starting a burn from the hilltop and allowing the fire to travel downwards until it burns out would be the best. Starting a fire at the hilltop, in other words, backing fire where you burn downhill would allow a slow-moving and thus easier to control fire to develop as the wind is pushing against it. Moreover, due to backing fire's slowness it would lead to a more intense burn that could kill seeds intolerant to fire such as the star thistle. The fire would also burn off or, at least, damage tree saplings which can then be finished off in the summer/fall by the goats.

While prescribed burning would eliminate star thistle and woody vegetation, it would also improve forage quality, increase coverage and diversity of native plants, and reduce fuel load. With burnings we would be able to improve the Chancellor and Koshland pastures' health and diversity, preventing the domination of non-native annual plants and allowing native habitats and ecosystems to flourish. However, fire is still fire – and should be used with caution, utilizing a risk analysis such as a Go/No go checklist of the weather and plant conditions on the burn day. Before we do any burn, we must evaluate the weather and plant conditions. If there is too much biomass/dry mass or the weather is very dry and hot, starting fires should be handled with much precaution or even possibly rescheduled for another day. In support of this, an article states, "prescription weather conditions preclude burning at rotation intervals sufficient to effect the control of fires ignited under severe weather conditions" (Keeley). Starting a fire in risky conditions could lead to too intense and fast-growing fire that could become a wildfire and be extremely detrimental and harmful, especially with the pastures located in the middle of Berkeley and on campus where there are both many students and faculty. The pasture is also next

to a building, Koshland Hall, that is filled with many toxic and flammable chemicals that could lead to great consequences if burned.

PRESCRIPTION EVALUATION/MONITOR

For a management plan to be fully successful it is necessary to evaluate the effectiveness of the management plan and make changes to it along the way to improve and increase efficiency. This is also known as adaptive management. To evaluate and measure the effectiveness of the management plans (effective monitoring), it may be useful to have a control area where none of the management strategies were used to compare how grazing and burning changed the rangeland. Thus, to evaluate the effectiveness of this management plan we will compare the managed land to a small patch of area unmanaged (15’ x 15’). If the managed and unmanaged land show similarities in plant composition it may be necessary to reevaluate the management plan as the plan may not be effective if it gets the same results as the unmanaged area. If there is a difference, where the managed land is reaching the desired results, then the management plan may continue as planned with maybe a few tweaks.

Some other possible techniques to monitor the rangeland are measuring the RDM levels before the burn and taking permanent photo points every season. By measuring RDM levels and comparing them to our desired RDM levels (500 lbs dry matter/acre) we will be able to determine if we are grazing too much or too little as well as determine if we are polluting water through runoff if there is too little RDM. As for permanent photo points, by taking a picture every season we would be able to see the effects our management plan is having, also known as compliance monitoring. With these monitoring techniques, we can evaluate and from there modify our management plan in ways that will increase its effectiveness in reaching our set goals.

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