Mission Folder: View Mission for 'Cedar Busters'

State	Texas
Grade	6th
Mission Challenge	Environment
Method	Scientific Inquiry using Scientific Practices
Students	Tori Hay (singingcowgirl) Justus Jacobus (bustus) Sawyer Means (TheCuriousScientist) Jett Hurst (JHurst)

Team Collaboration

(1) How was your team formed? Was your team assigned or did you choose to work with each other?

Cedar Busters was formed in April of 2020 after learning that each student at the school they attended was invited to participate in the eCybermission Challenge during 6th grade. Immediately, Justus Jacobus reached out to Sawyer Means and Jett Hurst. He asked if they wanted to help with an ecological threat at his ranch, salt cedar overtaking the native vegetation and impacting water availability. He knew both of the boys had a love for science and an amazing work ethic. They gladly accepted, and the team started investigating how to make a sustainable ecosystem in the intermittent spring-fed McDonald Creek.

Tori was added to the team in August when she transferred to our school. Her family has a ranch nearby, and once she learned the negative effects of salt cedar on the ecosystem, she immediately jumped on board with the research. Her ranch also has a salt cedar on the property and so this issue is not only a huge ecological threat throughout the western U.S., but it is a personal threat to our land. Over time, our team has brainstormed many opportunities dealing with salt cedar thickets. This includes studying the eradication styles, the riparian system's rebuilding, and the mechanically grubbed salt cedar's remains that could be repurposed. Our team works hard in the field, in the lab, at school, and at home all while enjoying the great outdoors.

(2) Provide a detailed description of each team member's responsibilities and jobs during your work on the Mission Folder.

Justus is our experiment designer. He can design an experiment that completely and correctly uses the information while making a clear and concise conclusion. Justus has been kayaking, exploring, fishing, and picking wildflowers on the Three Gringos Ranch ever since he was a toddler. He has a strong love for the land. When he found out that salt cedar has negative effects on the creek, he wanted to do something about it. He put together this smart, strong, and hard-working team to help the riparian system. Justus knows the land and creek by heart. He plays an important role in this project.

***Roles and responsibilities of Justus: Explorer, Writer, Speaker, Editor, Prioritizer, Checker

Jett Hurst is our deep thinking analytic. His innovative style of learning allows for new experiments as we study the negative effects of salt cedar. He is a whiz at math, especially when calculating our averages for results and putting them into a chart, table, or graph. Also, he is great at conducting experiments and has the heart of an engineer. He continues to think outside the box when solving problems. He has been a valuable asset with the repurposing portion of this project. His backyard has been one of the sites for termite testing, and his barn houses the mulch and oil absorption hands-on experiments.

***Roles and responsibilities of Jett: Innovator, Writer, Computer Guru, Thinker, Editor, Prioritizer

Tori Hay is our team leader; her confidence comes naturally to her. She helps us stay focused on what we are doing because our team is very social, and we can get off track easily. She is our team organizer and is extremely respectful when getting things done. She helps sort our experiments, slides, docs, website, and so much more. She is a creative force and helped design our team logo. After it was established, Tori came to our team but made up for lost time with her hard work, passion for removing salt cedar, and perseverance.

***Roles and responsibilities of Tori: Artist, Manager, Timekeeper, Prioritizer, Harmonizer, Recorder

Sawyer Means, our detailed researcher, and spokesperson. He knows the best websites to go to when learning about this invasive species. He gets good, quality information from the facts he reads and can articulate it to others. He is also a strong leader for our team with his humble attitude and work ethic. Sawyer stays focused and gets things done. If a team member needs help creating graphs, editing, or checking a citation, Sawyer is always willing to lend a helping hand. He has a significant role with this project as the spokesperson, and he tells the story of salt cedar eradication and repurposing well.

***Roles and responsibilities of Sawyer: Speaker, Writer, Computer Guru, Timekeeper, Editor, Prioritizer

Roles and responsibilities definitions:
Artist - design team logo and create a website
Checker - make sure everyone is on track and understanding all of the information
Computer Guru - uses technology to create charts and give technical assistance
Editor - mission folder answers

Explorer - find new areas to research
Harmonizer - creates positivity among team members
Innovator - Thinking outside the box with new experiments
Manager - ensures that the team meets all goals and stays on task
Prioritizer - makes a list of things to do
Recorder -takes notes of all discussions
Speaker - spokesperson for the team
Thinker - presents new ideas and solutions to existing problems
Time Keeper - keeps team members alert of deadlines
Writer - mission folder answers

(3) Did your team face any problems working together? If so, how did you solve them? If not, why do you think you were able to work together so well?

At our school, we are all required to do Ecybermission. Our team all goes to Southcrest Christian School. Our team worked great together. Our biggest struggle was being in different classes and not working on the project as a full team during the school day. Much of our research, meetings, and experiments had to be completed on weekends and evenings. Communication through texts, phone calls, and emails was vital to make sure everyone was staying accountable. With the pandemic, we had to rely on technology through facetime and zoom meetings to discuss our results and plans. Not meeting face to face during quarantine periods was difficult, but we all made the most of the current situation.

When we worked outside of the classroom on projects, we worked well together because we stayed on target, but once we finished our task, we always liked playing a basketball game or just goofing around. Being focused is very important when it comes to getting things done. When one of us got distracted, a team member would give a gentle reminder of what needed to be completed and offered help. This 10-month project brings you closer together as friends, and we definitely bonded.

(4) What were some possible advantages to working together as a team on this project? How would working as individuals have made this project more difficult?

The BIG advantage of working together is that you can get more things done. This benefits our team because this project has so much information, and salt cedar is harming our water quality and quantity. Working together benefits our whole team and the ecosystem. When everyone focuses and does their part, a lot of work is accomplished.

Our project's team brainstorming sessions helped us come up with many different ways to repurpose the dead salt cedar. The ideas kept flowing, and it was an exciting time for us all. We were able to see that this project was not only impacting the Three Gringos Ranch, but it has the potential to benefit so many other ranches in the USA. Our team is top-notch and gets things done.

As a one-person team, it would be much more stressful completing the multiple investigations on your own. If you are working individually, it is hard to get things done because of time restraints. It would be challenging to be a well-rounded kid, involved in sports, church, JH dance clubs, video games, boy scouts, band, cheer, and gymnastics if this project was on the weight of only your shoulders. The Cedar Busters team is very social and we like to be involved in many extracurricular activities.

Uploaded Files:

- [**View**] **Team Contract** (By: singingcowgirl, 02/09/2021, .pdf)
  The team contract was signed by all students to help us stay on-task and be accountable to one another.
- [**View**] **Rattlesnake Safety for the Team** (By: JHurst, 02/20/2021, .pdf)
  Rattlesnake safety is very important in wild areas of west Texas where we conducted fieldwork. Western Diamondbacks are common and knowing how to avoid them is key to working safely outdoors. This is the guide we used from the Texas Parks and Wildlife Department. We also consulted our team mentor who is a wildlife biologist and worked closely with Duane Lucia, a biologist for the U.S. Fish and Wildlife Service.
- [**View**] **Collaboration and Communication as a Team** (By: JHurst, 02/22/2021, .pdf)
  There were many times we needed to communicate this year. The use of Google Drive, email, texts, and Zoom kept our team connected with each other and our team advisor and mentors.
- [**View**] **Mentor Contacts List** (By: TheCuriousScientist, 03/04/2021, .pdf)
  Many people played a vital role in mentoring us during this project. Some of our most important contacts are listed here. We are grateful for their continued support.
- [**View**] **Team Overview Video Script** (By: TheCuriousScientist, 03/04/2021, .pdf)
  *This script was written to accompany our video overview of the team and what we have accomplished this year. ***Please view our video https://youtu.be/-EJS-vHbbDs*
- [**View**] **Video - Meet the Cedar Busters!** (By: TheCuriousScientist, 03/04/2021, .pdf)
  Check out the Cedar Busters and our goals for this year through this video made by our team member Sawyer! https://youtu.be/-EJS-vHbbDs
- [**View**] **Work Schedule and Timeline** (By: TheCuriousScientist, 03/04/2021, .pdf)
  Our team kept a spreadsheet in Google Sheets all year to record our team's work schedule throughout the year. Our timeline starts April 2, 2020 and is ongoing.
- [**View**] **Team Logo** (By: TheCuriousScientist, 03/04/2021, .pdf)
  The team designed a logo because there are many benefits to using one for recognition. The first impression can be professional with a logo; your project will be more memorable with a logo; and the logo itself can describe who and what you're about.
- [**View**] **Project Plan for the Team** (By: JHurst, 03/06/2021, .pdf)
  An action plan was put together to show the different aspects of this project and the big picture

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Scientific Inquiry

Problem Statement

(1) What problem in your community will your team be investigating through scientific inquiry using scientific practices? Specifically, based on this problem, what question will you be trying to answer?

Tamarisk, commonly called salt cedar, is found along McDonald Creek's banks in Garza County. McDonald Creek feeds into the Salt Fork of the Brazos River, the third-longest river in Texas. Salt Fork is one of three forks that make up the main stem of the Brazos. In Garza County alone, there are approximately 3800 acres that are infested with salt cedar.

This aggressive invasive species from Eurasia can produce as many as 500,000 seeds annually and these seeds can sprout within 24 hours. Salt cedar trees can consume up to 200 gallons of water a day. Salt cedar grows as dense thickets and harms native vegetation. The leaves and stems of salt cedar thickets release a high concentration of salt into the ground. The high amounts of salt prevent the native plants from growing and developing the right way. The wildlife is affected because of the lack of protein in the plant.
Our team plans to create a sustainable ecosystem in McDonald Creek after the eradication of salt cedar. Salt cedar eradication is an extensive and expensive process. There are many steps to remove the harmful, deciduous, dense, exotic weed. After salt cedar is eradicated, the riparian system needs to be evaluated, so it has the potential to thrive.

The questions we are trying to answer are:

What damage has occurred to the land after the salt cedar thickets were chemically sprayed and mechanically grubbed?

Did this removal process harm the aquatic and/or riparian system?

Was the chemical or mechanical eradication process more successful?

When evaluating the creek, the team noticed piles of mechanically grubbed dead salt cedar branches and wondered how these thickets could be repurposed.

Could salt cedar be mulched and used as ground cover?

Would salt cedar mulch be resistant to termites?

Could salt cedar mulch be used to absorb oil spills?

(2) Research your problem. You must learn more about the problem you are trying to solve and also what testing has already been done. Find AT LEAST 10 different resources and list them here. They should include books, periodicals (magazines, journals, etc.), websites, experts, and any other resources you can think of. Be specific when listing them, and do not list your search engine (Google, etc.) as a resource.

*** Please see uploaded files "Works Cited," "Research Summaries," "Video Clips" and "Expert Interviews" for a detailed look at the information sources.

Most of the Cedar Busters research began in August and continued into November, although we are continuing to gather information from sources as the project goes on. The Cedar Busters completed research papers in English class. Our English teacher and our Science teacher team up together, especially on shared projects. Our team used resources, including websites, videos, professional journals, and interviews with community experts. We created our citations through My Bib. Our resources are listed below:

VIDEOS:

Amarillo, Mundo, et al. "Salt Cedar Eradication Begins at Lake Meredith." https://www.newschannel10.com/story/8830034/salt-cedar-eradication-begins-at-lake-meredith/, Mundo Amarillo Metv Amarillo lelemundo Amarillo,

IPM: Salt Cedar Project. "IPM: Salt Cedar Project." YouTube, Oklahoma Gardening, 7 Jan. 2013, you.be/WTVXcKc1FAo. Accessed 17 Oct. 2020.

https://pvtimes.com/news/saltcedar-removal-underway-in-pahrump/
United States Department of Agriculture NATURAL RESOURCES CONSERVATION SERVICE Invasive Species Figure 1. A Large-Scale Infestation of Saltcedar (Middle-Ground of Photo) with Fall Foliage on Hell Creek in the Draw-down Zone on Fort Peck Reservoir. 2007.

PROFESSIONAL JOURNALS

Field Guide Agriculture Forest for Managing Service Southwestern Region Saltcedar. United States Department of Agriculture, Jan. 2010.

Heutte, Tom, and Steve Dewey. "Saltcedar Overview." 17 Oct. 2020.

Preserve, Audubon. "Salt Cedar Removal." Audubon Kern River Preserve, 14 July 2016, kern.audubon.org/landing/conservation/salt-cedar-removal. Accessed 13 Oct. 2020.

Dykstra, Dennis. Extraction and Utilization of Saltcedar and Russian Olive Biomass Saltcedar and Russian Olive Control Demonstration Act Science Assessment. USDA Forest Service, 2009.

WEBSITES:

Barranco, Angela. "Saltcedar - Invasive Species Summary Project - Columbia University." Www.Columbia.Edu, Angela Barranco, 11 Nov. 2001, www.columbia.edu/itc/cerc/danoff-burg/invasion_bio/inv_spp_summ/Tamarix_ramosissima.html. Accessed 1 Oct. 2020.

Booth, Michael. "Why Planting Tenacious Tamarisk Seemed like a Good Idea until It Wasn't, and Other Harrowing Tales of Colorado's Invasive Species." The Colorado Sun, The Colorado Sun, 9 June 2020, https://coloradosun.com/2020/06/09/invasive-species-tamarisk-southwestern-willow-flycatcher/
"details on salt cedar." Tsusinvasives.Org, Texas Invasive Species Institute, 2014, www.tsusinvasives.org/home/database/tamarix-spp-. Accessed 8 Oct. 2020.

Preserve, Audubon. "Salt Cedar Removal." Audubon Kern River Preserve, 14 July 2016, kern.audubon.org/landing/conservation/salt-cedar-removal. Accessed 13 Oct. 2020.

Hoddle, Mark, and Jeffery Lovich. "Saltcedar." Center for Invasive Species Research, cisr.ucr.edu/invasive-species/saltcedar.

"Tamarisk (Salt Cedar) Facts." Www.Softschools.Com, www.softschools.com/facts/plants/tamarisk_salt_cedar_facts/1285/. Accessed 15 Oct. 2020

Weisberg, Peter. “Tamarisk | ONE.” Www.Onlinenevada.Org, Nevada Humanities, 20 Mar. 2009, www.onlinenevada.org/articles/tamarisk. Accessed 16 Oct. 2020.

“TAMARIX RAMOSISSIMA.” Www.Texasinvasives.Org, www.texasinvasives.org/plant_database/detail.php?symbol=TARA. Accessed 15 Oct. 2020.

“Tamarisk Tree.” Discover Moab, Utah, Moab Area Travel Council, www.discovermoab.com/tamarisk-tree/. Accessed 7 Oct. 2020.

Team, Fluence News. “Non-Native Tree Sucking up Water in Southwest: Fluence.” Fluence Corporation, 2 Nov. 2017, www.fluencecorp.com/non-native-tree-sucking-up-water-in-southwest/.

MAGAZINES:

Brown, D. Paul. “From Weed to Wood: Producing Finished Products with Saltcedar Logs | D. Paul Brown.” Www.Highlandwoodworking.Com, Highland Woodworking, Dec. 2017, www.highlandwoodworking.com/woodworking-projects/building-out-of-salt-cedar-wooden-logs.html. Accessed 17 Oct. 2020.

Hughes, Candace. “How We Created a Monster In the American Southwest.” Smithsonian Magazine, 9 Oct. 2015, www.smithsonianmag.com/science-nature/how-we-created-monster-american-southwest-180956878/. Accessed 18 Oct. 2020.

BLOGS:

Abbas. “Herbs-Treat and Taste: THE TAMARISK TREE: HEALTH BENEFITS and USES of TWO TAMARISKS.” Herbs-Treat and Taste, 11 June 2012, herbs-treatandtaste.blogspot.com/2012/06/tamarisk-tree-health-benefits-and-uses.html#:~:text=The%20French%20tamarisk%20has%20been.

INTERVIEWS WITH EXPERTS

Lucia, Duane. “ Eradication and Restoration.” Personal Interview. 11 Feb. 2021

Durham, Bart. “Ecological Evaluation and Water Quality.” Personal Interview. 6 Feb. 2021

Marshall, William. “Termite Resistance to Salt Cedar Study.” Personal Interview. 21 Nov. 2020

(3) What did you find out about your problem that you didn’t know before? What kinds of experiments have been done by other people before you? Be sure to put this in your OWN words, do not just copy And paste information. Also, be sure to cite your sources.

*** Please see uploaded files “Research Summaries,” "Video Clips" and “Expert Interviews” for a detailed look at the information we summarized.

Saltcedar (Tamarisk) is a shrub and spreads through its seeds; upstream, the wind carries the seeds, and downstream they spread by a flood.

A single salt cedar tree can take in 200 gallons of water a day and grow 12 feet over the summer.

By the late 1990s, this invasive species had spread to 1.6 million acres in the West. Tamarisk became the most wanted plant in Colorado and the Four Corners.

The beetle, Diorhabda cardinalate, has been used as an eradication method to kill the tamarisk. It is the size of a ladybug and only eats one thing - salt cedar.

Booth, Michael. “Why Planting Tenacious Tamarisk Seemed like a Good Idea until It Wasn't, and Other Harrowing Tales of Colorado's Invasive Species.” The Colorado Sun, The Colorado Sun, 9 June 2020, https://coloradosun.com/2020/06/09/invasive-species-tamarisk-southwestern-willow-flycatcher/

People from Eurasia, in the 1800s, brought it to America because it was an ornamental plant for landscaping. Salt cedar thickets also were used to stop mudslides and as a windbreak.

Tamarix takes up so much water because its leaves and stems release high salt amounts into the ground.

Tamarix, salt cedar, can harm the environment by destroying native vegetation like willows and cottonwood.

“Details.” Tsusinvasives.Org, Texas Invasive Species Institute, 2014, www.tsusinvasives.org/home/database/tamarix-spp-

Salt cedar uses the taproot to suck up water deep beneath the soil.

Tamarisk, salt cedar, is one of the top ten nefarious weeds.

Mature tamarisk's taproots can go below the soil down to thirty meters.

Once established, salt cedar can survive extreme drought and prolonged flooding.

Weisberg, Peter. “Tamarisk | ONE.” Www.Onlinenevada.Org, Nevada Humanities, 20 Mar. 2009, https://www.onlinenevada.org/articles/tamarisk . Accessed 16 Oct. 2020.

Tamarix is composed of fifty-four different species. Six of these species are in the United States.
Salt cedar is not a true cedar. It is actually a shrub.

Salt cedar can be repurposed for quality wood projects.

Brown, Paul. “From Weed to Wood: Producing Finished Products with Saltcedar Logs | D. Paul Brown.” Www.highlandwoodworking.com, Highland Woodworking, 1 Dec. 2017, www.highlandwoodworking.com/woodworking-projects/building-out-of-salt-cedar-wooden-logs.html.

Salt cedar can be spotted along rivers and bodies of water. Tamarisk can lead to increased salinity in the soil and water.

Beetles are sometimes used as an eradication method. Essentially, the Beetles eat their way through the salt cedar. It took nearly 10 years for beetles brought in near the Rio Grande to begin to have an impact on the eradication effort.

It is somewhat unknown the effect beetles play in the destruction of other native vegetation.
Eradicating salt cedar can help a variety of other vegetation to thrive and bring back additional wildlife.

Stuart, Andrew. “In the Fight with Salt Cedar, Leaf Beetle Makes Headway.” KRTS 93.5 FM Marfa Public Radio, KRTS 93.5 FM Marfa Public Radio, 5 May 2016, marfapublicradio.org/blog/nature-notes/in-the-fight-with-salt-cedar-leaf-beetle-makes-headway.

Salt cedar infestations can result in a loss of grazing ability to a landowner’s livestock.

Beetles can be used to defoliate salt cedar leaves which helps to inhibit their growth. Without their leaves, it makes it hard for the tree to store enough energy for spring growth.

Challenges to using beetles for eradication include not deploying enough beetles to establish a population.

Ants can feed on larvae and pupae of beetles, thus decreasing their effectiveness in salt cedar eradication.

Salt cedar eradication with beetles can be slow.

Knutson, Allen. Muegge, Mark. DeLoach, Jack. Biological Control of Tamarix in Texas. 2009, https://www.wsweedscience.org/wp-content/uploads/slide-presentations/10%20Biological%20Control%20of%20Tamarix%20in%20Texas%20-%20Knutson.pdf.

