

Comprehensive Herbaceous Optimization Management Plan

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Strategic Trampling of Organic Matter Properly

CHOMP + STOMP

Holistic Animal Grazing for Invasive Plant Removal and Community Sustainability

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Project Overview

Watershed Management Group (WVG) and Holistic Engineering and Land Management (HELM) received a grant from the Southwest Vegetation Management Association (SWVMA) with match from the Pima County Regional Flood Control District (PCRFC) to develop and initiate a Holistic Management Plan to address invasive or pest plants by grazing animals on the site.

This method of invasive weed management has been successful in other parts of the country and has been successful in Pima County, Arizona where TEP required indiscriminate full clearing of vegetation below solar panels. It has never been attempted in Pima County for clearing noxious weeds near beneficial native species. Based on results in other arid environments, management of vegetation with the right animals, in the right numbers at the right time can reduce invasive/undesired plants, improve soil health while increasing plant and animal species diversity.

In 2017, under a contract with PCRFC, WVG developed a 5-acre stormwater harvesting demonstration site in Midvale Park south of Drexel Ave on a 40-acre PCRFC property that was barren before the project construction. Today, the stormwater harvesting features support many native plant varieties, but also have become congested with Buffelgrass, Russian Thistle and Johnsongrass causing the following issues:

- a reduction in stormwater harvesting flow capacity;
- an increase in the potential for flooding;
- a restriction of the potential for native species to grow;
- an increase in potential fire hazard.

Pre-stormwater harvesting construction



Below: The approximate parcel boundaries in black and the project area in blue



Post-stormwater harvesting construction, after a rain event



Below: 1 year of desirable native and undesirable (Russian Thistle) growth in the same basin as above



Relevant Research

Conventional methods used to remove invasive plants, including mechanical and chemical technology, are costly. These methods commonly produce negative environmental consequences including decreased soil health, water and air pollution as well as other potential environmental and human health concerns. The evidence for the need for alternatives for glyphosate based invasive plant removal are increasing. The recent supreme court case ruled that the use of glyphosate is linked to cancer. There is also considerable evidence of glyphosate's negative impact on pollinators¹

Alternatively, intensive animal grazing for the consumption of invasive species and vegetation management has been vetted as an effective invasive management strategy in California, New Mexico as well as across the Pacific Northwest, Midwest and Northeast. The Chicago O'Hare Airport has its own shepherd. Tucson Electric Power has utilized sheep to ensure vegetation is managed below its large solar panel installations². This provided significant cost savings due to the elimination of dust creation from vegetation management activities relative to mowing. One study by the Contra Costa County Flood Control and Water Conservation District in California found conventional grazing removed 47% of invasive cover with no significant impact to water quality parameters for non-recreation use. Herbicides only reduced invasive coverage by 18%³. Surveys of grazers using Holistic Management practices across the US showed both increases in biodiversity while also increasing profitability⁴. Research also shows appropriate grazing can have a positive impact on plant biodiversity and hydrologic function. Test plots that included grazing in the wetland ecologies grasslands with vernal pools demonstrated "a cover of native plant species 5 to 20% higher in the ungrazed plots...Ungrazed pools held water for a shorter period of time than pools grazed under historic regime"⁵.

Frost and Launchbaugh found that grazing is an important tool in Integrated Pest Management. They found that for invasive plants the viability of seed in manure is anywhere from 0-60%. However, seed viability was less relevant with proper animal grazing due to the successional conditions created that tend to favour native grasses and forbs and reduce the probability of invasive seed germination. Additionally, timing of animal grazing is ideal before plants go to seed to eliminate the opportunity for animal dung to germinate invasive plant seeds⁶.

Moreover, animal grazing offers multiple community benefits: as an environmentally friendly invasive plant management strategy, it improves soil health by increasing soil carbon levels of degraded desert soils, improving water quality. This may lead to the production of valuable agricultural products such as meat, milk, wool, and hides. HELM is building the knowledge-base for local effectiveness of animals, such as goats, sheep, cattle, and chickens for reducing both Buffelgrass and Johnsongrass biomass and seeds. Based on the site and context, other undesirable plant species can be targeted.

¹ Motta, E.V.S., Raymanna, K., Moran, N.A., National Academy of Sciences, Glyphosate perturbs the gut microbiota of honey bees.

² Tucson Electric Power, accessed Feb 25, 2019, <https://www.tep.com/news/sheep-clear-weeds-at-tep-solar-array/>

³ Contra Costa County Flood Control & Water Conservation District, Streambank Vegetation Management Study, Walnut Creek, July 2015

⁴ Stinner, D.H., Stinner, B.R., Martsolf, E., Biodiversity as an organizing principle in agroecosystem management: Case studies of holistic resource management practitioners in the USA. *Agriculture, Ecosystems & Environment*. Vol. 62, Issues 2-3, April 1997, Pages 199-213.

⁵ Marty, J.T., Loss of biodiversity and hydrologic function in seasonal wetlands persists over 10 years of livestock grazing removal. April 18th, 2015 *Restoration Ecology: The Journal of the Society for Ecological Restoration*.

⁶ Rachel A. Frost and Karen L. Launchbaugh, 2003, Prescription Grazing for Wildland Weed Management A new look at an old tool to control weeds on rangelands. *Rangeland* 25:43-47

Project Approach

Holistic Management (HM) is a framework for studying ecological processes and responding to challenges or land management problems with natural solutions. These solutions promote healthy soil through increasing levels of ecological succession. This small-scale pilot at Midvale Park is intended to study the impacts of intensive animal grazing. The parameters initially considered include:

1. Using the right number of animals (stock density).
2. Placing the stock on-site at the right time.
3. Locating the right place.