OTHER experiments dealing with salt cedar eradication:

Over the years, many acres have been eradicated to eliminate salt cedar by either chemical or mechanical procedures. Government funding has been given to eliminate this invasive species. The Texas Parks and Wildlife set up a partnership with landowners in 2015 to help manage salt cedar along the Brazos River. This is an aerial herbicide treatment (chemical eradication) and was free to the landowners.

“Texas Parks & Wildlife Department: Aquatic Invasives.” TPWD, Texas Parks and Wildlife Department, tpwd.texas.gov/landwater/water/aquatic-invasives/saltcedar-upperbrazos.phtml.

Typically a prescribed burn is how to remove brush piles or dead salt cedar thickets left by the river’s edge after eradication. During an interview with Duane Lucia, he joked, saying, “Nothing good comes from salt cedar- it’s not even good for barbecue.”

United States Department of Agriculture , 2010, Field Guide for Managing Salt Cedar, www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5180537.pdf.

The defoliating beetle was released across parts of Texas in the early 2000s hoping that the beetle would eat off the leaves of the salt cedar tree. This method reduces the number of leaves on the plant each year, depleting it of the resources it needs to grow and sustain.

“Biological Control of Saltcedar | Texas A&M AgriLife Research and Extension Center at Amarillo.” Amarillo.tamu.edu, amarillo.tamu.edu/jerry-michels-ph-d/biological-control-saltcedar/.
?
PAST Experiments of repurposing salt cedar

Our team is constantly brainstorming ways the Cedar Busters could use this exotic weed for good. We have chipped it, tested the absorption levels, filtered it, made it into a mulch, planted it in termite traps, and made it into a potential project piece.

1. Another component that sets us apart is the repurposing of the unwanted dead salt cedar thickets. We read about a decorative box being built with salt cedar planks. The hard and strong wood had a reddish color, and the project piece turned out nicely.

Brown, D. Paul. “Wood News Online.” Www.highlandwoodworking.com/Woodworking-Projects/Building-out-of-Salt-Cedar-Wooden-Logs.html, Dec. 2017, www.highlandwoodworking.com/woodworking-projects/building-out-of-salt-cedar-wooden-logs.html.

2. The french tamarisk, Tamarix Gallica, has been used for medical purposes, including astringent qualities to stop blood flow from wounds, treat diarrhea and dysentery, and boost the immune system.

Abbas. “Herbs-Treat and Taste: THE TAMARISK TREE: HEALTH BENEFITS and USES of TWO TAMARISKS.” Herbs-Treat and Taste, 11 June 2012, herbs-treatandtaste.blogspot.com/2012/06/tamarisk-tree-health-benefits-and-uses.html#:~:text=The%20French%20tamarisk%20has%20been.

Experimental Design

(4) Based on the question you are trying to answer, and your research, what is your team’s hypothesis for this investigation? Be sure to include the independent and dependent variables and how they are related along with evidence of your research.

OVERALL INVESTIGATION HYPOTHESIS:
If mechanical and chemical eradication of salt cedar are both applied to the intermittent spring-fed McDonald Creek, then the mechanical grubbing area will be more successful with growth in the aquatic and riparian ecosystems while providing an opportunity to repurpose the dead salt cedar thickets that were mechanically excavated.

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality
Hypothesis 1: If mechanical and chemical eradication of salt cedar are both applied to the intermittent spring-fed creek, then the mechanical grubbing area will be more effective in limiting growth in the aquatic and riparian ecosystems along McDonald Creek.

Investigation 2: Salt Cedar And Termite Resistance - tested two different locations.

Evidence of Research - We believe that salt cedar is termite resistant since it is so high in salt content. This would be a good way to use the otherwise wasted material from eradication. It could also be used for furniture or tools.

Hypothesis 2: If salt cedar is resistant to termites, then the wood will show no signs of termite damage after weeks and then months of exposure.

Investigation 3: Repurposing Salt Cedar as Garden Mulch
Hypothesis 3: If salt cedar is disposed of after eradication, then garden mulch can be successfully made from the branches using a chipper.

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project
Hypothesis 4: If salt cedar is used in a system with oil exposure, then it will absorb oil and could be used as an effective way of clean-up during oil spills.

Investigation 5: Filtration
Because of its high salt content, we believe that a salt cedar mulch might filter out calcium & magnesium in tap water. Water softener systems commonly use types of salt in those household filters.
Hypothesis 5: If salt cedar mulch is used as the active ingredient in a water softener filter system, then it will remove magnesium and calcium from the hard tap water.

(5) Identify the independent and dependent variables in your investigation.

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality
Independent Variable:
Eradication Treatment Type
Site 2, 3 - Mechanical Eradication,
Site 4, 5 - Chemical Eradication
Dependent Variable:
Recording Data:
Temperature, Conductivity, Turbidity, Salinity, Dissolved Oxygen, pH, Number of Organisms, Number of Taxa, Number of salt cedar per site - kill ratio

Investigation 2: Salt Cedar And Termite Resistance

Independent Variable: Termite exposure to salt cedar
Dependent Variable: Amount of damage caused to salt cedar by termites

Investigation 3: Repurposing Salt Cedar as Garden Mulch
Independent Variable: Different kind of wood chipped- Salt Cedar wood and Red Oak wood
Dependent Variable: Amount of bean grown (in triplicate layout), and number of sprouts per container

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project
Independent Variable: Amount of oil put into the cups and how much salt cedar mulch was used in each cup - tested separately to keep variables under control.
Dependent Variable: The amount of oil absorbed by the salt cedar based on amount of oil remaining in cup

Investigation 5: Filtration
Independent Variable: Wood being tested
Dependent Variable: Water Hardness following exposure to salt cedar

(6) What are the constants in your investigation?

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality
Constants:
Same Day Sampling
IBI Metrics
Sampling Protocol Tools
Following the same protocol for every test performed

Investigation 2: Salt Cedar And Termite Resistance
Constants: Termite Station Salt Cedar Log size and method of exposure

Investigation 3: Repurposing Salt Cedar as Garden Mulch
Constants: Same Plant used, Amount of Water Used, Kinds of Soil, and Container

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project
Constants:
Same amount of oil (50 ml per cup)
Same amount of salt cedar sawdust (15g per cup)
Same type of cup
Same scale measured in grams
All test conducted for same period of time and in triplic

Investigation 5: Filtration
Constants: Cups used, same measurements used, procedure followed in the same way

(7) Will your investigation have a control group? If so, describe the control group. If not, why not?

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality
Control Group:
The sites that underwent no salt cedar eradication (Site 1, 6 - neighboring ranches) served as the control group

Investigation 2: Salt Cedar And Termite Resistance - Tested two Different Locations.
Control: A termite commercial Bait Log was used as the control

Investigation 3: Repurposing Salt Cedar as Garden Mulch
Control: Soil without mulch and soil with red oak mulch were the control groups

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project
Control: Oil used without a salt cedar and red oak wood additive were the control groups

Investigation 5: Filtration
Control: Tap Water, Bottled Water, and Coffee Filters were used separately as controls

Experimental Process

(8) List all of the materials you used in your experiment. Be sure to include all physical materials as well as any technology or website used to collect data (not websites you used in your research).

In all experiments, we used Google Sheets and/or Excel to make graphs and calculations, a notebook and pen to take notes, and a digital camera to take pictures.

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality

SAFETY MATERIALS
Proper clothing including long pants and sturdy shoes
Handwashing station
Hand sanitizer

TECHNOLOGY MATERIALS
Multiparameter water quality meter
Turbidimeter
Digital Camera
Binoculars
Google Sheets
Excel

TESTING MATERIALS
12” D-frame kick nets
Benthic Macroinvertebrate Laboratory Bench Sheets
Metal tray
Sieve
Sample jars
Preserving ?Ethanol Alcohol
Buckets
Plastic turbidity vials
Water Quality Notebook
Tweezers/Forceps
Wide Mouth 1 Gallon Clear Glass Jar
Small Glass Test Containers

Investigation 2: Salt Cedar And Termite Resistance

SAFETY MATERIALS
Gloves
Handwashing station

TESTING MATERIALS
Salt cedar log
Termite bait station
Termites
Shovel

Investigation 3: Repurposing Salt Cedar as Garden Mulch

SAFETY MATERIALS
Proper clothing including long pants and sturdy shoes
Safety goggles
Ear protection
Handwashing station
Gloves
Hand sanitizer

TECHNOLOGY MATERIALS
Sears/Craftsman 9HP Shredder
Computer
Microscope
Microscope slides
Scale
Growing tent
Controller for the tent (to control heat, humidity, etc..)
Digital Camera
Google Sheets
Excel

TESTING MATERIALS
Saltcedar branches
Red Oak branches
Galvanized bucket
Trash can
Ziplock bags
Berger BM7 bark mix
Red Oak wood mulched
Salt Cedar mulched
Bean seeds
Water
Measuring Cup
Planter

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project

SAFETY MATERIALS
Gloves
Handwashing station

TECHNOLOGY MATERIALS
Triple beam balance (g)
Food processor

TESTING MATERIALS
Castrol GTX Oil
Solo Cups
Salt cedar (mulched)
Beaker (ml)
Sheets of paper to record information
Strainer

Investigation 5: Filtration

SAFETY MATERIALS
Handwashing station

TECHNOLOGY MATERIALS
Google Sheets
Excel
Digital camera

TESTING MATERIALS
Salt cedar
Coffee filters
Tap water
Bottled water
Cups
Water hardness test strips

(9) Explain your experimental process. Be sure to list all of the steps and ALL SAFETY PRECAUTIONS for your experiment. Remember to write it so someone else could follow the steps and recreate your experiment.

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality

Safety: Adult supervision required while outdoors, rattlesnake safety will be reviewed by the team members, proper clothing will be worn while in the field such as long sleeves, boots, sunscreen, caps or cowboy hats, and insect repellent. When near McDonald Creek, care will be taken to not fall in the creek and adults will be present to supervise.

Procedure:

1. Six 100m sampling sites were established along McDonald Creek.
2. Evaluate each site even if the water is not present. Using the multiparameter water quality meter, measure the temperature, conductivity, salinity, dissolved oxygen, pH, and turbidity at each site. Do this in triplicate and record the average. This will be listed as BEGINNING on the bar graphs.
3. During the summer heat, take samples at all sites with a 12'' D-frame kick net. A total of 10 linear meters of each site will be sampled. Place all contents in a glass jar labeled with the site's number.
4. Using the multiparameter water quality meter, record the temperature, conductivity, salinity, dissolved oxygen, and pH at each site in triplicate for an overall average. This will be listed as MIDDLE on the bar graphs.
5. Fill creek water in the plastic turbidity vial at each site; label vial.
6. Filter water gently through samples using a sieve, metal tray, and tweezers. All samples will be pooled into a single site sample for identification and processing.
7. All samples will be placed in a glass jar labeled according to the site and preserved in pure ethanol alcohol for transport to the Lubbock Christian University Laboratory to be processed.
8. Macroinvertebrates in each sample will be enumerated and identified to the lowest taxonomic level possible (most likely order or genus) using the Benthic Macroinvertebrate Laboratory Bench sheets.
9. At the conclusion of the project timeline, count the salt cedar growth along the 100m sampling area. Complete in triplicate and take average to determine the dead/alive salt cedar ratio.
10. Water samples were taken at each site, in triplicate, as a final analysis. This was listed as END on the bar graphs for temperature, conductivity, salinity, dissolved oxygen,

and pH.
11. After samples were taken from the creek for turbidity, the water samples were poured into small glass test containers and inserted into the turbidimeter. The NTU score was displayed immediately, and we added this to our data log.

Investigation 2: Salt Cedar And Termite Resistance

Safety: Appropriate clothing should be worn to protect team members from harsh weather conditions while burying and checking the termite station. Team members should be aware of their surroundings and use caution when turning over logs while looking for termites. The band saw to be used to remove bark from the salt cedar log will be operated by a skilled adult. Care will be taken when removing the salt cedar log from the station in case arachnids or other insects are present.

Procedure: We will test if salt cedar is resistant to termites. We will place a salt cedar log in a termite station buried in the ground near a woodpile. We will check to see if the termites eat the salt cedar. We will record our results during the procedure.

Investigation 3: Repurposing Salt Cedar as Garden Mulch

Safety: There was very low risk involving this experiment but all of the research and conducting of this experiment was done under adult or under a guardian’s supervision. Eye and Ear protection was worn while chipping the branches. All lab procedures were followed when examining the wood chip in the school’s lab. Masks were worn in the classroom.

Procedure:
1. Gathered salt cedar branches from the ranch.
2. Cut down red oak branches from the front yard tree.
3. Brought both types of wood to the neighbor's house to chip the branches with the Sears/Craftsman 9HP Shredder. Eye and ear protection were both worn.
4. As the wood was being shredded, the wood chips would fall in the designated galvanized bucket.
5 Separated the red oak mulch and the salt cedar mulch in two different galvanized trash cans.
6. Put the salt cedar and red oak in labeled ziplock bags and deliver them to the Cedar Busters team.
7. The team analyzed the salt cedar and red oak mulch in the science lab making notes of the properties of each style of wood chips..
8. Team examined both kinds of wood chips through a microscope while taking notes. Team members placed a small amount of the wood type on the microscope slides.
9. Team weighed the salt cedar as another comparison.
10. Team set up planter boxes, a growing tent, and a controller to regulate heat and humidity.
11. Soil was added to box #1 with bean seeds. 1” of water was added to this first section.
12. Saltcedar mulch was added to the soil and bean seeds in box #2. 1” of water was added to this second section.
13. Red oak mulch was added to the soil and bean seeds in box #3. 1” of water was added to this second section.
14. After 2 weeks, we observed how many bean sprouts were in each planter.
15. Finally, we recorded the data we learned.

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project

Safety: There was very low risk involving this experiment but all of the research and conducting of this experiment was done under adult or under a guardian’s supervision. The investigation was completed in a well-ventilated area.

Procedure:
1. Using the salt cedar chips from the mulch investigation, the team used a food processor to chop the wood chips into fine dust.
2. First, we took six empty cups and filled them with the same amount of oil. (47.35 grams or 50 ml)
3. Then, we took salt cedar sawdust and put 15 grams into three of the cups. (test group)
4. Next, we took the remaining three cups and used them as a control which contained just oil. (Control group)
5. After 14 days, we poured oil through a strainer to remove the salt cedar and to measure the ending weight of the oil alone.
6. We compared the weight of the oil to our beginning weight to determine the amount of oil that the salt cedar had absorbed accounting for the weight of the cup.

Investigation 5: Filtration

Safety: Care was taken when filling coffee filters with salt cedar and when using the stapler. Masks were worn when doing this experiment.

Procedure:
We measured the water hardness of the following multiple times for accuracy
Tap water

Tap water filtered with salt cedar mulch & coffee filters

Tap water filtered only by coffee filters

Bottled water only

STEPS:
1. We dipped a water hardness test strip in plain tap water for 1 second, shook off the excess water and waited 30 seconds before reading the results.
2. We placed salt cedar inside two coffee filters and stapled the top. We poured tap water over the coffee filters filled with salt cedar to collect a filtered water sample. We dipped a hard water test strip in the filtered water for 1 second, shook off the excess water, and read the results after 30 seconds.
3. We dipped a water hardness test strip in tap water filtered with 2 coffee filters for 1 second, shook off the excess water, and waited 30 seconds before reading the results.
4. We dipped a water hardness test strip in bottled water for 1 second, shook off the excess water and waited 30 seconds before reading the results.

Data Collection and Analysis

(10) Present the data you collected from your experiment. Be sure to include all of the data you collected from your observations and measurements. Use of graphs and charts is HIGHLY encouraged. Explain how your data supports or refutes your hypothesis.

Please see our uploaded lab reports (Google Slide presentations saved as pdf files) for each of the investigations 1-5 which contain data tables, graphs, charts, and our data analysis, along with the Charts uploads (Excel files saved as pdf files) with graphs and charts.

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality

Data:
Summary of IBI July 2020:
Number of Organisms: Animals, plants or single-celled life forms found in our creekwater samples. Site 3 (13 n), Site 4 (20 n), Site 5 (17 n)

EPT Chart: Site 3 (23%), Site 4 (20%), Site 5 (0%) EPT% (Ephemeroptera, Trichoptera, Plecoptera) represents the percent of sensitive aquatic and riparian insects, which consists of three categories. These categories give the scientist a good feeling of whether the creek is in equilibrium or chaos.

Number of Taxa: Site 3 (2), Site 4 (5), Site 5 (5) A taxon (taxa - plural) consists of a group of one or more populations of an organism or organisms seen by a taxonomist as one unit. Due to the drought, dragonfly larvae may not have hatched this year because they wait for the conditions to be optimal for survival.
Dissolved Oxygen Chart: Site 3 (8.89 Beginning, 4.75 Middle, 0.07 End), Site 4 (5.97 Beginning, 10.98 Middle, 12.27 End), Site 5 (4.75 Beginning, 1.54 Middle, 12.08 End) Dissolved Oxygen (DO) is the amount of O2 or gaseous oxygen dissolved in the water. These levels could also be used to calculate the H2O molecule count per cubic inch of water. Healthy water should have DO concentrations above 6.5-8 mg/L.

Temperature Chart: Site 3 (17.3 C Beginning, 26.5 C Middle, 10.32 C End), Site 4 (21 C Beginning, 27.54 C Middle, 11.16 C End), Site 5 (26.85 C Beginning, 26.2 C Middle, 10.53 C End) There is more dissolved oxygen (DO) in cold water. When the water temperature is low, the dissolved oxygen concentration is high and when the water temperature is high, the dissolved-oxygen concentration is often lower. Water temperature plays an important part in the riparian system. The water temperature is a strong influence on biological activity. When the temperatures get too high or low of the preferred range, the number of the species decreases until they are all gone.

Salinity Chart: Site 3 (3.1 Beginning, 5.35 Middle, 3 End), Site 4 (2.4 Beginning, 8.42 Middle, 2.71 End), Site 5 (6.15 Beginning, 4.46 Middle, 6.72 End) Salinity is a measure of the amount of dissolved ions in the water. Typical freshwater systems have a salinity of 0.5 PPT% or less. As a point of reference, the ocean has an average salinity of 35 PPT% and the Dead Sea is 280 PPT%. McDonald Creek has a very high PPT%; this is affecting the integrity of the riparian system.

Conductivity Chart: Site 3 (4.916 Beginning, 9.827 Middle, 3.98 End), Site 4 (4.1 Beginning, 15.31 Middle, 3.63 End), Site 5 (11.5 Beginning, 8.12 Middle, 8.54 End) Conductivity measures the ability of water to carry an electrical current. Because salt can conduct an electrical current, conductivity rises when salinity rises which is what our measurements have shown. This is why the measurements are almost identical to each other. The increasing levels of conductivity result in increased levels of pH.

pH Chart: Site 3 (8.98 Beginning, 9.46 Middle, 5.75 End), Site 4 (8.25 Beginning, 9.3 Middle, 10.73 End), Site 5 (9.71 Beginning, 8.38 Middle, 7.85 End) The pH measurement shows how acidic or basic the levels of the creek water are. The pH affects which organisms can survive within the creek system. The optimum pH of a freshwater river would be 7.4. Fish can become stressed in water with a pH from 4.0-6.5 and 9.0-11.0. Our results show that there is no clear effect on the pH with the 2 styles of treatments.

Turbidity Chart: Site 3 (Beginning, 16.8 Middle, 6.34 End, 2.98) Site 4 (Beginning, 7.64 Middle, 5.11 End, 4.8), Site 5 (Beginning, 8.57 Middle, 4.42, End 1.99) Turbidity measures the relative clarity of a liquid. It is a characteristic of water. Turbidity measures the amount of light scattered by material in the water when light is shined through it. When there is more salt in the water, it will be clearer. We used an instrument called a turbidimeter to calculate the turbidity.

Percent kill rate: Control sites (Site 1 - 2 dead/156 alive, Site 6 - 4 dead/56 alive) Mechanical sites (Site 2 - 0 dead/0 alive, Site 3 - 0 dead/0 alive) Chemical sites (Site 4 - 72 dead/ 25 alive, Site 5 - 58 dead/39 alive)
Dead-Alive Ratio - KILL RATE: Control sites averaged - 2%, Mechanical sites averaged - 100%, Chemical sites averaged - 67%

Percent of Eradication by site: Site 1 - 1%, Site 2- 100%, Site 3 - 100%, Site 4 - 74%, Site 5 - 60%, Site 6 - 7%

Eradication Cost Comparison: Chemical Eradication- $3,000, Mechanical Eradication- $4,775

Time Frame In Hours: Mechanical Eradication- 33 Hours, Chemical Eradication- 4 Hours

Acres Eradicated: Mechanical Eradication- 8.4 Acres, Chemical Eradication- 17 Acres

Investigation 2: Salt Cedar And Termite Resistance

No termite damage was observed to the salt cedar log over the course of our experiment. Please see our “Termite Resistance to Salt Cedar Study” PDF in the mission folder uploads for more information.