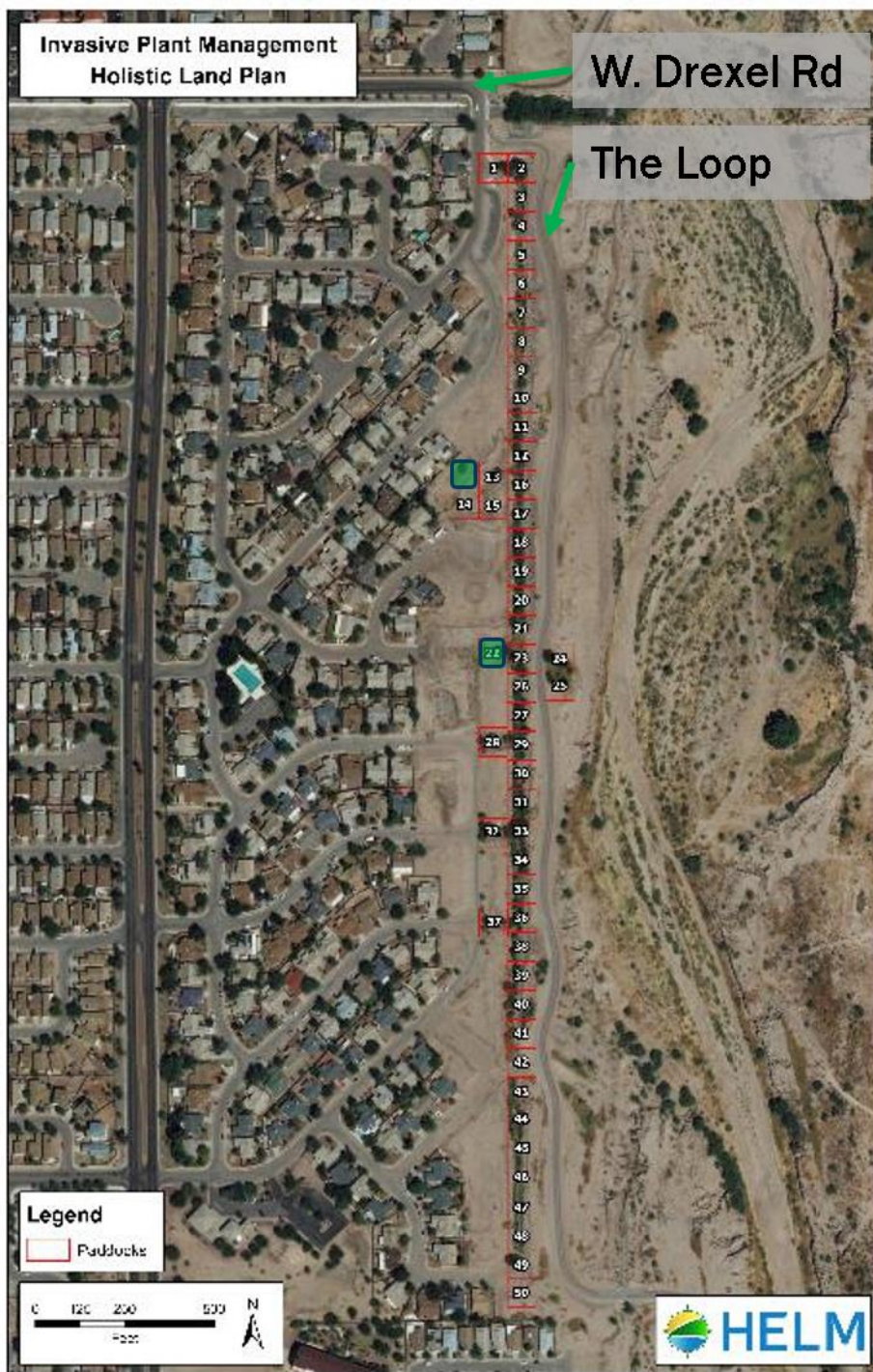
The goals are to manage invasive species, improve soil health, reduce fire risk, promote native plant and animal habitat, reduce dust, improve drainage, and improve water quality. This approach can be used in conjunction with mechanical and chemical technology; however, the intent of this work is to study the effectiveness of HM without using mechanical or chemical practices. We are using the animals' preferential grazing habits in combination with the unique timing of the greening of invasive plants to target invasive species with intensive grazing.

This effort received an initial seed grant in 2017 of \$2,500 from the Southwest Vegetation Management Association with a \$2,500 match from PCRFCFCD. Additional funding of \$4,000 from PCRFCFCD allowed ongoing maintenance and coordination activities. The grant funding developed and initiated a HM plan and process. Urban Grazers, a local contract grazer focused on sustainable grazing and holistic land management, brought a herd of 15 goats onto PCRFCFCD property for 3 days in mid-October 2018 to test the effectiveness of HM practices on Buffelgrass, Johnsongrass and Russian Thistle. Additional funding from PCRFCFCD allowed for an additional 3-day test run of the animals that also coincided with the Santa Cruz River Research Days conference tour in November 2018. The tour attracted approximately 20 professionals and community members. PCRFCFCD has agreed that previously funding allocated for Midvale maintenance can be used to allow Urban Grazers to return for approximately 8 days to the site as needed. It is desired to expand this effort to other PCRFCFCD district sites needing vegetation management.

Holistic Management Plan

Construction, planting and seeding of the Midvale site was completed in July 2017. In the Spring of 2018, a HM plan was developed based upon a site assessment of vegetation and soil, as well as knowledge of precipitation data from a PCRFCFCD ALERT Gauge at Valencia and the Santa Cruz River, located approximately 0.3 miles from the site. The assessment revealed the general health of soil and vegetation onsite to be poor except for the water harvesting areas where deposition of nutrients from stormwater as well as the breakdown of mulch was slowly improving soil texture, moisture and fungal activity. Outside of the water harvesting areas, little vegetation was growing except in the existing drainage channel. Most of the vegetation in the channel is non-native including South American mesquite, Mexican paloverde, desert broom and buffelgrass. In the upland areas, soil health was very poor with little organic matter that results in high dust emissions. Most upland soil is barren except for Russian thistle growth.