Investigation 3: Repurposing Salt Cedar as Garden Mulch
Data:
The data shows that the control (just soil and plant) had 5 bean sprouts throughout 2 weeks. Salt cedar in a mulched state with soil and a bean plant produced 4 sprouts over the span of 2 weeks. Finally, red oak in a mulched state with soil and a bean plant produced 3 sprouts over a span of 2 weeks.

The results were:
5 sprouts in the control planter (soil only)
4 sprouts in salt cedar mulch planter
3 sprouts in red oak mulch planter

Salt cedar mulch had more sprouts than the red oak mulch, however, the control (just the soil) is better than both salt cedar and red oak.

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project

Data:
Starting weight of control:
Cup 1 - start 48 grams, end 48 grams
Cup 2 - start 49 grams, end 49 grams
Cup 3 - start 52 grams, end 52 grams

Absorption test:

Cup 1 - (23 g - 5 g SC) / 5 = 3.6 g
Cup 2 - (18 g - 5 g SC) / 5 = 2.6 g
Cup 3 - (20 g - 5 g SC) / 5 = 3.0 g
3.6 g + 2.6 g + 3.0 g = 9.2 g / 3 = 3.06 g of absorption per gram of salt cedar mulch.

Over the two weeks that this experiment was conducted, the team noticed that the salt cedar looked as if they were soaking up the oil, but it was very hard to tell if the oil was actually being absorbed. After a week, you could see the oil being absorbed slowly, but it was being absorbed by the salt cedar nonetheless. The very last day the experiment was conducted, we noticed the oil had not been completely absorbed, but a large portion of the oil had.

Investigation 5: Filtration

Data: Quantitative Data
Tap Water Only
Water Hardness Reading
7 gpg / 120 ppm

Tap Water Filtered by Salt Cedar & Coffee Filters
Water Hardness Reading
7 gpg / 120 ppm

Tap Water Filtered with
Coffee Filters
Water Hardness Reading
7 gpg / 120 ppm

Bottled Water Only
Water Hardness Reading
0 gpg / 0 ppm

(11) What are your potential sources of error? Remember, this doesn't mean "Did everything work?", all tests have potential sources of error, so make sure you understand what that means. Explain how these sources of error could have affected your results.

There are two types of sources of error that can occur in science investigations. Both are related to how reliable the measurements can be and it is important to analyze both types of error. The first type is called systematic error and this refers to the accuracy of data. It can be caused by instruments that are faulty, not maintained well, or miscalibrated. No matter how many times a test is repeated, systematic errors can not be eliminated. The second type of error is called random error. This is the kind of error that happens when there is uncertainty in measurements such as reading an instrument between two lines or performing counts of bacteria where there are many things to count and it affects the precision of the data. Random error can be reduced by repeating tests multiple times and taking an average of those readings. All experiments have systematic and random errors that should be identified to let others know how you minimized the errors that existed.

Our team experienced systematic errors when measuring the pH levels with the multiparameter. On January 29, the Cedar Busters took (END) water quality levels, and in each site, the pH would read -6.75 to -4.88. We knew this was a potential source of error. We had learned that when pH levels move away from the optimum range (6.5-9.0), it can stress riparian systems and reduce the survival rates of the fish.
Justus contacted Dr. Bart Durham about the inaccurate measurement. Dr. Durham explained that the faulty calibration of the pH probe had developed a short in it. He recommended that Justus, under parent supervision, could carefully twist the cord and kink it slightly just below the base where it goes in the meter. The next day, Justus returned to the creek and was able to get accurate readings.

Random errors could be involved when counting hundreds of salt cedar in the six sites. Sometimes our numbers fluctuated, but the team would always do experiments in triplicate. We feel like our investigation was more precise because multiple measurements were taken and then averaged.

Drawing Conclusions

(12) What conclusions can you draw based on the data you gathered during your experiment(s)? Be sure to include data and how it relates to the experiment(s) and the original question. Your conclusion should be related to your original problem and your experiment, include the data you collected, and discuss if your hypothesis was supported or refuted by your experiment.

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality

Conclusion:
Many different elements were evaluated over the course of this study. With a kill rate of 100%, mechanical grubbing worked best in terms of removal; however, the chemical eradication has more water flow. Overall, our hypothesis of mechanical grubbing proved correct as a more effective eradication method. When looking at the water quality in the 2 eradicated areas, these results were found:

Dissolved Oxygen (DO): Site 5 (chemical) has an average of 6.42 mg/L, and this measurement is best for growth and survival. The average of both chemical sites is 8.08 mg/L.

Conductivity: Overall, data is strongest in site 3 (mechanical), but the high spike in site 4 (chemical -midpoint measurement) was a result of extreme temperatures. There were 11 days in a row of triple-digit temperatures. This was an interesting measurement that we want to continue evaluating in the future.

Salinity: High salinity might be correlated to any kind of precipitation. Looking back on the times of measurements this is what was found: Beginning - 9 days before the measurements were taken, the area received 0.02" of rain. Middle - early to mid-July brought the heat. Highs reached the triple digits 11 days in a row. End - there was very little precipitation in January. 19 days before the measurements were taken, the creek had 0.1" of moisture. Salinity will be diluted if there is a large rainfall, but there was not. Sometimes there may be a hyper-saline event if there has only been a little bit of rainfall which would be caused by the salt on the shores being washed into the creek. This is a slight possibility. The clear winner is mechanical with an average of 3.81 PPT%; the chemical average was 5.105 PPT%.

pH: Nothing stands out as super consistent with this data. It appears that the chemical application may not have a negative effect on the creek. The mechanical average is 8.06 and chemical average is 9.02. The ranges are close, but mechanical is the winner. It does make us wonder how much the results would change if site 2 contained water over the study period. The water in site 2 is there, but it is underground.

Turbidity: The water collected during the study showed that the chemical sites had the optimum turbidity average of 5.45 NTU. The saltier the water means clearer water.

Percent kill rate: Our team went to each site and counted dead and alive trees within a 100-meter sampling area.

Control sites (1,6) Alive trees were present. Dead trees found were due to the life cycle. The thickets in site 6 were much larger than any other site.

Mechanical sites (2,3) Grubbing was very effective. 100% Kill Rate in the counting radius.

Chemical sites (4,5) The 67% kill rate is a success with the first application. There will be follow-up steps of spot spraying, crunching, and burning.

While looking for a consistent pattern that would show major differences with the 2 types of eradication treatments, the data is varied and many factors must be considered. The Cedar Busters, at this point of the study, would recommend the mechanical eradication method. Our hypothesis was supported by the data collected since April.

Investigation 2: Salt Cedar And Termite Resistance

Conclusion: Our hypothesis that termites would not feed on salt cedar because of its high salinity holds true so far. The termite station has been planted near a woodpile on the ground since the fall of 2020. Since that time, no termite damage has been observed on the log at site #1 or site #2. We did have a severe freeze unlike what is typical in our area from February 14 -18, 2021. This has the potential to impact our data if termites were dormant or died during that time.

Investigation 3: Repurposing Salt Cedar as Garden Mulch

Conclusion: In conclusion, our hypothesis was refuted because the control had more sprouts than the salt cedar mulch.

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project

Conclusion: The control had no change since oil cannot evaporate, but cup 1 would absorb 3.6 g of oil per gram of salt cedar. Cup 2 would absorb 2.6 g of oil per gram of salt cedar. Finally, cup 3 would absorb 3.0 g of oil per gram of salt cedar. Making the salt cedar 66% effective to absorb oil. Meaning that 1 pound of oil (3785 grams) would take 1,237 grams of salt cedar to absorb. Concluding that our hypothesis was correct because salt cedar did absorb oil like it was predicted.

Investigation 5: Filtration

Conclusion: Our results showed that the salt cedar filter was ineffective in filtering out the dissolved calcium and magnesium in the water.The bottled water measured out to 0 gpg on the water hardness scale, while all tap water samples regardless of whether salt cedar or coffee filters were used to filter out calcium and magnesium resulted in NO change. All samples measured at 7 gpg on the water hardness test strips which showed us that no calcium or magnesium was being filtered out by the salt cedar mulch. Our hypothesis was refuted.

Uploaded Files:

- [**View**] **Lab Report - Investigation 1: Cedar Busters in the Field: Eradication and Water Quality** (By: TheCuriousScientist, 03/04/2021, .pdf)
  A complete lab report including the plan, problem, hypothesis, variables, protocols, data tables, charts, graphs, analysis, photographs, results, and conclusions, is included here.
- [**View**] **Lab Report - Investigation 2: Salt Cedar and Termite Resistance** (By: TheCuriousScientist, 03/04/2021, .pdf)
  A complete lab report including the plan, problem, hypothesis, variables, protocols, data tables, charts, graphs, analysis, photographs, results, and conclusions, is included here.
- [**View**] **Lab Report - Investigation 3: Repurposing Salt Cedar as Garden Mulch** (By: TheCuriousScientist, 03/04/2021, .pdf)
  A complete lab report including the plan, problem, hypothesis, variables, protocols, data tables, charts, graphs, analysis, photographs, results, and conclusions, is included here.
- [**View**] **Lab Report - Investigation 4: Oil Absorption** (By: TheCuriousScientist, 03/04/2021, .pdf)
  A complete lab report including the plan, problem, hypothesis, variables, protocols, data tables, charts, graphs, analysis, photographs, results, and conclusions, is included here.
- [**View**] **Lab Report - Investigation 5: Salt Cedar as a Water Filtration Material** (By: TheCuriousScientist, 03/04/2021, .pdf)
  A complete lab report including the plan, problem, hypothesis, variables, protocols, data tables, charts, graphs, analysis, photographs, results, and conclusions, is included here.
- [**View**] **Data Tables, Graphs, Charts - Investigation 1** (By: TheCuriousScientist, 03/04/2021, .pdf)
  These are the data tables, graphs, and charts from investigation 1. Please also see the Lab Report Google Slides presentation (pdf) Investigation 1 for many details.
- [**View**] **Data Tables, Graphs, Charts - Investigation 3** (By: TheCuriousScientist, 03/04/2021, .pdf)
  These are the data tables, graphs, and charts from investigation 3. Please also see the Lab Report Google Slides presentation (pdf) Investigation 3 for many details.
- [**View**] **Data Tables, Graphs, Charts - Investigation 4** (By: TheCuriousScientist, 03/04/2021, .pdf)
  These are the data tables, graphs, and charts from investigation 4. Please also see the Lab Report Google Slides presentation (pdf) Investigation 4 for many details.
- [**View**] **Data Tables, Graphs, Charts - Investigation 5** (By: TheCuriousScientist, 03/04/2021, .pdf)
  These are the data tables, graphs, and charts from investigation 5. Please also see the Lab Report Google Slides presentation (pdf) Investigation 5 for many details.
- [**View**] **Ranch Field Work Report - Index of Biotic Integrity (IBI)** (By: TheCuriousScientist, 03/04/2021, .pdf)
  Following mechanical and chemical removal of salt cedar along the banks of McDonald Creek, an Index of Biotic Integrity (IBI) was conducted to determine the impact of eradication on the fauna. This report was written following the July 2020 field day at the ranch site. This includes photographs of the team working, some of the species we saw and collected that day, and details of the work on the IBI.

- [View] **Ranch Field Work Report II - Final Measurements of Salt Cedar Growth and Final Measurements** (By: TheCuriousScientist, 03/04/2021, .pdf)

  Final measurements were taken of salt cedar growth along McDonald Creek in January 2021, six months after collecting initial data. This report shows the findings of this field day at the ranch.

- [View] **Works Cited** (By: TheCuriousScientist, 03/04/2021, .pdf)

  Works Cited

- [View] **Interviews with Experts in the Community** (By: TheCuriousScientist, 03/04/2021, .pdf)

  A slide show was put together to show the experts in the community who we interviewed this year and what their contribution was to our background knowledge. We are grateful to these mentors!

- [View] **Ranch Field Work - April 2020** (By: TheCuriousScientist, 03/04/2021, .pdf)

  To begin the project, baseline measurements were needed to see where we were on water quality and properties. This report tells about the first trip out to the ranch for field work.

- [View] **Report over Termite Experiment Results** (By: TheCuriousScientist, 03/04/2021, .pdf)

  An investigation with termites began November 21 and final results were determined February 20. This is the report full of photographs and information about how salt cedar could be repurposed after studying the impact termites might have on this wood.

- [View] **Research Summaries** (By: TheCuriousScientist, 03/04/2021, .pdf)

  Our science teacher and English teacher teamed up this year to do research papers on the topic chosen by students for eCYBERMISSION. During English class, we each researched a subtopic and these are the summaries that were written from each source in our Works Cited document.

- [View] **Background Information** (By: TheCuriousScientist, 03/04/2021, .pdf)

  The issue of salt cedar on the ranch dates back several years. This tells the "before-the-cedar-busters" story and shows where our journey begins.

- [View] **Video - Cedar Busters Working on the Ranch** (By: TheCuriousScientist, 03/04/2021, .pdf)

  A video of several clips of the team working on the ranch. https://youtu.be/gPEllYixUZw

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Community Benefit

(1) Explain how investigating the problem your team chose will help the community. Be sure to include the impacts your research will have on individuals, businesses, organizations, and the environment in your community (if any). Make it very clear why solving this problem would help your community.

Salt cedars create many problems for riparian systems. Salt cedar can absorb 200 gallons of water per day from rivers, streams, and other water sources. Salt cedar can block native plants from receiving the water and nutrients they need. The leaves and stems of salt cedars release a high concentration of salt into the ground. Wildlife is also affected by salt cedar due to the lack of protein in the plant. There is an increased displacement of sediments in salt cedar-infested streams, which causes blockages. These deposits encourage clumps of salt cedar growth.

Our research and investigations focused on extracting salt cedar, minimizing its impact, and creating a sustainable McDonald Creek ecosystem. The location of the Three Gringos Ranch is in the northeastern portion of Garza County, approximately fifteen miles northeast of Post, Texas. This ranch has water features that are unique to the area. McDonald Creek has live water year-round and runs through this ranch's center, entering the northeast side and exiting the south-central side. McDonald Creek feeds into the Salt Fork of the Brazos River. This is one of three forks that make up the main stem of the Brazos. The Salt Fork travels about 175 miles from its beginning in Crosby County in West Texas, passing through Garza. This is where the study is located.

The full name of the river is Los Brazos de Dios, translated “The Arms of God.” It is the longest river that runs entirely within the state and has been dammed to form flood control, city use for drinking water, and for recreational use. This is an important river throughout its length and has been used near settlements for close to 600 years, as Tokonohono Caddo natives used the river for food, water, and transportation.

The ecosystem along the Brazos River is heavily affected by salt cedar stands. Salt cedar harms the water and overpowers the native vegetation, wildlife, and macroinvertebrates in the riparian system. There are five species of vertebrates that are endangered species. Two of those, one salamander and one toad, are indicator species that allow the overall quality of the Brazos to be measured, effectively gauging the health of the entire ecosystem. The river is vital to the region. The time has come to get rid of this invasive species.

In 2019, the salt cedar thickets were eradicated on McDonald Creek. Our project will evaluate the methods of eradication used in this location. The two eradication types used were chemical and mechanical. Mechanical eradication uses an excavator to dig down below the root crown and rip the salt cedar out onto the ground. Chemical eradication involves spraying salt cedar from a helicopter with a certain type of chemical. The chemical mix includes 1% imazapyr and .5% non-ionic surfactant. Government-funded helicopters sprayed ten gallons of this mixture per acre onto the property.

Salt cedar is mechanically grubbed quite often, and it is just placed on the side of the riverbank. Our team examined each eradication method to determine which style was the most effective. We hope to educate other landowners on which method to use to rid this exotic weed taking over the land and water.

When our team visited the ranch after eradication, we noticed mounds of dead salt cedar. We are trying to find alternate uses for the unused salt cedar mounds. By doing this, we can help the community by finding uses for the wasted wood. Our team has four repurposing ideas:

- We want salt cedar to be used as garden mulch.
- We tested to see if salt cedar is a termite-resistant wood. This feature would be key for doing quality wood projects.
- We tested to see if salt cedar bark can help filter out calcium and magnesium from tap water.
- We used salt cedar sawdust to absorb moisture from oil spills.

If these repurposing ideas spread to other communities as well, these wasted dead branches would be useful and not wasted. The more alternate uses there are for people to use salt cedar, the more people would want to eradicate this invasive species.

IMPACTS MADE ON TEAM MEMBERS
- Awareness of negative impacts of invasive species
- Appreciation of natural resources
- Knowledge of the Brazos River watershed
- Ability to have an impact on our community and others
- Awareness of the damage termites pose to homeowners
- Equipped with mitigation strategies to help deter the attraction of termites as future homeowners

IMPACTS MADE ON INDIVIDUALS OF THE COMMUNITY

- Helped community with awareness of methods to remove salt cedar
- Identified the most effective eradication method for salt cedar
- Ecotourism on privately owned land was increased, bringing financial gain to area families
- Informational video and brochures give us the ability to educate community families
- Website and YouTube channel helps us further the spread of information about the invasiveness of salt cedar & effects on water supply, native vegetation, wildlife, as well as educate others on potential uses of the eradicated trees.
- Opened the door for termite-resistant salt cedar as a potential use for mulch along pathways or for using to absorb oil spills.
- Homeowners will be less susceptible to termite damage if they use termite-resistant materials near their home
- We even sparked Terminix's interest in knowing if salt cedar would be termite resistant!

IMPACTS MADE ON BUSINESSES
- Sustainable creeks lead to opportunities for recreation, impacting local businesses such as bait shops, concession stands, and camping facilities throughout the region
- Wildlife photography opportunities increased
- Opportunities created for landscaping businesses & nurseries to use salt cedar as mulch in ground cover and in pathways moving forward
- Expand job opportunities for salt cedar eradication and repurposing in building materials
- Salt cedar eradication helps ranchers to sustain adequate & quality water supply for livestock
- Provide lumber companies with an alternative, termite resistant building material
- National pesticide control company Terminix would be interested in the results

IMPACTS MADE ON ORGANIZATIONS

- First Friday Art Trail benefits from wildlife photography displays of McDonald Creek
- U.S. Fish and Wildlife Service benefits from studying the data we have gathered in concluding the most beneficial treatment method of salt cedar eradication U.S. Fish and Wildlife Services is dedicated to funding and overseeing the eradication of salt cedar in their effort to increase water flow to and in the Brazos River
- Texas Parks and Wildlife benefits by seeing an increase in the variety and quantity of the wildlife and native grasses in the region
- Brazos River Authority benefits from the increased flow of water from the McDonald Creek into the Brazos River
- Area 5th graders learned first hand about the local impact on invasive species and endangered species, both of which are Next Generation Science Standards, Interdependent Relationships among Ecosystems
- Area high school students learned of personal impacts to land for state education standards in environmental sciences - Texas Essential Knowledge and Skills TEKS 112.37 A-L

IMPACTS MADE ON THE ENVIRONMENT

- pH moved into an acceptable range in McDonald Creek
- Salinity was decreased throughout McDonald Creek where salt cedar was removed
- Macroinvertebrates which are the base of the food web increased due to the increased quality and quantity of the water supply
- Brazos River endangered salamander, Houston Toad, and Shiners benefited from increased water flow from the Salt Fork tributary into the Brazos
- Native grasses such as blue grama, sideoats grama, buffalo grass, big bluestem can grow and thrive because they no longer have to compete with salt cedar.
- Greater erosion control through the root systems of native grasses along the banks of McDonald Creek
- Food sources increased due to native wildflower seed production in the Brazos watershed area
- Aquatic wildlife now have opportunities to sustain, multiply and thrive with an adequate and quality water supply

Cedar Busters has made a community impact by identifying the most effective eradication method of salt cedar used along McDonald Creek. Salt cedar eradication allows for other native vegetation to grow and thrive along the McDonald Creek which feeds into the Brazos River. The eradication has opened the door for a variety of wildlife to flourish. This is hard to achieve when an invasive species such as salt cedar takes root and chokes out other vegetation. The endangered species in the vital Brazos River system will be better protected with the water flow increase from McDonald Creek.

We also researched and formulated potential uses of eradicated salt cedar. This benefits businesses by providing termite-resistant wood that can be mulched and used in landscaping and building materials. This will have a positive impact on current and potential home and business owners by helping them protect one of their most valuable assets.

Cedar Busters would like to leave you with a final thought from John Paul II. "The earth will not continue to offer its harvest, except with faithful stewardship. We cannot say we love the land and then take steps to destroy it for use by future generations." It is OUR generation that is now responsible for the protection of the environment. As citizen scientists, we will continue to find ways to make a difference and encourage others to do the same.

Uploaded Files:

- [**View**] **Community Contacts and References** (By: JHurst, 02/22/2021, .pdf)

Collaboration within our community and others was very important to the success of this project. Many people played a vital role in mentoring us during the year. Some of the most important contacts are listed here, along with their contributions to the team. We are grateful for their continued support.

- [View] **Ongoing Testing throughout the Year** (By: JHurst, 02/22/2021, .pdf)

  A ranch day meeting and workday was organized for mentors and our team. Much data was collected as we continue to add to the body of knowledge about salt cedar and its impact on water systems. These are some of the notes from a beautiful January day!

- [View] **Website Link, QR Code, YouTube Channel, Video Overview of the Cedar Busters** (By: TheCuriousScientist, 03/04/2021, .pdf)

  Cedar Busters created a website to teach others about the issues surrounding the invasive species salt cedar or tamarisk. It looks at the impacts on the water, environment, and endangered species in this community and so many others across the country. Included are community outreach events, videos, photos, research, experiments, and how to empower citizen scientists like ourselves to eradicate salt cedar. A QR code to this site is also available and is used for community outreach. The Cedar Busters YouTube Channel link is included, along with the video overview of our team's work this year.

- [View] **Informational Brochure** (By: TheCuriousScientist, 03/04/2021, .pdf)

  An informational brochure was put together by the team and used for community outreach.

- [View] **Making Mulch from Salt Cedar** (By: TheCuriousScientist, 03/04/2021, .pdf)

  When salt cedar is mechanically removed from riparian areas, there are HUGE piles of branches left on the property. Could these be repurposed into something useful? This was one of our biggest concerns! This report explains how mulch was made from salt cedar - taking trash and turning it into treasure!

Mission Verification

We have reviewed the eCYBERMISSION Rules and Guidelines

Yes

We have worked with our Team Advisor and we have discussed the possible risks involved in the project and completed the Risk Assessment Form (and attached it to our Mission Folder).

Yes

The project involves hazardous chemicals, activities, or devices.

No

The project involves potentially hazardous biological agents (If yes, complete this form and attach to your Mission Folder).

No

We acknowledge that we followed proper safety precautions during the work on our project.

Yes

The project involves testing one or more of the following and requires prior approval by an Institutional Review Board (IRB):

Humans

No

Non-Human Vertebrates

No

You will need to include an abstract of 250 words or less. As part of the abstract you will need to describe your project and explain how you used STEM (Science, Technology, Engineering and Mathematics) to improve your community

Salt cedar is an invasive species causing adverse effects on the North American environment. Salt cedar stops native vegetation and can absorb 200 gallons of water per day, harming the riparian system. Working with the U.S. Fish and Wildlife Service, its recommendation was to eradicate salt cedar along the waterways, but it is very difficult to remove. We conducted five different investigations to compare chemical and mechanical eradication methods on a ranch.

An Index of Biotic Integrity (IBI) was conducted after salt cedar had been chemically and mechanically grubbed from McDonald Creek. The salinity, conductivity, turbidity, pH, water temperature, and dissolved oxygen levels were measured. Mechanical eradication of salt cedar was more effective in keeping stream water healthy, using these six indicators. McDonald Creek water flow increased after eradication which means hope for endangered species in the Brazos River downstream.

Repurposing downed salt cedar was our next goal. It was tested in termite traps to see if its high salinity would deter pests. Our hypothesis was supported when no damage to the wood was detected after months of exposure to known colonies. The use of this wood in building materials seems promising, and in tests using salt cedar as mulch, plants thrived.

John Paul II said, “The earth will not continue to offer its harvest, except with faithful stewardship. We cannot say we love the land and then take steps to destroy it for use by future generations.” It is OUR generation that is now responsible for the protection of the environment. As citizen scientists, we will continue to find ways to make a difference and encourage others to do the same.

Uploaded Files:

- [View] **Safety Contract** (By: JHurst, 02/20/2021, .PDF)

  This Flinn Safety Contract was used to keep us safe by providing guidelines when we work in the high school Biosafety Lab BSL-1 facility. It keeps us on our toes and being safe for all experimental procedures.

- [View] **Biosafety Lab Level 1 Safety Agreement** (By: JHurst, 02/22/2021, .pdf)

  The work we did at school was in a BSL-1 facility. The safety agreement is attached.

- [View] **Risk Assessment** (By: TheCuriousScientist, 03/04/2021, .pdf)

A risk assessment was completed with our team advisor to identify and minimize the safety risks and hazards involved with this project.

Administered by nsta National Science Teaching Association

Cedar Busters Team Contract

Team name: Cedar Busters Team members: Tori, Justus, Jett and Sawyer

Our team aims to find uses for dead salt cedar. Why? Because salt cedar is an invasive plant that hurts the environment and the plants around it. So, it (salt cedar) is killed and wasted, so we decided to try to find some uses for the wasted material.

What we expect from each other:

1. We will communicate with each other frequently about the project.
2. We will help each other out.
3. We will not argue or disrespect each other.
4. We will share information about our experiments and results with our team.
5. We will not go off task when conducting an experiment.
6. We will work hard and be responsible.

We will remember to communicate frequently about the project and we will do our best to help each other out. We will not argue or disrespect each other, we will share information and results with our team. We will make sure to never go off task and always work hard and responsible.

Signatures:

Sawyer Means

Sawyer means

Tori Hay

Tori Hay

Jett Hurst

Jett Hurst

Justus Jacobus

Justus Jacobus

First aid for snake bites can prevent disability, disfigurement or death if it is applied effectively and efficiently.

Recommendations have changed drastically over the years, and staying informed on effective first aid should be a priority of everyone working in snake habitat. A good first-aid course from a qualified instructor should be sought.

- Assume envenomation has occurred even before symptoms appear.
- Identify the species of venomous snake with care. This could help with the medical treatment but will complicate the situation if there is more than one victim. If you cannot identify the snake, don't pursue it.
- Keep the victim as calm as possible. Keep yourself calm as well.
- Know and treat for any symptoms of shock – elevate feet, loosen clothing, etc. Wash the bite area with disinfectant soap.
- Remove constricting clothing or jewelry in the bite area. Prevent movement of the bitten extremity. Splint it, if necessary.
- Seek medical attention as soon as possible.

UNDER NO CIRCUMSTANCES should you cut between the punctures, suck the venom out or apply electric shock!

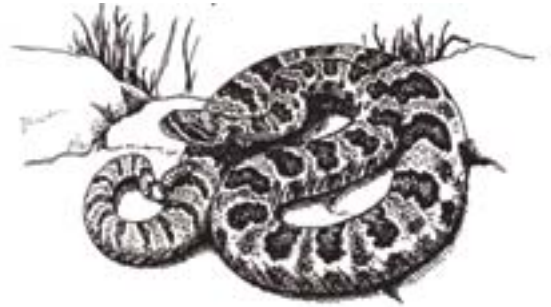
For more information

Excellent, current information on Texas snakes and particularly the venomous snakes, can be found in a number of books. Some suggested reading includes:

Price, Andrew H. (1998) *Poisonous Snakes of Texas.* Texas Parks and Wildlife Press, Austin.

Tennant, Alan. (1998) *A Field Guide to Texas Snakes.* Second Edition. Gulf Publishing Company, Houston.

Werler, Jon E. and James R. Dixon. (2000) *Texas Snakes: Identification, Distribution, and Natural History.* University of Texas Press, Austin.



TEXAS PARKS & WILDLIFE

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TEXAS PARKS AND WILDLIFE

Texas Venomous Snakes

SAFETY FIRST!

Safety and first-aid information about venomous snakes found in Texas

The state of Texas is home

to 15 potentially dangerous venomous snake species or subspecies.

Despite this, each year there have been more deaths in Texas attributed to lightning than to venomous snakebites. This is due, in part, to the public's increasing awareness of snakes around us, improved first-aid and medical practices, and excellent educational and outreach efforts by herpetologists and snake enthusiasts across the state. More information on each of these species can be found in many excellent books, including Andy Price's *Poisonous Snakes of Texas.*

This brochure provides simple and timely safety and first-aid information about the venomous snakes found in Texas. It is important to remember that not every snake is venomous, and while the very mention of the word often sends chills up the spines of many humans, snakes do have an important role in our Texas ecosystem. Their contribution can hardly be overstated. Equally important is an understanding that envenomation is a defensive mechanism for the snake, as they do not sit in the grass waiting for the unfortunate human to come by. Nor do they pursue or hunt humans. Bites are almost always a result of the snake being surprised or cornered, or being handled.

Safety around the home

As our population continues to grow and people continue to move into "pristine" and "untouched" areas, encounters with venomous snakes are going to occur. Many of these encounters happen around the home, with the result that incidents of bites close to home are statistically high.

Snakes in general are found around a home for the specific purpose of seeking food and shelter. Keeping these things in mind provides us with guidelines to help prevent snakebites:

- Keep wood piles, brush piles, trash dumps and livestock pens as far as possible from the residence. Exercise caution when working in these areas. Never put an arm or leg into something if you cannot see the bottom.
- Keep storage areas and livestock sheds/barns as neat as possible. Treat tools and materials stored on the floor as possible snake shelters.
- Treat overturned boats, tarps and similar objects as potential shelter for transient snakes moving through the area.
- Remember that snakes are adept at finding their way through small openings. Keep this in mind when entering crawl spaces, garages, basements and similar areas.

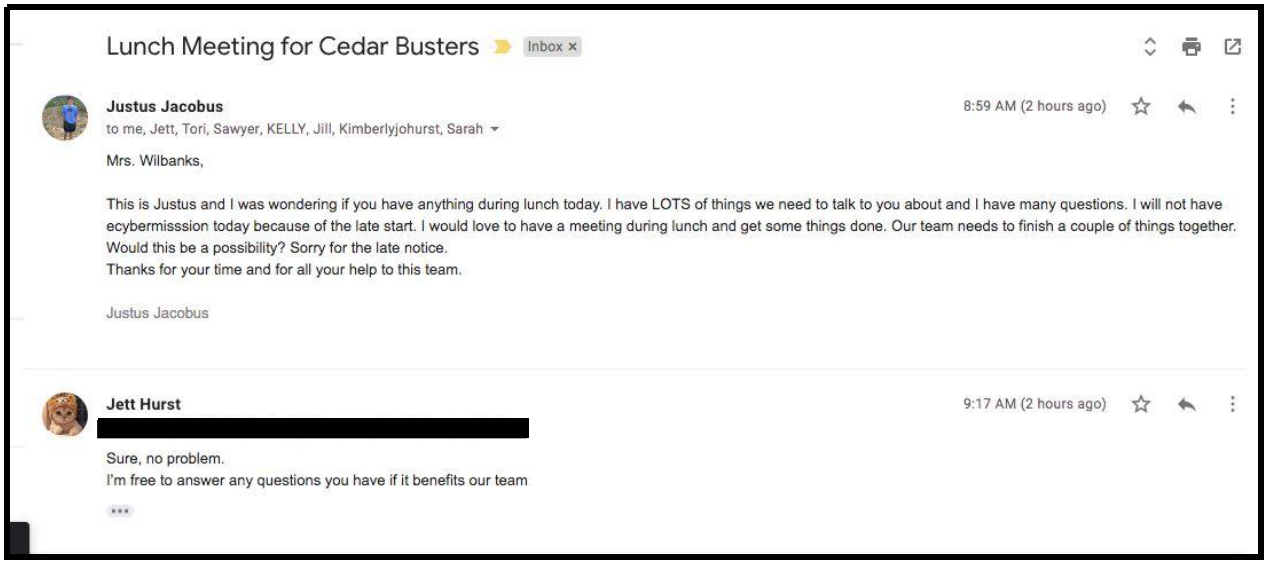
Safety in the field

Since venomous snakes are more common in the rural areas of Texas, it is important for ranchers, hunters, rural residents, outdoor enthusiasts, and others who frequent these areas to exercise caution.

- Be careful where you put your hands and feet. Don't reach or step until you see the bottom.
- Never step over a log without first seeing what is on the other side. If you must move a log, use a long stick or garden tool first, to ensure snakes are neither on, under or around these favored places.
- Use a flashlight when moving about, even in your yard at night.
- Animal burrows make excellent habitat for snakes. Don't reach in without checking first.
- Wear protective clothing if working in areas where you suspect snakes are nearby. Heavy footwear, snakeproof trousers and/or leggings will help reduce your risk.
- Freeze when snakes are known to be nearby until you know where they are. Allow the snake to retreat. If you must move, back slowly and carefully away from the snake.

Team Collaboration - Communication with Team Advisor and Mentors

Lunch Meetings - Our team scheduled lunch meetings with our mentor and our team advisor to stay on track. We knew it was our responsibility to do that and we used email and texts to communicate. This gave us extra time outside of class time that was dedicated to projects.



Lunch Meeting for Cedar Busters Inbox ×

Justus Jacobus 8:59 AM (2 hours ago)
to me, Jett, Tori, Sawyer, KELLY, Jill, Kimberlyjohurst, Sarah

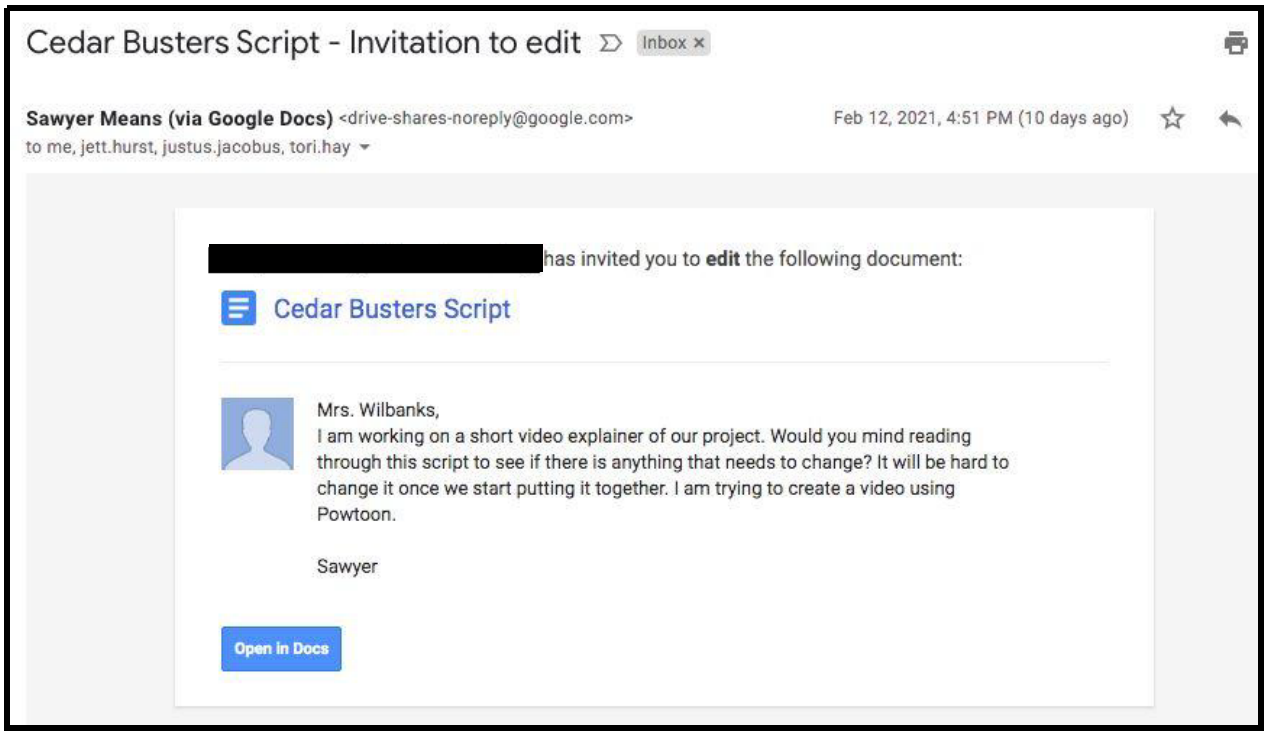
Mrs. Wilbanks,

This is Justus and I was wondering if you have anything during lunch today. I have LOTS of things we need to talk to you about and I have many questions. I will not have ecybermisssion today because of the late start. I would love to have a meeting during lunch and get some things done. Our team needs to finish a couple of things together. Would this be a possibility? Sorry for the late notice.
Thanks for your time and for all your help to this team.

Justus Jacobus

Jett Hurst [redacted] 9:17 AM (2 hours ago)

Sure, no problem.
I'm free to answer any questions you have if it benefits our team



Cedar Busters Script - Invitation to edit Inbox ×

Sawyer Means (via Google Docs) <drive-shares-noreply@google.com> Feb 12, 2021, 4:51 PM (10 days ago)
to me, jett.hurst, justus.jacobus, tori.hay

[redacted] has invited you to **edit** the following document:

Cedar Busters Script

Mrs. Wilbanks,
I am working on a short video explainer of our project. Would you mind reading through this script to see if there is anything that needs to change? It will be hard to change it once we start putting it together. I am trying to create a video using Powtoon.

Sawyer

Open in Docs

Contact List

Many people played a vital role in mentoring us during this project.
Some of our most important contacts are listed here.
We are grateful for their continued support.

Community Partners	Duration of Mentorship	Major Contribution to the Cedar Busters
Dr. Bart Durham **Associate Professor of Natural Resources, Ecology and Conservation** Lubbock Christian University Lubbock, TX 806.720.7709	April 2020 - ongoing	Taught us how to identify macroinvertebrates in creek water and use those to determine water quality and effects of salt cedar; allowed his graduate students to assist us in conducting the IBI.
Mr. Duane Lucia **Wildlife Biologist** U.S. Fish & Wildlife Service Lubbock, TX 806.445.6477	April 2020 - ongoing	Taught us to survey salt cedar along McDonald Creek; grant support in mechanical and chemical removal methods of salt cedar.
Mr. William Marshall **Pest Control Agent** Terminix Lubbock, TX 806.787.7881	November 2020 - February 2021	Taught us how to identify species of termites; showed us damage to wood and how to trap termites; donated traps to our team for use near salt cedar.
Joe Marts **Construction** LLC Post, TX 806.789.0221	April 2020 - ongoing	Taught us about grubbing the salt cedar thickets - mechanical removal methods of salt cedar.

Cedar Busters Overview Video Script

1. Welcome to our ecybermission project! We are Cedar Busters!

2. We've learned so much about salt cedar over the past months and we can't wait to share with you some of the things we have discovered!

3. Our team is top notch! Justus Jacobus is our avid outdoorsman who helps us get things done right, Jett Hurst is our deep thinking analytic! Tori Hay may be the only girl on the team, but we couldn't make it without her! She's our team leader, organizer and creative force! Then there's Sawyer Means, the detailed researcher. Hey!…..that's me!

4. We formed Cedar Busters to study the effectiveness of saltcedar eradication at the Three Gringos Ranch.

5. If you don't know, saltcedar, also called tamarisk, is an invasive plant species that can be found in riparian areas of the Southwestern United States. It has taken root in the US since first being introduced in the early 1800s. Saltcedar is considered invasive because it spreads like wildfire and consumes up to 200 gallons of water PER DAY! That certainly amounts to a community problem!

6. Over the past few years, the Three Gringos Ranch has made an effort to eliminate salt cedar along the McDonald Creek bed. They have used two different methods to eradicate the tree, mechanically grubbing the trees from 2 separate sites, chemically spraying to eradicate the trees in another two sites, and there were 2 sites we were able to access on neighboring properties that were untreated. This helped us determine how effective the eradication was.

7. Cedar Busters was invited in to analyze the effectiveness of the eradication methods and study the water quality at the sites.