Based on the density of undesired plants, a paddock size of 20' x 20' was set for 15-20 animals to intensively graze a paddock for 1-3 hours. These numbers will be adjusted based on field observations. The figure below shows a plan for the drainage area where overgrown vegetation was identified as a problem. As the site matured, vegetation management was a greater priority in the areas adjacent to the native plantings where non-native species were beginning to outcompete the planted native species.



Invasive Plant Management Holistic Land Plan for Midvale Park

Grazing paddocks were laid out across the initial priority areas of invasive plants that were also causing drainage capacity constraints. Two areas highlighted in green were identified as pilot project areas based on presence of invasive plants and for the potential to alleviate drainage concerns.

Close up view of paddock areas

Paddock 22 as show below is an area were Johnson Grass, Buffelgrass and Russian Thistle are clogging a water harvesting drainage outlet. This is creating the potential for additional sedimentation, deposition of seed and continuation of the cycle of non-native species creating excessive ponding and reducing the potential of the site to drain flows adequately in high flow events.





Pre-treatment view of Paddock 22 looking east with brightness and contrast adjusted to better show vegetation density – note the H post in the fence just to the right of the tree trunk to reference the photo below



Post-treatment view of Paddock 22 looking south – note the H post in the fence to the left of the tree

The 15 goats successfully grazed all vegetation within the paddock to acceptable levels in less than 2 hours.

Area north of Paddock 14 with buffelgrass that is creating a drainage nuisance



Area north of Paddock 14 showing the density and height of buffelgrass as well as mesquite vegetation



Post-treatment showing the reduced density of buffelgrass and mesquite canopy reduction



Lessons learned

We learned the great potential for goats to efficiently target invasive species and to create improved soil conditions to advance ecosystem successional processes. Below is a summary of outcomes from this pilot project.

- Timing is critical with vegetation management. This pilot project began with unideal conditions with dense, mature stands of invasive plants. Targeting plants earlier in their growth cycle with less biomass and before plants go to seed is desirable.
- The goats loved and vigorously ate Buffelgrass, Johnson grass, Russian thistle (young or dry!) and salt cedar.
- If the goal is to have goats remove grassy vegetation, and trees are within the target species, the trees must be pruned up or animal access to lower branches must be restricted. Goats will indiscriminately eat both the tree branches, as well as the noxious vegetation, thus reducing removal of the target species. If the trees are mature enough, this can be beneficial to the trees.
- Goat browsing can be a major strength if leveraged with drainage channel maintenance. By reducing woody vegetation in the low to mid canopy heights, channel capacity will not diminish.
- Initially, the paddocks at the pilot site were too large. Observations quickly determined smaller paddocks were more efficient. The paddocks were down-sized near the end of the 6 grazing days.
- Overnight paddock areas for animals should be rotated to maximize the soil area benefitting from the dunging and urinating of the animals at night. After only 2 nights, during both grazing periods, ant colonies, an indicator of improved conditions, immigrated to the paddock area. Ant colonies are an indicator that the successional restoration processes have begun.
- To maximize the efficiency of herbivore weed management, sheep are an ideal complement to the goats. Goats target the upper parts of the plant while sheep target the remaining plant biomass and roots system. Many noxious weeds, including Buffelgrass, must have the root removed or they will easily grow again. This system is especially effective when the grasses have developed significant biomass, such as areas that have long been neglected and need an intense initial approach. This combination could present a significant reduction in the costs of invasive plant removal with animals. Additionally, because goats and sheep have different gut biomes, diversity of soil organic matter will increase faster from their different dung and urine also prompting the successional restoration process

This pilot program cannot be considered cost effective, but the lessons learned will result in a much more efficient approach for the future.