8. During our time on the ranch we noticed piles and piles of dead saltcedar that had been mechanically grubbed out and we wondered if there was a way it could be useful to the community?

9. We have been on a mission to find out! Here's what we've been researching!

10. Can salt cedar be mulched and used as ground cover?

11. Because salt cedar excretes a high amount of sodium through its leaves we had to investigate the impact this might have in other ways, like: would salt cedar mulch allow other vegetation to grow?

12. We also looked at whether saltcedar mulch would be resistant to termites because of its high salt content. We figured this would be important to know IF it was used as a ground cover or in building materials!

13. We also researched whether salt cedar could be used to absorb oil spills.

14. We can’t wait for you to dive into all we have found out!

15. We hope you will visit our website and our YouTube channel to learn more about our project!

SCS Cedar Busters - Project Information

This is a hyperlink to our video overview of Cedar Busters. It is a must see!

This video overview of the team and our goals this year can also be found at this URL:

https://youtu.be/-EJS-vHbbDs

Cedar Busters

9 subscribers

HOME VIDEOS PLAYLISTS CHANNELS

Uploads ▶ PLAY ALL

SCS Cedar Busters - Project Information

8 views • 1 hour ago

Ranch Field Work

25 views • 3 weeks ago

Cedar Busters Project Timeline

Date	Work Completed	Team Member
April 2, 2020	Science Class - learn about Ecybermission and select team members for 6th grade	Sawyer Means, Justus Jacobus, Jett Hurst
April 8, 2020	Contacted Sawyer Means and Jett Hurst about forming a team	Justus Jacobus
April 10, 2020	Contacted Duane Lucia and Dr. Bart Durham and project plans, and ask if they would be mentors to our 6th grade group.	Justus Jacobus
April 18, 2020	Took photos of creek, saltcedar eradication, determined six sites for IBI study, Initial Water Samples were taken	Justus Jacobus
July 17, 2020	Collected IBIs at the 3 Gringo Ranch. Collected organisms from water samples for lab review, used the multiparameter to measure the creek water	Justus Jacobus, Jett Hurst, Sawyer Means
July 18, 2020	IBI water samples taken to Lubbock Christian University for analysis	Justus Jacobus
July 21, 2020	Create Excel spreadsheet with IBI data from July 17th	Sawyer Means
July 28, 2020	Create a Google Photos shared album for eCYBERMISSION project photos & add photos	Justus Jacobus
August 16, 2020	Add Tori Hay to the team - she is interested in environmental issues and saltcedar is on her property as well	Justus Jacobus, Jett Hurst, Sawyer Means
August 22, 2020	Evaluated the creek for an additional IBI - little to no water in 4 sites due to drought/ took photos/video	Justus Jacobus
August 25, 2020	eCYBERMISSION parent, team advisor meeting	Cedar Buster moms
September 2, 2020	Team collaboration - work on strengths, roles, responsibilities for the year	Sawyer Means, Tori Hay, Justus Jacobus, Jett Hurst
September 5, 2020	Add photos from July IBI collection & create project timeline	Sawyer Means
September 16, 2020	Develop Action Plan and brainstorm alternative uses for saltcedar after eradication	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
September 20, 2020	Google Slides was created to show protocol of IBI	Justus Jacobus
Sept 21 - Oct 15, 2020	Research different subsets of information for the project - English class daily for 4 weeks	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
September 23, 2020	Create graphic organizer showing the overall project design and goals for the action plan	Jett Hurst, Tori Hay
September 30, 2020	Identify more in depth research needs, select areas to learn more about, develop outlines	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
October 1, 2020	Use Easybib.com to create a bibliography from research sources we used so far	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
October 7, 2020	Design experimentation - one major lab for every team member - begin lab reports for all 4	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
October 14, 2020	Watch TED Talks on eradication of saltcedar - chemical and mechanical methods	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
October 21, 2020	Identify endangered species being affected by saltcedar in the Brazos River	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus

Cedar Busters Project Timeline

Date	Work Completed	Team Member
October 28, 2020	Contact experts in the field of insect management and meet with environmental scientists via email	Justus Jacobus, Sawyer Means, Jett Hurst
November 4, 2020	Community Benefit - work on Mission folder question concerning who will benefit this year	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
November 7, 2020	Conduct initial saltcedar filtration experiment using saltcedar wood chippings and Dr. Bronners soap (this experiment was later repeated using water hardness test strips).	Sawyer Means
November 11, 2020	Brainstorm innovative ways of using cut saltcedar to avoid waste of a potential resource	Jett Hurst
November 18, 2020	Work on interview questions and a plan for using saltcedar for construction	Sawyer Means, Tori Hay and Jett Hurst
November 21, 2020	Cedar Busters meet with Mr. William Marshall with Terminix to learn to identify termites, the damage they cause and learn more about their behavior.	Sawyer Means, Tori Hay and Jett Hurst
November 26, 2020	Termite station with a saltcedar log is planted near a woodpile to begin testing of termite resistance	Jett Hurst
December 2, 2020	Write up notes from meetings with experts and add photos of interviews to Google Slides	Sawyer Means, Jett Hurst
December 6, 2020	Gathered saltcedar at the ranch and wood chipped it to begin the process of making mulch	Justus Jacobus
December 9, 2020	Examined salt cedar wood chips/began experiment in the Southcrest lab.	Justus Jacobus, Jett Hurst, Sawyer Means, Tori Hay
December 16, 2020	Collect data from wood chips experimentation in the high school science lab	Justus Jacobus, Jett Hurst
January 6, 2021	Team meeting to organize for the last 8 weeks of research - assign reports and notes to all members	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
January 7, 2021	Begin to answer Mission Folder questions - Scientific Inquiry	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
January 13, 2021	Use time in computer science class to format lab reports and notes for judges	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
January 16, 2021	Cedar Busters meet to check for termite damage on saltcedar log inside of the termite station and discuss next steps for project	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
January 17, 2021	Cut down red oak branch and wood - chipped it to be used as a variable	Justus Jacobus
January 20, 2021	Website development, QR code development for community outreach	Tori Hay
January 24, 2021	Create charts from IBI and multiparameter data, expand on project timeline, work on termite presentation	Sawyer Means
January 25, 2021	Termite station is removed from site 1 for replanting near known active termites	Jett Hurst, Sawyer Means
January 27, 2021	Began information brochure for community outreach	Tori Hay
January 27, 2021	Begin edits of Mission Folder answers - compare to rubric on ecyber website	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
January 29, 2021	Team met at ranch to count saltcedar in all 6 locations, took readings of the creek with the multiparameter	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus

Cedar Busters Project Timeline

Date	Work Completed	Team Member
January 30, 2021	Cedar Busters met Mr. William Marshall to replant the termite station at site 2. Team worked on graphing results from multiparameter readings.	Justus Jacobus, Sawyer Means
January 31, 2021	Using multiparameter, double checked pH levels in 3 locations that had water, work on termite report, work on interview presentation, started oil and using salt cedar as garden mulch experiment	Justus Jacobus, Sawyer Means, Jett Hurst
January 31, 2021	Created YouTube channel with research and team videos.	Tori Hay
February 3, 2021	Finalize formatting in Google Slides and Google Docs files - draw conclusions	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
February 6, 2021	Repeat saltcedar filtration experiment, this time using coffee filters and water hardness test strips	Sawyer Means
February 6, 2021	Met with Dr. Bart Durham and asked questions about IBI results, water results, and saltcedar count	Justus Jacobus
February 7, 2021	Completion of community outreach information brochure.	Tori Hay
February 10, 2021	Upload files that are complete - lab reports, team collaboration support files, comm. files	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
February 11, 2021	Met with Mr. Duane Lucia and interviewed him on the results of the study and future plans.	Justus Jacobus
February 12, 2021	Worked on Cedar Buster project overview script for video	Sawyer Means
February 13, 2021	Worked on Cedar Buster project overview video. Checked termite station for damage to saltcedar log, finished oil absorption and garden mulch experiment	Sawyer Means
February 16, 2021	Tweak and finish Cedar Buster video	Sawyer Means
February 17, 2021	Add additional data from termite experimentation to mission folder document and analyze as a team	Jett Hurst, Sawyer Means
February 19, 2021	Add final photos to bean experiment and analyze results	Jett Hurst
February 20, 2021	Collect final water sample from the Three Gringos Ranch	Justus Jacobus
February 20, 2021	Checked termite station for damage to saltcedar log. Working on filter experiment PowerPoint, Working on updating termite report and termite PowerPoint	Sawyer Means
February 21, 2021	Team met together as a group to discuss mission folder questions and discuss any last minute items that needed to be taken care of before submission.	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
February 23, 2021	Met with Dr. Bart Durham to test turbidity from water samples	Justus Jacobus, Sawyer Means
February 24, 2021	Final edits of mission folder answers - spelling and grammar check	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus
March 1, 2021	Make final Cedar Busters website edits and publish	Tori Hay
March 3, 2021	Ask Team Advisor to submit Mission Folder - write thank you notes to Mission Control	Jett Hurst, Sawyer Means, Tori Hay, Justus Jacobus

Cedar

BUSTERS

Project Plan

Salt Cedar Eradication: Mechanical vs.Chemical

Water Quality Testing

Temperature pH
Conductivity
Dissolved Oxygen
Salinity Turbidity

Index of Biotic Integrity Testing

Number of Organisms
Number of Taxa
Macroinvertebrates

Salt Cedar & Termites

Termite resistant wood
Salt Cedar could be
used in construction

Repurposing Salt Cedar

Salt Cedar Mulch
Custom Knives
Oil Absorption

CEDAR BUSTERS in the Field:
ERADICATION and WATER QUALITY

Purpose:

- Complete an Index of Biotic Integrity (IBI) on McDonald Creek after chemical and mechanical salt cedar eradication. The IBI is a scoring metric system used to measure strong responses to natural effects, human disturbance, and/or pollution in wetlands. This system accounts for many different variables and data points that could be affecting the environment.
- Evaluating the water quality with a multi-parameter at the beginning, middle, and end of the project (in triplicate).
- Counting the salt cedar in each of the six sites while recording the dead/alive ratio (in triplicate).
- All to determine which eradication treatment is more efficient.

Cedar BUSTERS

Questions:

Salt cedar eradication is an extensive and expensive process. There are many steps to remove the harmful, deciduous, dense, exotic weed. After salt cedar is eradicated, the riparian system needs to be evaluated so it has the potential to thrive.

- **What damage has occured after the salt cedar thickets were chemically sprayed and mechanically grubbed?**
- **Did this removal process harm the riparian system?**
- **Was the chemical or mechanical eradication process more successful?**

Cedar BUSTERS

Problem:

Tamarisk, commonly called salt cedar, is found along McDonald Creek's banks. This deciduous shrub from Eurasia can produce as many as 500,000 very small seeds annually.

The seeds have a tuft of fine silky hairs on one end so they can travel long distances with the wind or on water. These seeds are short-lived and germinate within 24 hours of detecting moisture. Broken plant parts and leaf-scales can take roots and start new plants. Salt cedars grow rapidly and can survive harsh conditions.

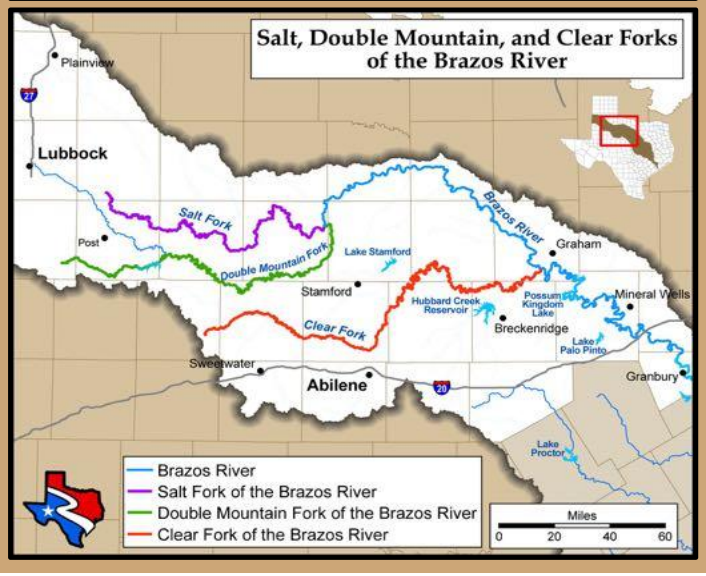
Salt cedar trees can consume up to 200 gallons of water a day. Salt cedars grow as dense thickets and are harming native plants from receiving necessary amounts of water to sustain life. They displace native vegetation which lowers the salinity of the creek. The leaves and stems of salt cedars release a high concentration of salt into the ground. This prevents native vegetation from growing and developing properly. Wildlife is affected due to the lack of protein in the plant. There is also an increased displacement of sediments in salt cedar infested streams which causes a blockage. These sediment deposits encourage dense clumps of salt cedar growth.

Location:

The location of the 3 Gringos Ranch is in the northeastern portion of Garza County, approximately fifteen miles northeast of Post, Texas. This ranch has water features that are very unique to the area. McDonald Creek has live water year-round and runs through the center of this ranch, entering the northeast side and exiting the south-central side. McDonald Creek feeds into the Salt Fork of the Brazos River. This is one of three forks that make up the main stem of the Brazos. The Salt Fork travels about 175 miles from its beginning in Crosby County in West Texas, passing through Garza, this is where the study was located.

The ecosystem, along the Brazos River, is heavily affected by salt cedar stands. Salt cedar not only harms the water, but it overpowers the native vegetation, animals are also affected, and macroinvertebrates in the riparian system are suffering from this invasive species. A study by the U.S. Forest Service on saltcedar in several watersheds notes that “on the Brazos River in Texas … this trend has continued over 40 years and has reduced the river's width by up to 71 percent in some places.”

Cedar BUSTERS



Hypothesis:

If mechanical and chemical eradication of salt cedar are both applied to the intermittent spring-fed creek, then the mechanical grubbing area will be more successful with growth in the aquatic and riparian ecosystems along McDonald Creek.

Variables:

Independent:

- Eradication Treatment Type:
  - Site 2, 3 - Mechanical Eradication
  - Site 4, 5 - Chemical Eradication

Dependent:

- Recording Data:
  - Temperature
  - Conductivity
  - Salinity
  - Dissolved Oxygen
  - pH
  - Number of Organisms
  - Number of Taxa
  - Number of salt cedar per site - kill ratio
  - Turbidity

Control:

- Sites 1 and 6- No Eradication

Constant:

- IBI Metrics
- Sampling Protocol Tools
- Same-Day sampling

Cedar BUSTERS

Background:

Six 100m sampling sites will be established on McDonald Creek running north to south across the ranch property.

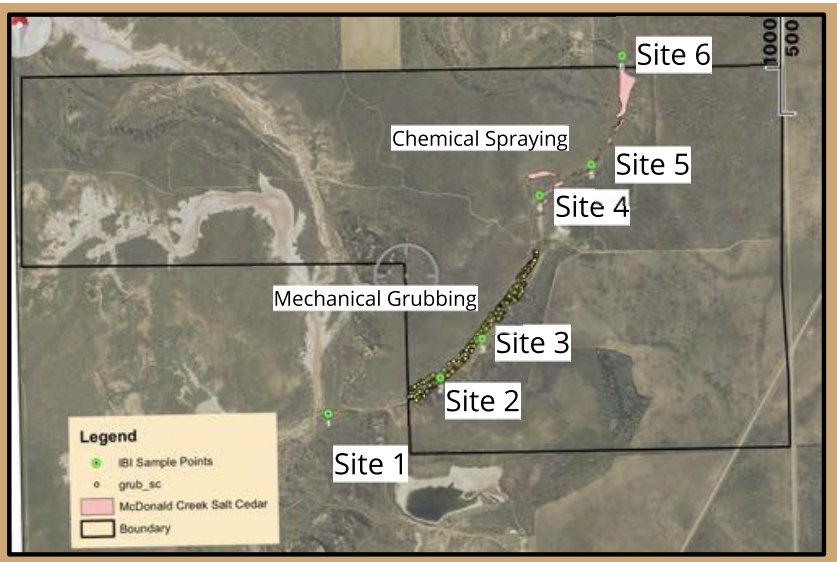
The southernmost and northernmost site will be reference sites located on neighboring ranches. There was no control on these sites, but they were used as reference points. (Site 1,6)

Chemical control was conducted on the northern section of the property where salt cedar are more abundant on September 8, 2019. (Site 4,5)

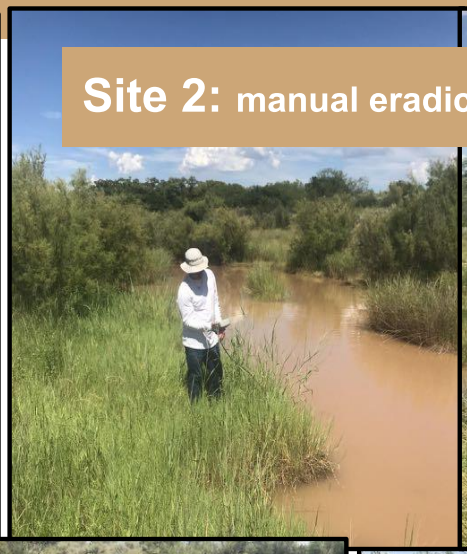
Mechanical control was conducted on the southern section of the property where salt cedar are less dense on October 18, 2019. (Site 2,3)

Two sampling sites will be located within the chemical control area (4,5) and two sites will be located within the mechanical control area (2,3).

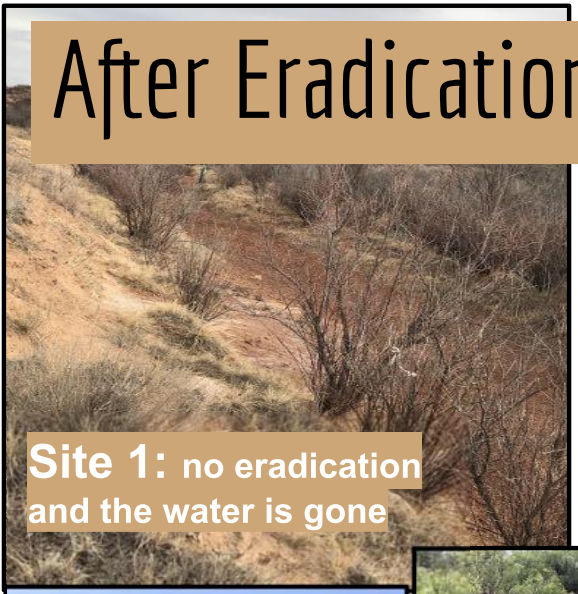
Cedar BUSTERS



Before Eradication:



After Eradication and the Beginning of the Study:



Site 1: no eradication and the water is gone

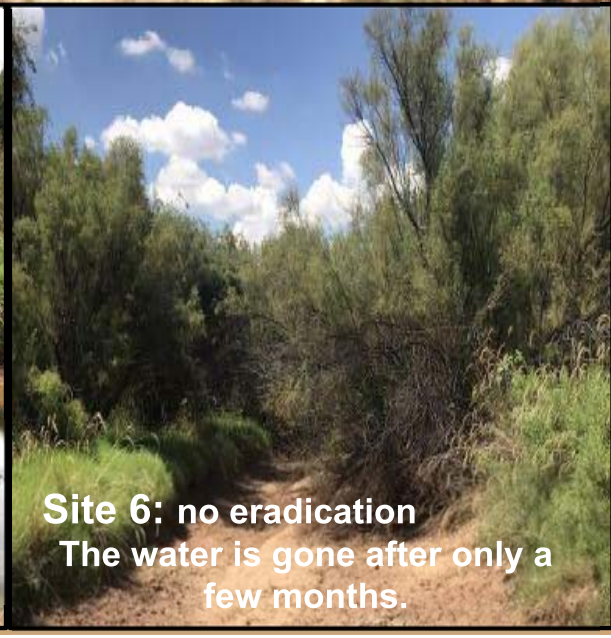
Site 2: Mechanical eradication

The water is gone and so are the salt cedar thickets.

Site 3:
Mechanical
No More Salt Cedar
The water looks so healthy and fish are appearing.

Site 4:
Chemical eradication
The water is a beautiful aqua color .

Site 5:
Chemical eradication
water is coming back



Site 6: no eradication
The water is gone after only a few months.

Materials:

1. 12” D-frame kick nets
2. Benthic Macroinvertebrate Laboratory Bench Sheets
3. Metal tray
4. Sieve
5. Sample jars
6. Preserving Ethanol Alcohol
7. Multiparameter water quality meter
8. Buckets
9. Plastic turbidity vials
10. Water Quality Notebook
11. Tweezers
12. Wide Mouth 1 Gallon Clear Glass Jar
13. Turbidimeter
14. Glass Test Containers

Cedar BUSTERS

Procedure:

1. Six 100m sampling sites were established along McDonald Creek.

2. Evaluate each site even if water is not present. Using the multiparameter water quality meter, measure the temperature, conductivity, salinity, dissolved oxygen, pH, and turbidity at each site. Do this in triplicate and record the average. This will be listed as BEGINNING on the bar graphs.

3. During the summer heat, take samples at all sites with a 12'' D-frame kick net. A total of 10 linear meters of each site will be sampled. Place all contents in a glass jar labeled with the site's number.

4. Using the multiparameter water quality meter, record the temperature, conductivity, salinity, dissolved oxygen, and pH at each site in triplicate for an overall average. This will be listed as MIDDLE on the bar graphs.

5. Fill creek water in the plastic turbidity vial at each site; label vial.

6. Filter water gently through samples using a sieve, metal tray, and tweezers. All samples will be pooled into a single site sample for identification and processing.

Cedar BUSTERS

Procedure Continued:

7. All samples will be placed in a glass jar labeled according to the site and preserved in pure ethanol alcohol for transport to the Lubbock Christian University Laboratory to be processed.

8. Macroinvertebrates in each sample will be enumerated and identified to the lowest taxonomic level possible (most likely order or genus) using the Benthic Macroinvertebrate Laboratory Bench sheets.

9. At conclusion of the project timeline, count the salt cedar growth along the 100m sampling area. Complete in triplicate and take average to determine the dead/alive salt cedar ratio.

10. Water samples were taken at each site, in triplicate, as a final analysis. This was listed as END on the bar graphs for temperature, conductivity, salinity, dissolved oxygen, and pH.

11. After samples were taken from the creek for turbidity, the water samples were poured into small glass test contatiers and inserted into the turbidimeter. The NTU score was displayed immediately, and we added this to our data log.

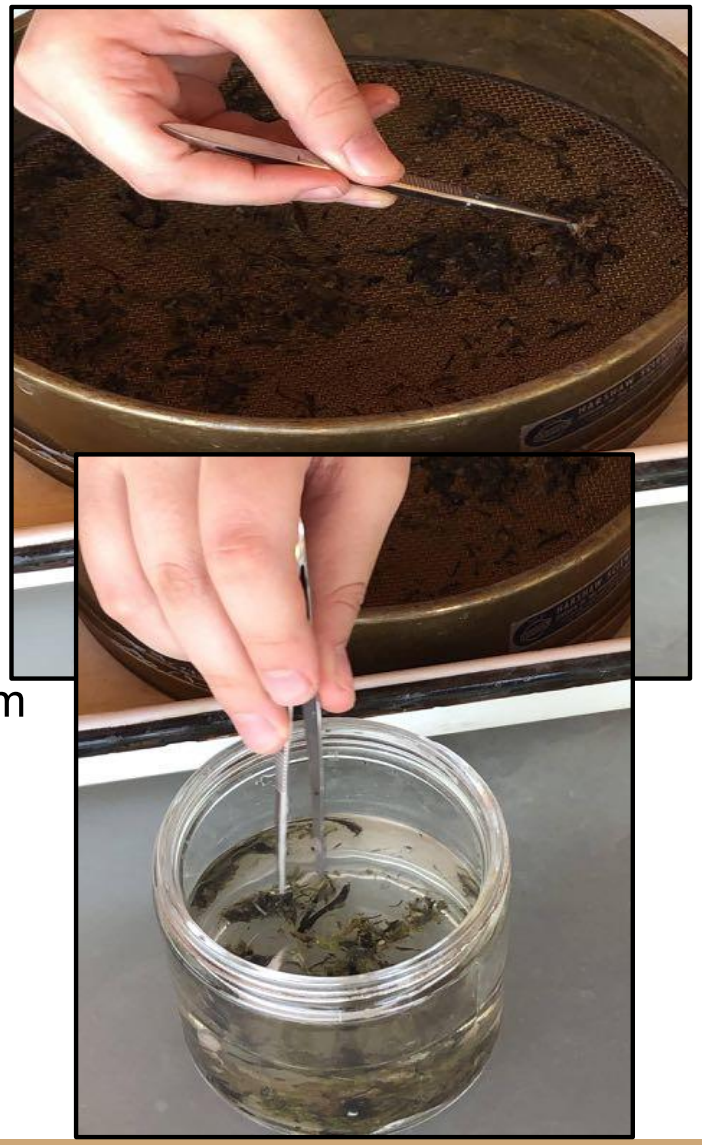
IBI Metrics:

Following is a list of the specific IBI metrics that we will be using for this project.

1. *Catch per Unit Effort (CPUE)*: total number of individuals collected per 10 linear meters of kick-net sampling

2. *Total Richness*: The total number of different taxa collected

3.*EPT%*: The percent to find individuals in the total sample from the orders Ephemeroptera (mayflies),+ Plecoptera (stoneflies), + Trichoptera (caddisflies)



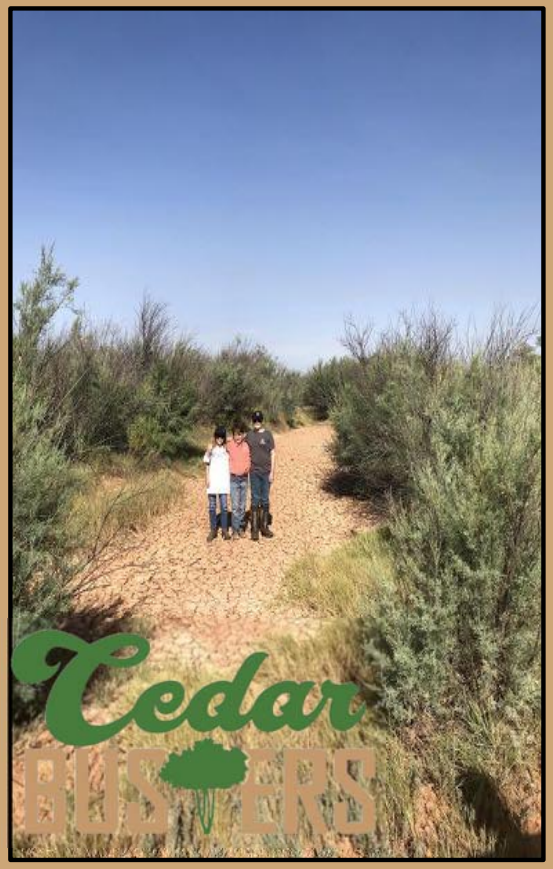
Cedar Busters

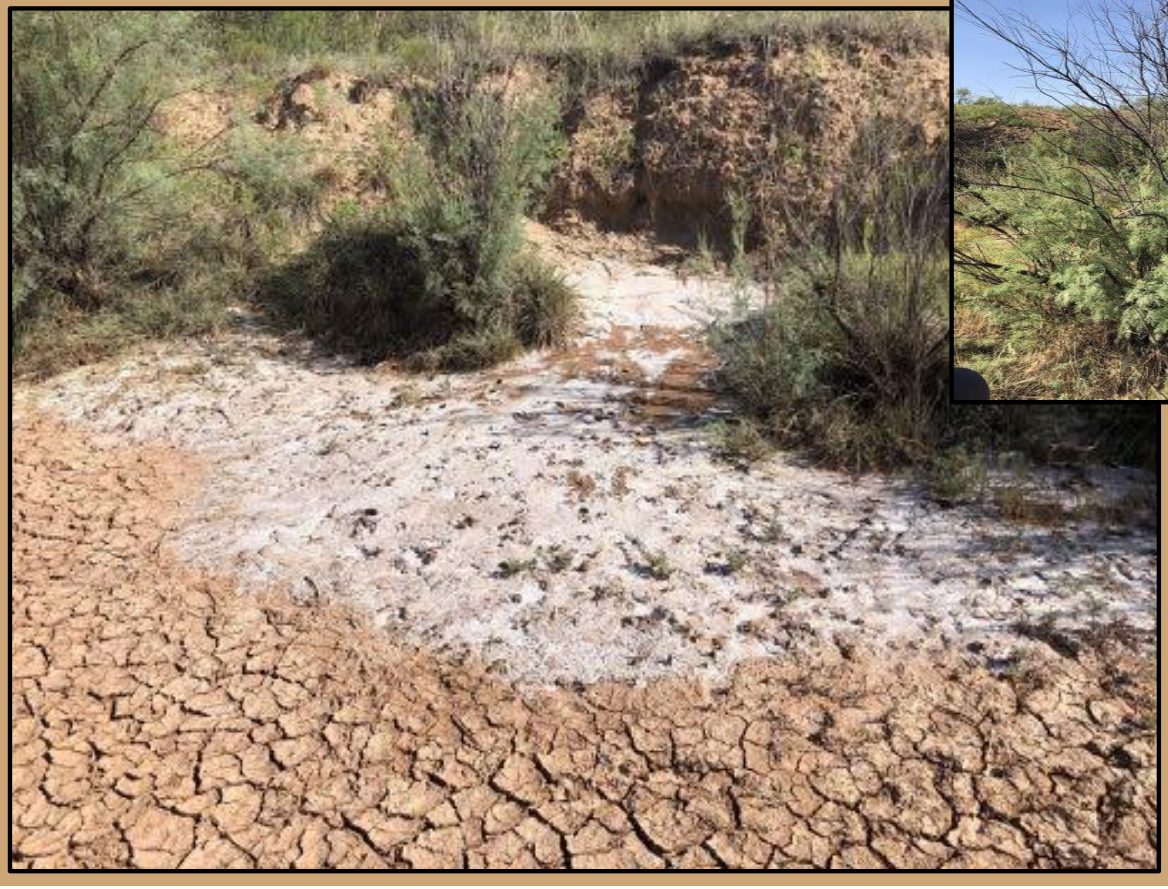
Site Analysis During IBI:

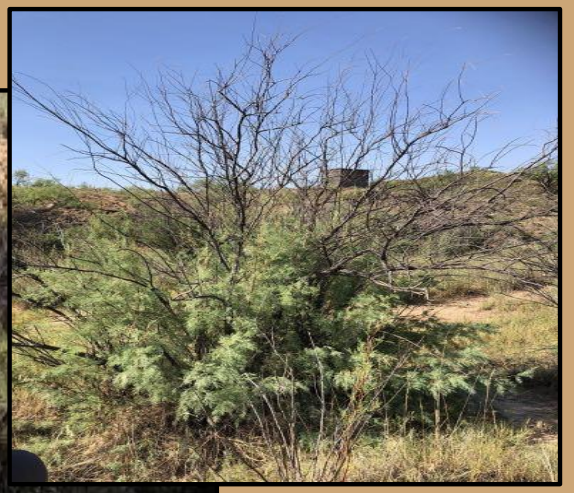
July 17, 2020

Site 1: no water present/hog and coyote prints

Salt cedar thickets still present in abundance - no removal at this site.







The team experienced problems with the lack of water in the creek due to a drought.

Site 2:

no water present

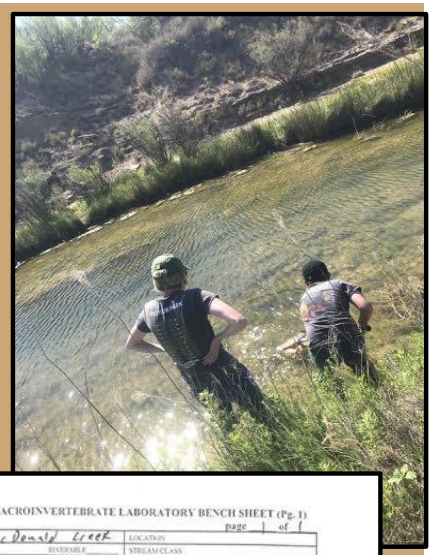
(Mechanical removal
Of salt cedar in 2019)

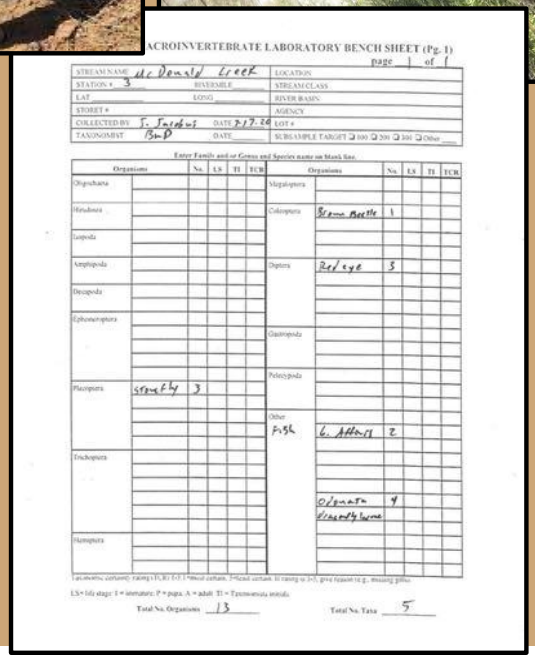
Many mounds of salt cedar branches are piled at this site. What do you do with the branches after they are excavated?

Site 3:

White Heron, grasshoppers, frogs, minnows, baby bass, water spiders, birds picking at fish were all seen

(Mechanical removal of salt cedar in 2019)





MACROINVERTEBRATE LABORATORY BENCH SHEET (Pg. 1)

page 1 of 1

STREAM NAME McDonald Creek	LOCATION
STATION # 3	STREAM CLASS
LAT	LONG
STORET #	AGENCY
COLLECTED BY J. Sanders	DATE 7-17-20
TAXONOMIST BnD	DATE

Enter Family and/or Genus and Species name on blank line.

Organisms	No.	LS	TI	TCR	Organisms	No.	LS	TI	TCR
Oligochaeta					Megaloptera				
Hirudinea					Coleoptera	Stone Beetle	1		
Isopoda									
Amphipoda					Diptera	Red eye	3		
Decapoda									
Ephemeroptera					Gastropoda				
					Pelecypoda				
Plecoptera	stonefly	3			Other				
					Fish	G. Affinis	2		
Trichoptera									
						Odonata	4		
						Dragonfly larvae			
Hemiptera									

LS = life stage: I = immature; P = pupa; A = adult; TI = Taxonomist initials

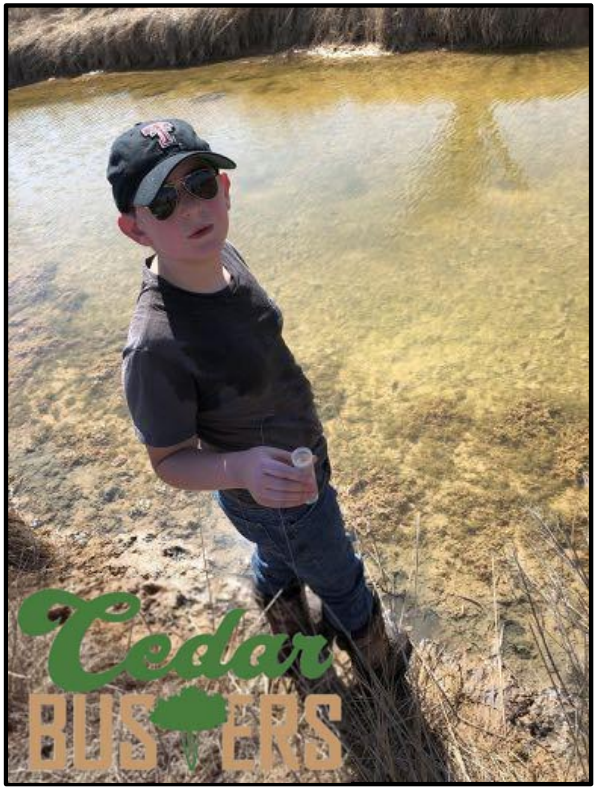
Total No. Organisms 13 Total No. Taxa 5

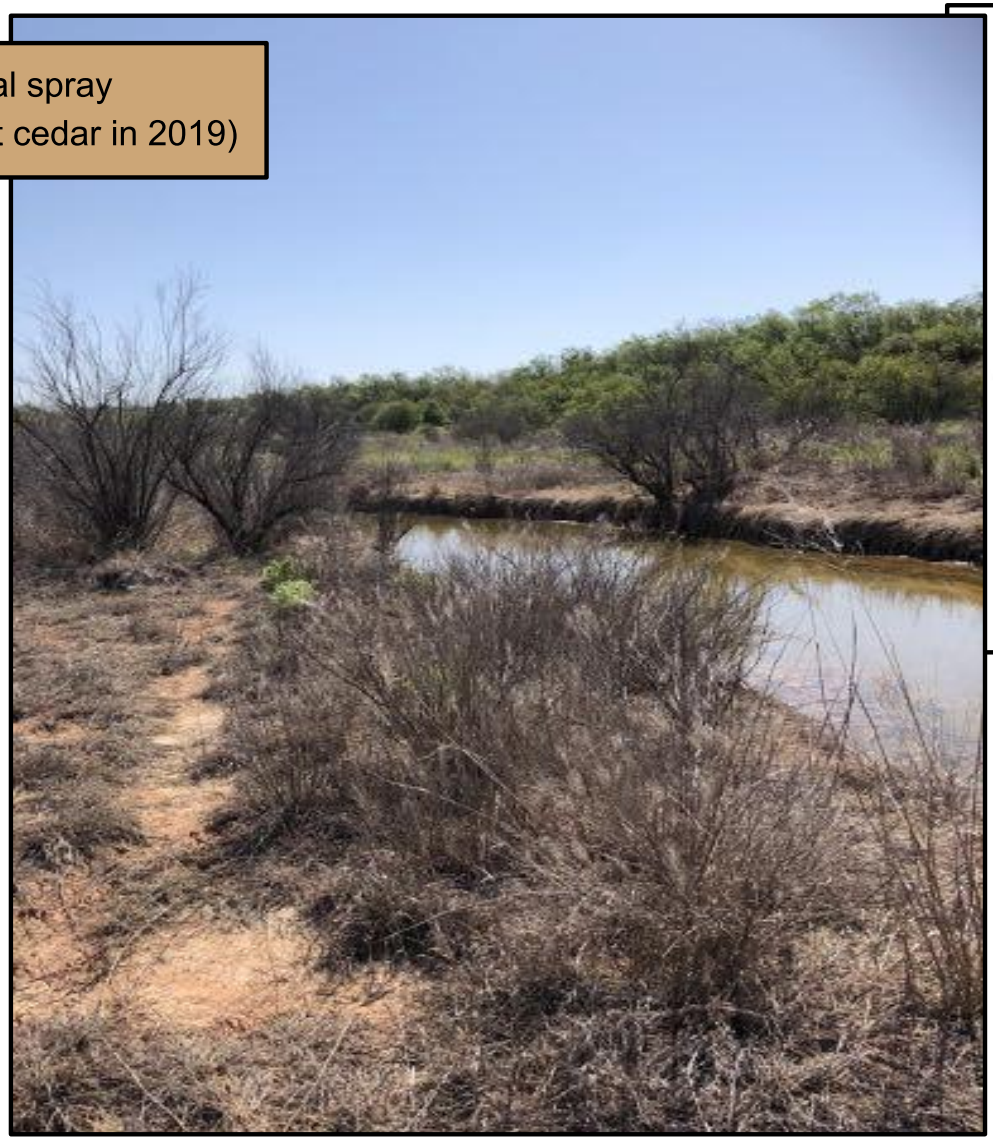
Cedar BUSTERS

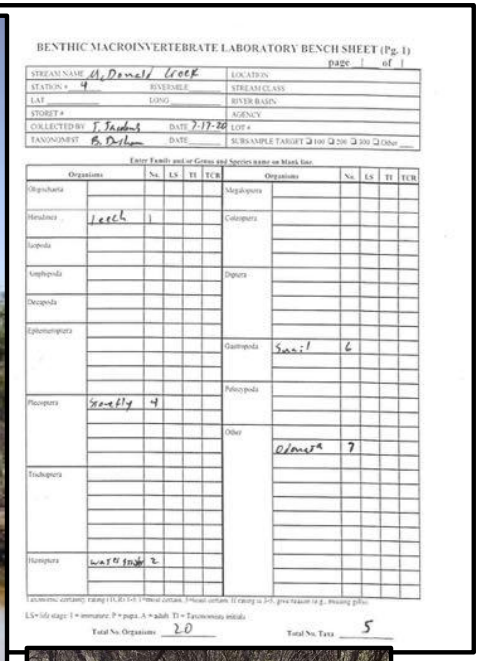
Site 4:

Dragonfly
a covey of quail
Turkey
deer bones on the shoreline
minnows were are present

(Ariel chemical spray applied to salt cedar in 2019)







BENTHIC MACROINVERTEBRATE LABORATORY BENCH SHEET (Pg. 1)

page 1 of 1

STREAM NAME McDonald Creek	LOCATION
STATION # 4	RIVERMILE	STREAM CLASS
LAT	LONG	RIVER BASIN
STORET #	AGENCY
COLLECTED BY J. Jacobs	DATE 7-17-20	LOT #
TAXONOMIST B. Dillon	DATE	SUBSAMPLE TARGET ☐ 100 ☐ 200 ☐ 300 ☐ Other

Enter Family and/or Genus and Species name on blank line.