- The herd was too small. A large heard will consume vegetation more efficiently.
- The animal handlers now have a much greater understanding of the goats' capabilities.
- The lack of maintenance in this area resulted in very dense invasive vegetation and more difficult conditions. Continuous maintenance is much more efficient than sporadic, reactive clearing.

With planning, regular treatments at the right time and a larger herd, costs are expected to drop significantly. This modified approach can be competitive or quite possibly lower in cost than herbicide or manual human management. Pilot program costs were approximately 4 times greater (\$0.45/sq ft vs \$0.11/sq ft) than the costs to use laborers and mechanical equipment to remove Russian thistle from the same site by Watershed Management Group. HM does scale very efficiently. In the Three Canyons project in Cochise County, 480 acres are being managed with HM for \$100,000/year resulting in a per area cost

of about \$200/ac or \$0.005/square foot. It is also expected that the long-term savings and community benefits from HM will be achieved through improved soil conditions that will promote native plant growth while mitigating dust, erosion and improve infiltration while reducing the number of treatments needed over time relative to mechanical and chemical technology.

It is not easy to place a value on all the beneficial factors, such as protecting the watershed from harmful chemicals and the health of soils. These in turn provide the foundation for vegetation growth, habitat creation, and support of pollinators, bird and wildlife. It is especially important to support alternatives to chemical technology given the risks and impacts of these technologies. Given the water solubility of glyphosate, the potential risks to human and environmental health are only now becoming better understood.

Moving Forward

Based on the lessons learned, some example HM protocols are listed below based on potential vegetation management needs:

- Russian Thistle sprouts
 - Sheep and/or goats (20 animals/400 sq ft)
- Mature Russian Thistle
 - Goats and/or sheep (20-25 animals/400 sq ft)
- Rain event – Buffelgrass & Johnsongrass greens
 - Sheep/goats early monsoon: 5-10 days after rain (20-25 animals/400 sq ft)
- Drainage channel erosion & vegetation clogging
 - Cattle, goats or sheep (stocking varies based on channel conditions)
- New site: Over-rested land/over grown vegetation
 - Cattle, Goats and/or sheep high density and intensity
 - Organic mulch & native seed

HELM is interested in continuing to build the momentum for HM practices and intends to engage additional stakeholders in the region to develop HM plans and projects. To achieve this goal, HELM will host HM training, provided by Ricardo Aguirre, HELM's HM Accredited Professional. As more traditionally-trained professionals learn the value of Holistic Management, a critical mass of design approach may shift to this philosophy.

Although a proposal that was submitted to the Department of Forestry and Fire Management Invasive Plant Grant program was not funded, HELM will continue to look for funding partners to support the development of HM planning and projects throughout Pima County.

Future work can include:

Ecological monitoring and evaluation are core components of HM to ensure the appropriate actions are taken in response to the changes in land and vegetation changes. HELM can work with the University of Arizona (UA) to design effective pre and post-treatment assessments and controls. Project metrics for success include:

- % change in invasive vs native plants species
- changes in soil organic matter
- fungal/bacterial ratios
- microbial activity
- stormwater infiltration rates

UA can conduct regular assessments to evaluate these metrics 2-3 times per year to inform subsequent grazing activities under this grant and to inform HM best practices with respect to goats.

Contract grazers can work with local governments to have certain lands managed through HM include the Ecological Outcome Verification (EOV) process which can be used in conjunction with the Land to Market program, which means that valuable agricultural products such as meat, milk, wool, and hides could be purchased from companies desiring to set themselves apart as environmentally conscious, where the Land to Market logo will indicate to consumers that those products were raised on regenerating land.

Future study can better address the following overarching goals and objectives of this project:

- How does HM perform as a vegetation management & restoration tool after 2-5 years in the Sonoran Desert?
- What is the best combination of animals for the variety of weeds and invasive plants at Midvale Park and other properties?
- How does animal impact compare to other vegetation management strategies with a holistic cost benefit analysis?