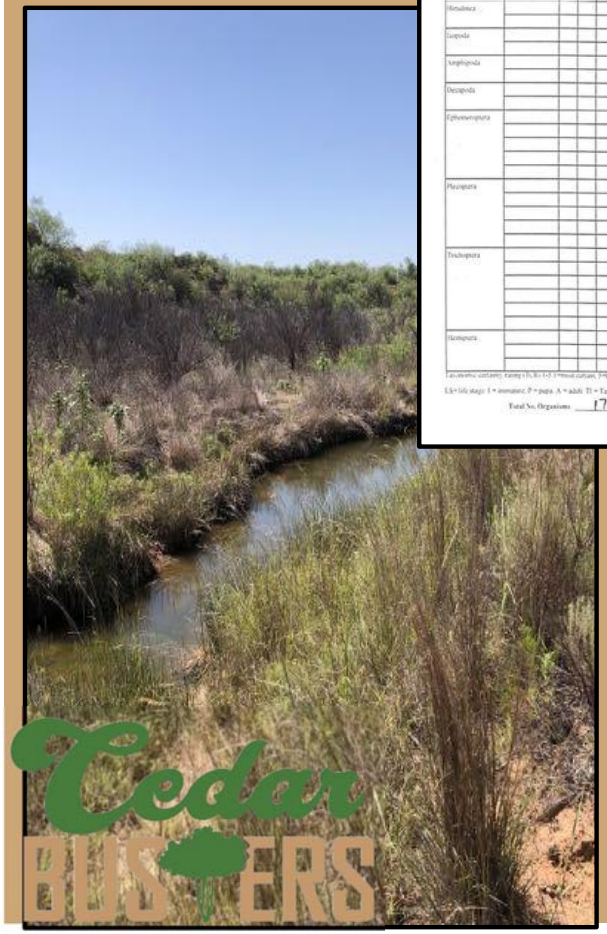
Organisms	No.	LS	TI	TCR	Organisms	No.	LS	TI	TCR
Oligochaeta					Megaloptera				
Hirudinea	Leech	1			Coleoptera				
Isopoda									
Amphipoda					Diptera				
Decapoda									
Ephemeroptera					Gastropoda	Snail	6		
Plecoptera	Stonefly	4			Pelecypoda				
					Other				
Trichoptera						Odonata	7		
Hemiptera	Water strider	2							

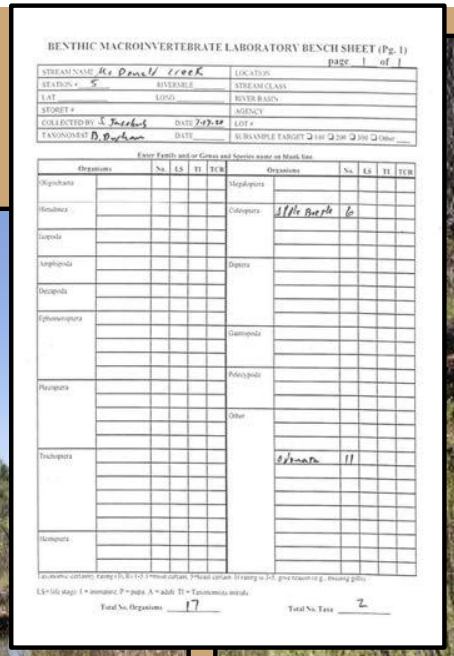
LS = life stage: 1 = immature, P = pupa, A = adult, TI = Taxonomic Initials

Total No. Organisms 20 Total No. Taxa 5

Site 5:

massive frog
dragonflies





BENTHIC MACROINVERTEBRATE LABORATORY BENCH SHEET (Pg. 1)

page 1 of 1

STREAM NAME Rio Penasco Creek	LOCATION
STATION # 5	RIVERMILE	STREAM CLASS
LAT	LONG	RIVER BASIN
SITE/ET #	AGENCY
COLLECTED BY J. Tweedy	DATE 7-17-19	LOT #
TAXONOMIST B. Bonham	DATE	SUBSAMPLE TARGET ☐ 100 ☐ 200 ☐ 300 ☐ Other

Enter Family and/or Genus and Species name on blank line.

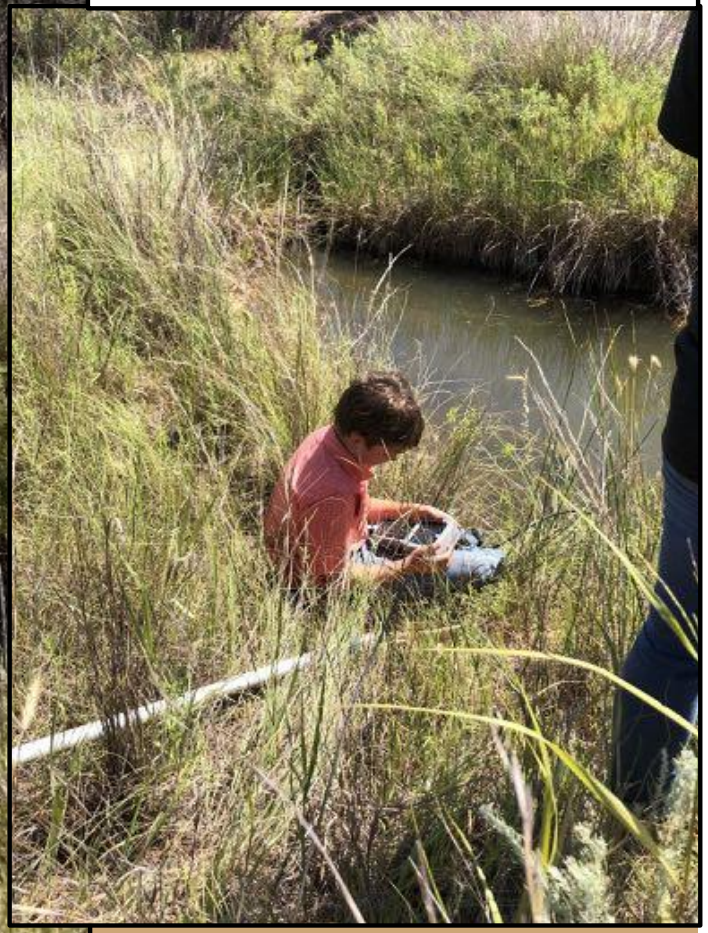
Organisms	No.	LS	TI	TCR	Organisms	No.	LS	TI	TCR
Oligochaeta					Megaloptera				
Hirudinea					Coleoptera	Diving Beetle	6		
Isopoda									
Amphipoda					Diptera				
Decapoda									
Ephemeroptera					Gastropoda				
					Pelecypoda				
Plecoptera					Other				
Trichoptera						Odonata	11		
Hemiptera									

Taxonomic certainty rating = 1, 2, or 3 *Head capture, †Head capture. If rating is 2 or 3, give reason (e.g., missing gills).

LS = life stage: I = immature, P = pupa, A = adult. TI = Taxonomic initials

Total No. Organisms 17 Total No. Taxa 2

(Ariel chemical spray applied to salt cedar in 2019)



Site 6:

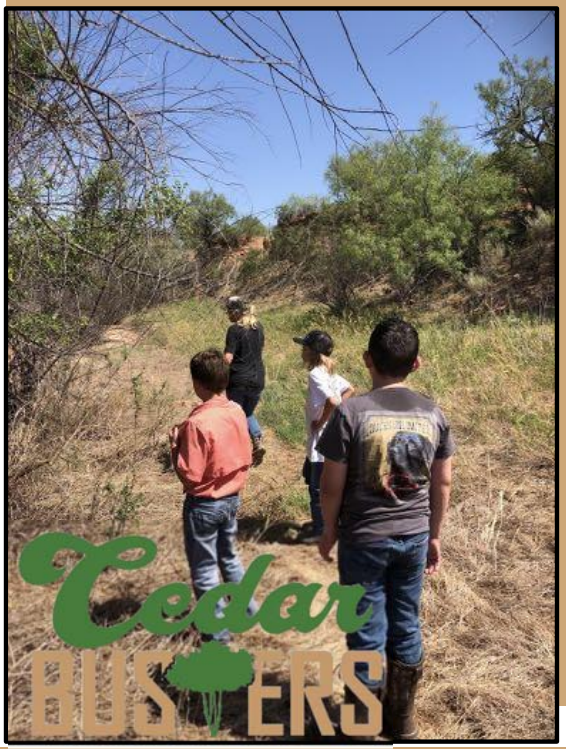
No water present

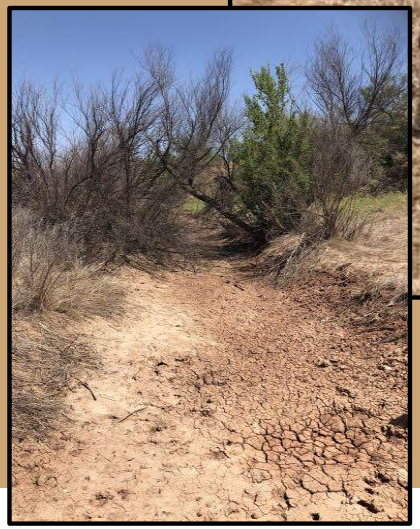
Dead grass from over-spray

Bees

Bunny

Grasshoppers





Extremely large salt cedar thickets still present in abundance - no removal at this site.

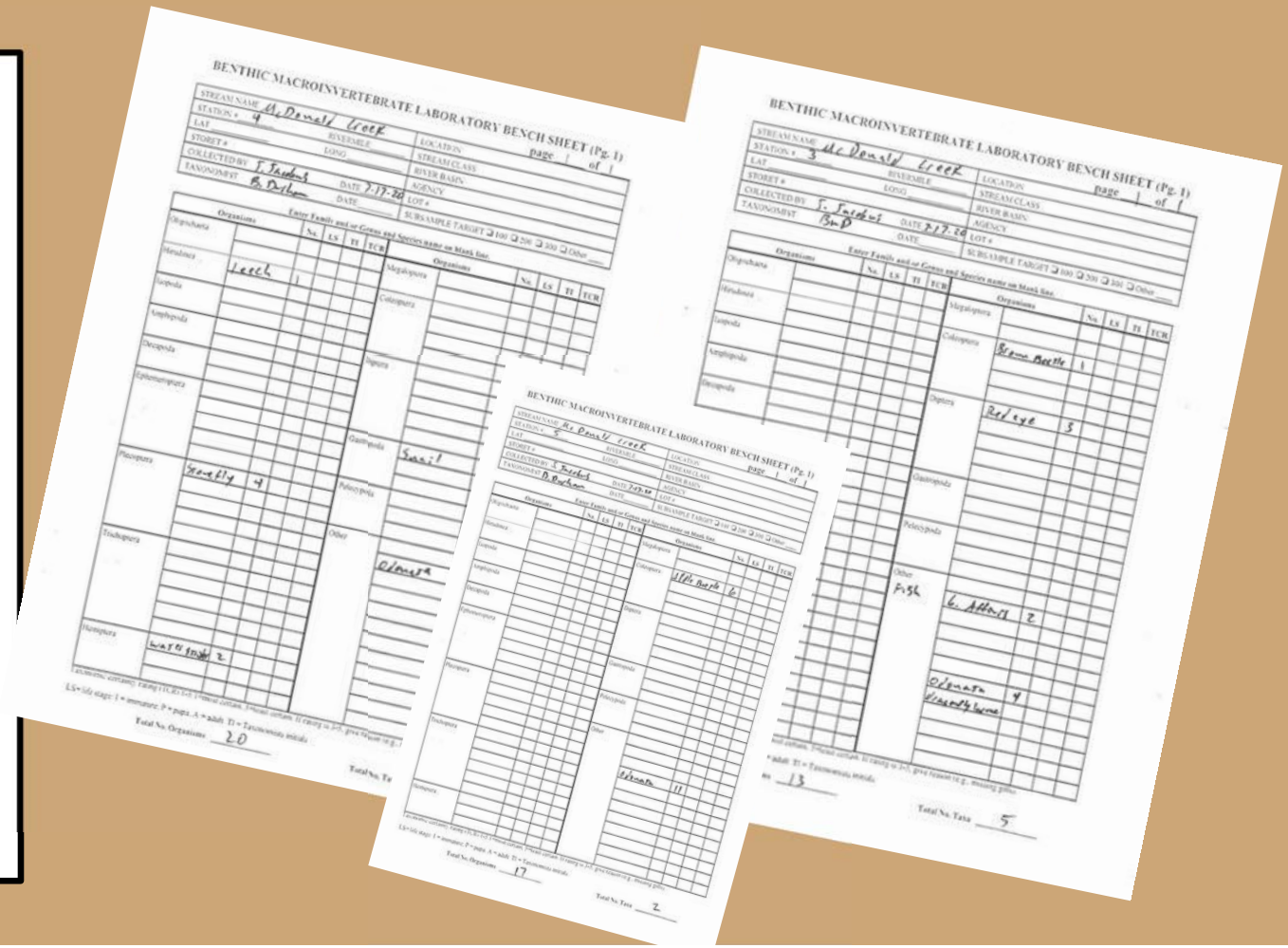
No further IBIs were performed due to the lack of water in the creek.

Macroinvertebrate Identification Procedure:

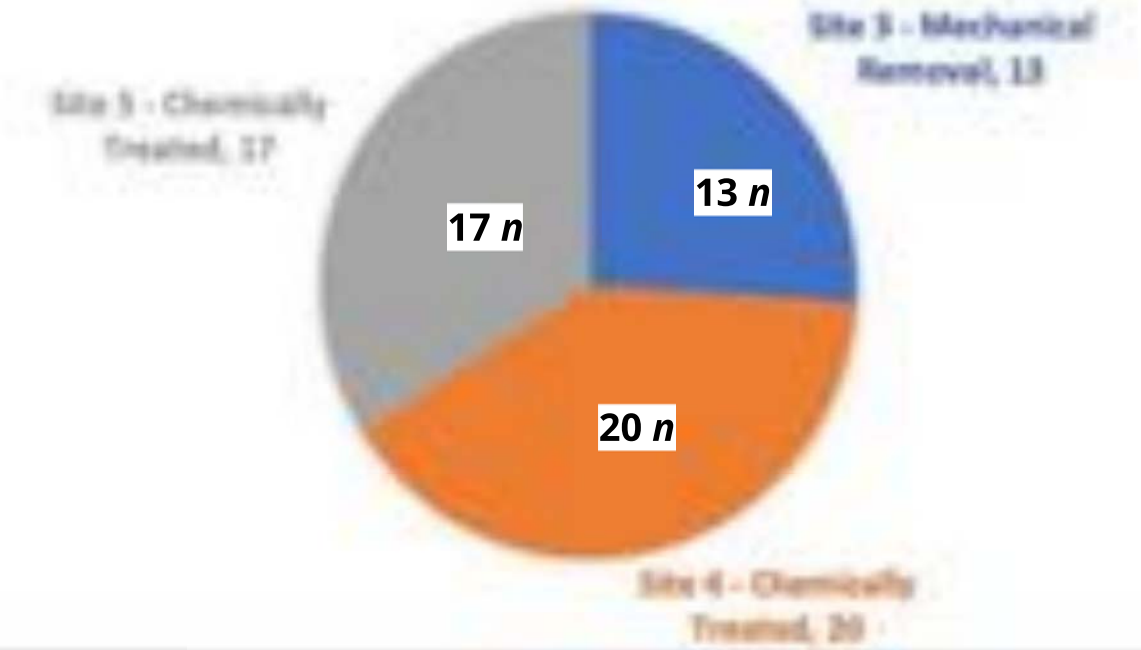
Lab Work by **Dr. Bart Durham**
at Lubbock Christian University

Associate Professor
of Natural Resources,
Ecology, and Conservation

- Datasheets were made with the collected items
- Benthic Macroinvertebrate Laboratory Bench Sheet
- Family and/or genus and species name was listed



NUMBER OF ORGANISMS FOUND IN CREEK WATER - JULY 2020 IBI

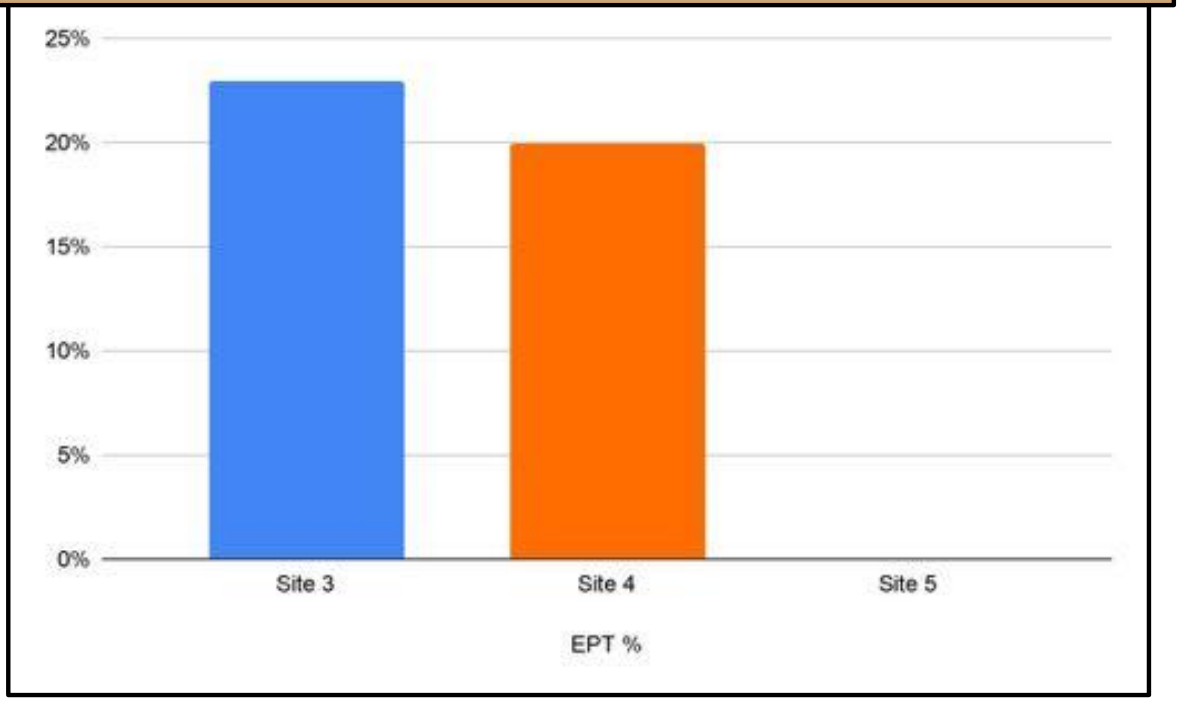


Cedar BUSTERS

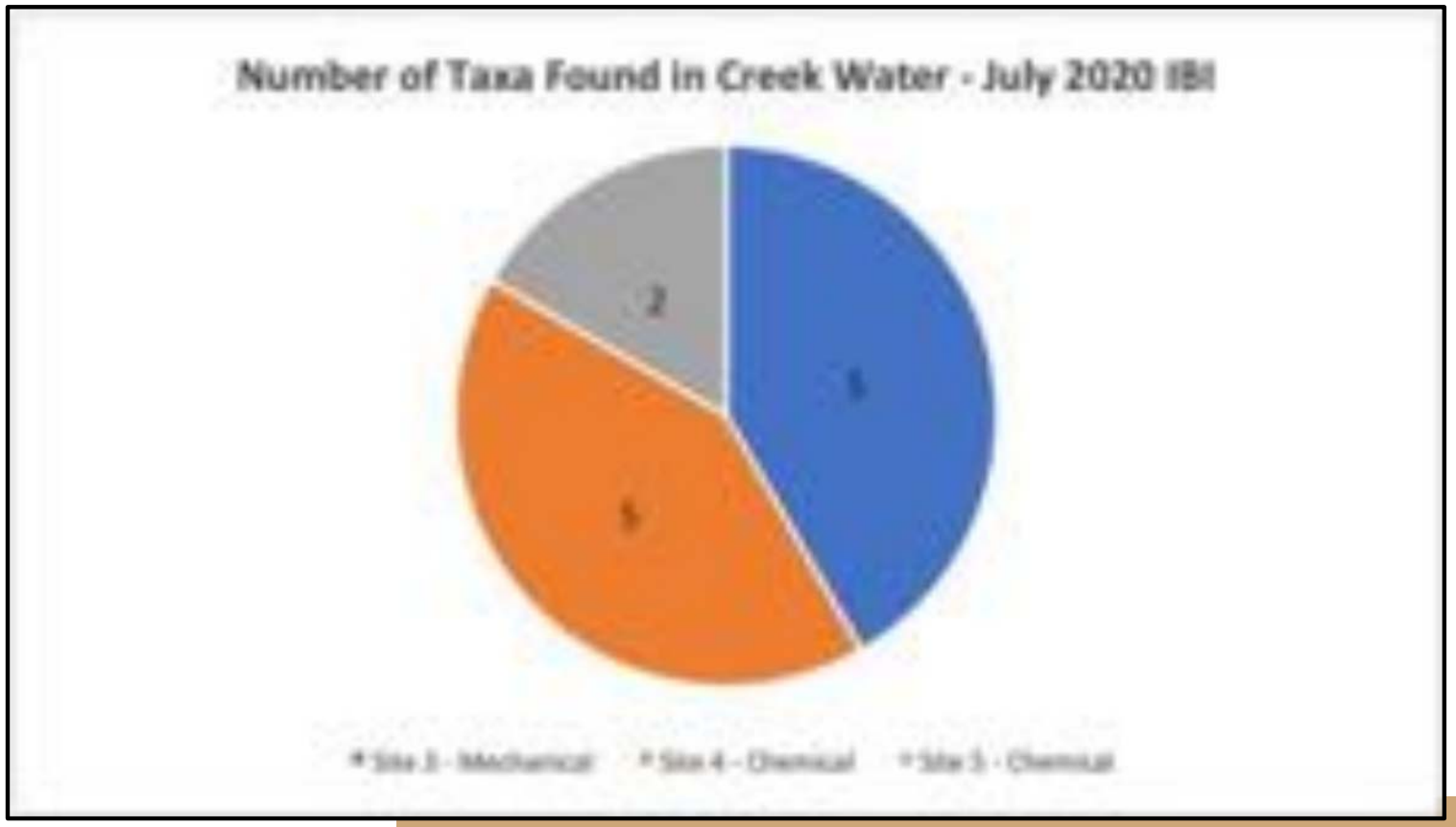
Animals, plants or single-celled life forms found in our creekwater samples.

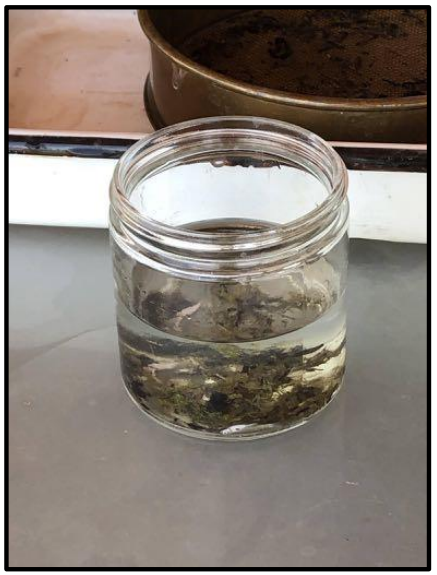
EPT% CHART

From July 2020 IBI



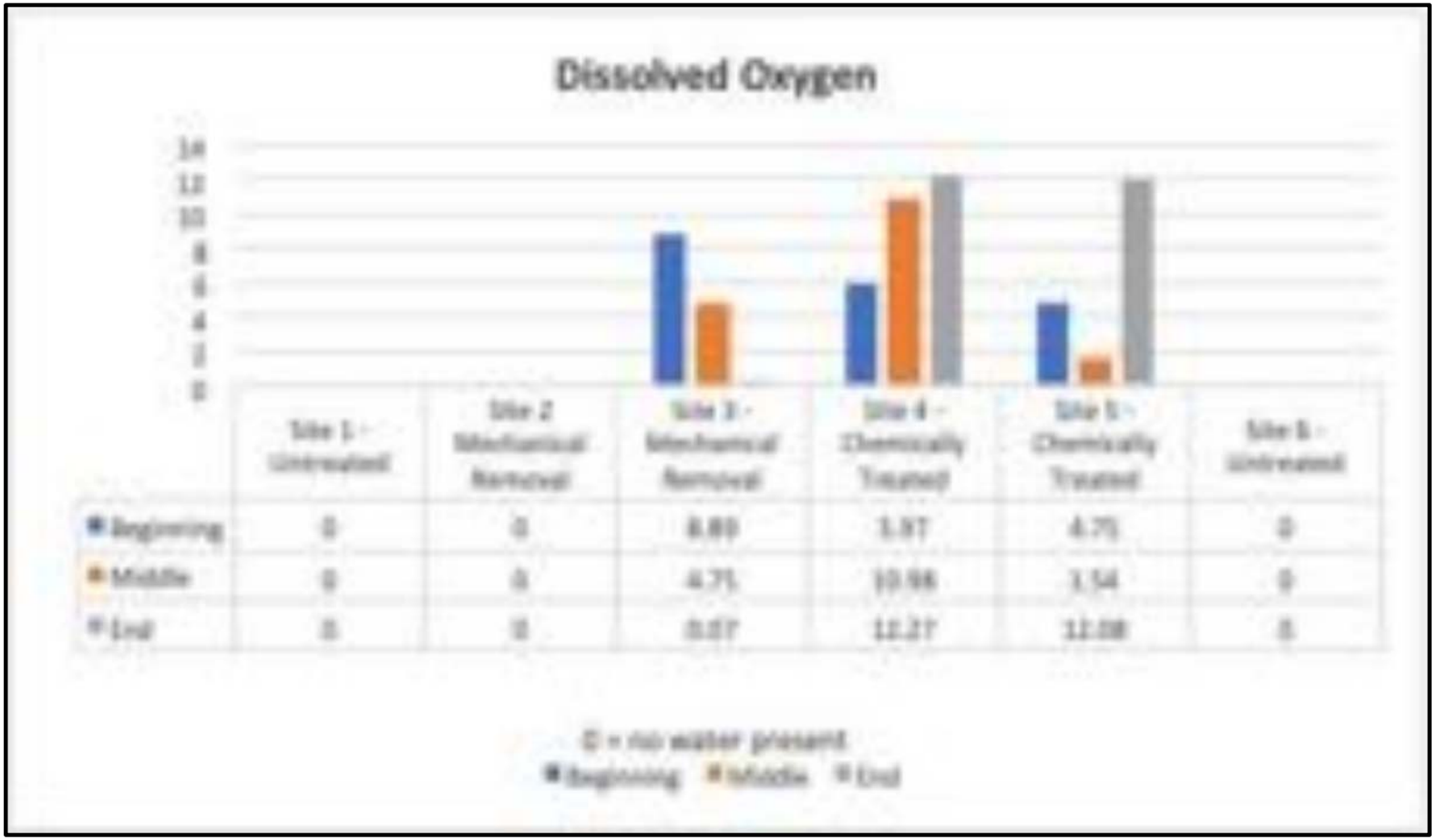
EPT% (Ephemeroptera, Trichoptera, Plecoptera) represents the percent of sensitive aquatic and riparian insects, which consists of three categories. These categories give the scientist a good feeling of whether the creek is in equilibrium or chaos.





A taxon (taxa - plural) consists of a group of one or more populations of an organism or organisms seen by taxonomist as one unit. Due to the drought, dragonfly larvae may not have hatched this year because they wait fo the conditions to be optimal for survival.

The next 6 sides have creek measurements taken at the Beginning, Middle, and End of the study. These were done in triplicate.



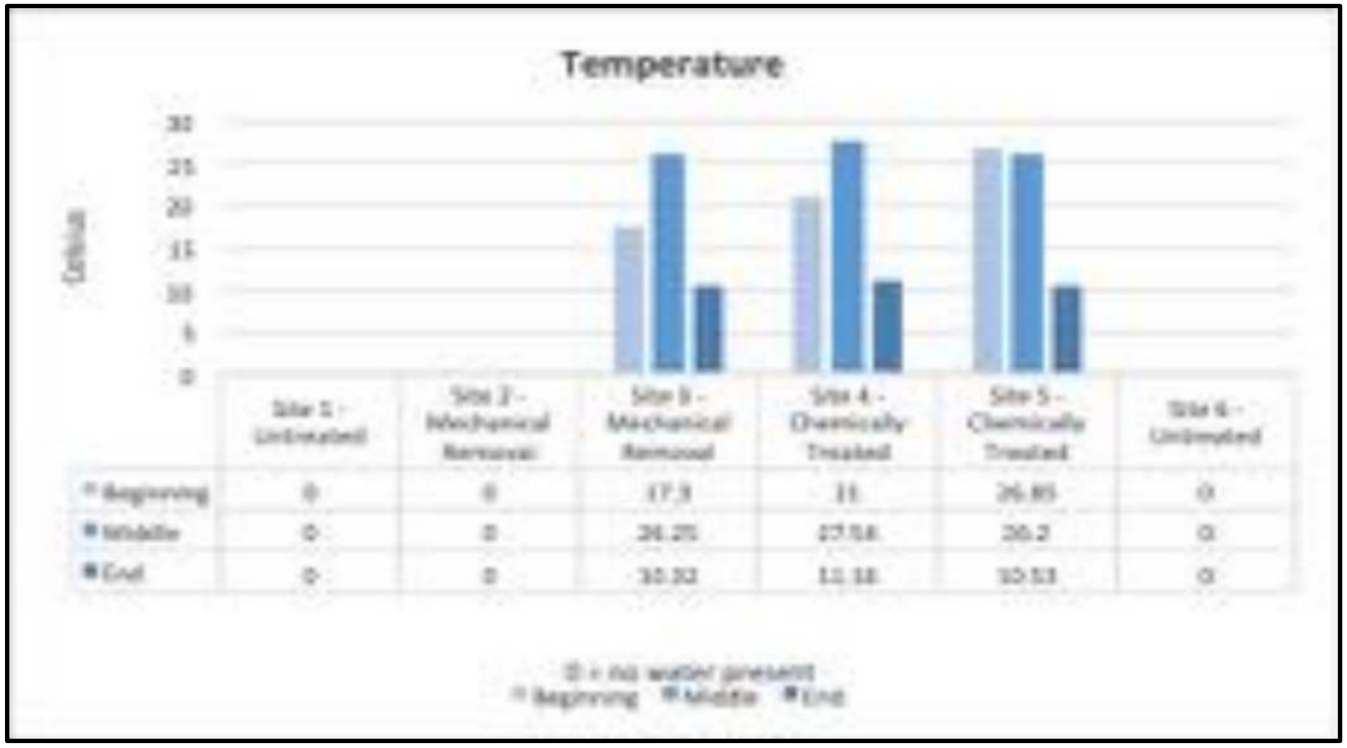
Cedar BUSTERS

Dissolved Oxygen (DO) is the amount of O2 or gaseous oxygen dissolved in the water. These levels could also be used to calculate the H2O molecule count per cubic inch of water. Healthy water should have DO concentrations above 6.5-8 mg/L.

When comparing the **DO** and **Temperature** data:

- Site 3 END should be very high but it's DO was 0.07
- Site 4 MIDDLE had 10.98 as the DO level, and it was the warmest temperature.
- Site 5 followed the DO/Temp rule the most on all 3 measurement days.

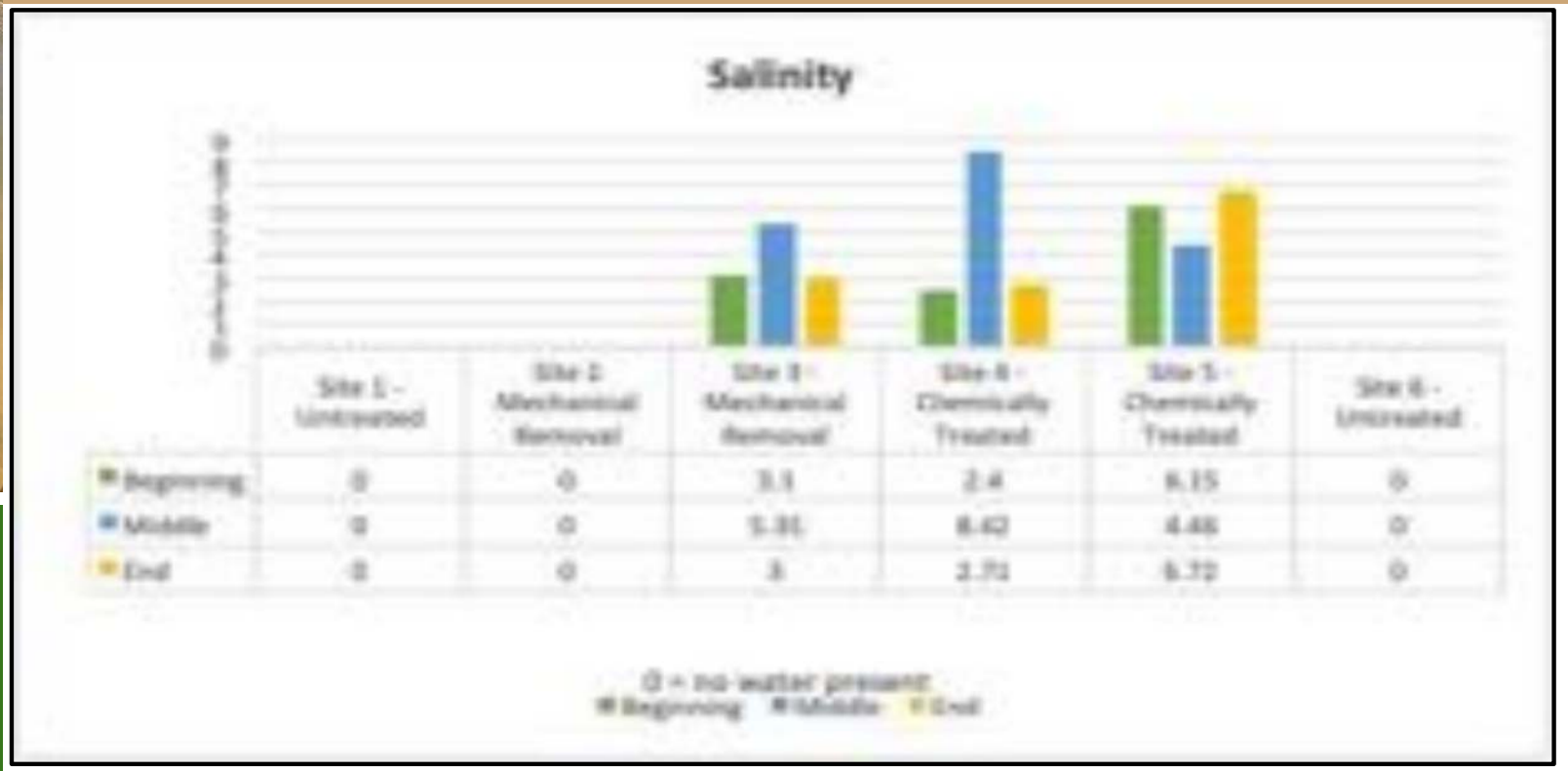
There is more dissolved oxygen (DO) in cold water. When the water temperature is low, the dissolved oxygen concentration is high and when the water temperature is high, the dissolved-oxygen concentration is often lower.



Water temperature plays an important part in the riparian system.
The water temperature is a strong influence on biological activity. When the temperatures get too high or low of the preferred range, the number of the species decreases until they are all gone.

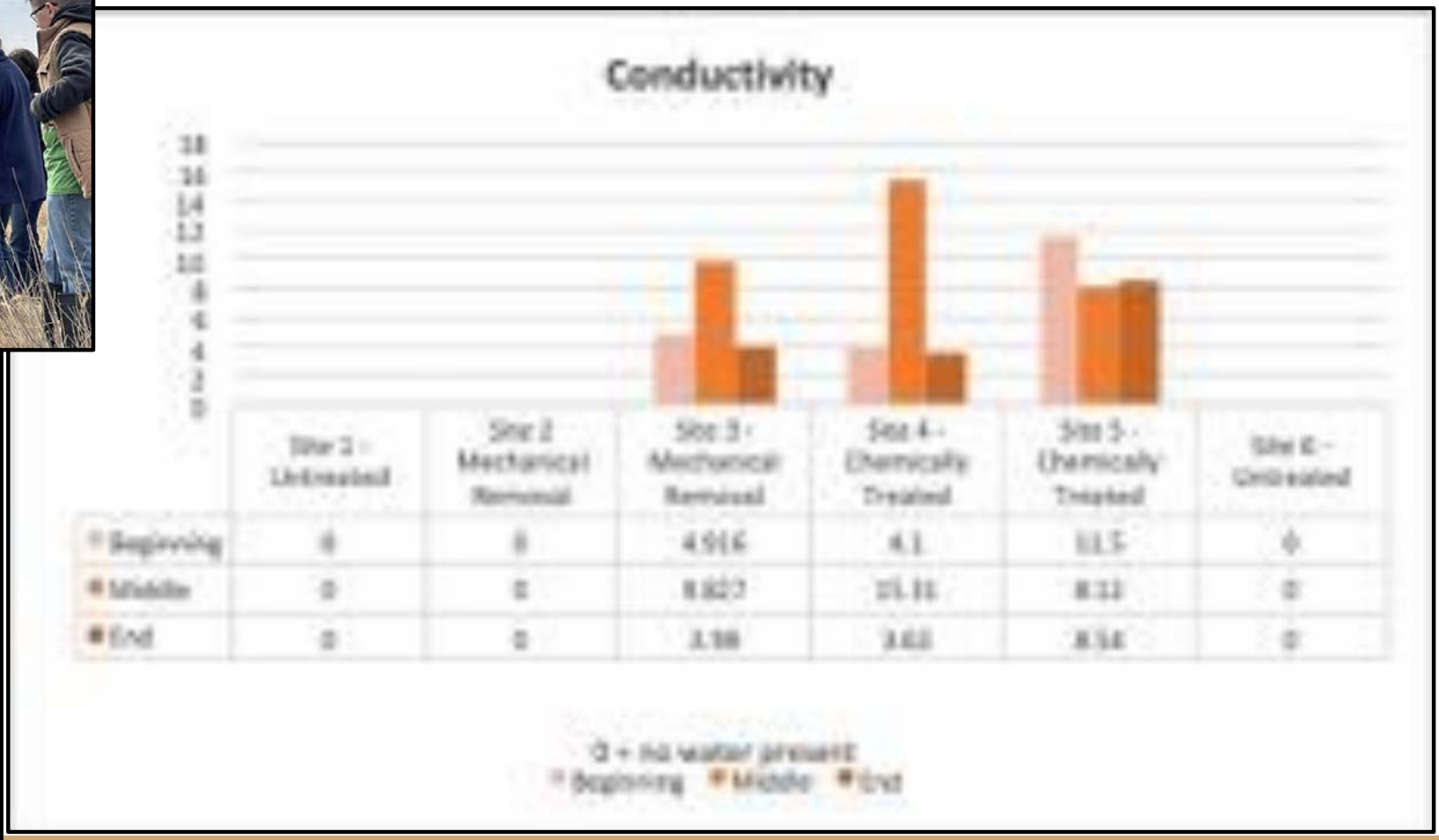
The precipitation was studied on each of the measurement days. Results are in the conclusion.

Did you know that the saltier the water, the clearer it appears?

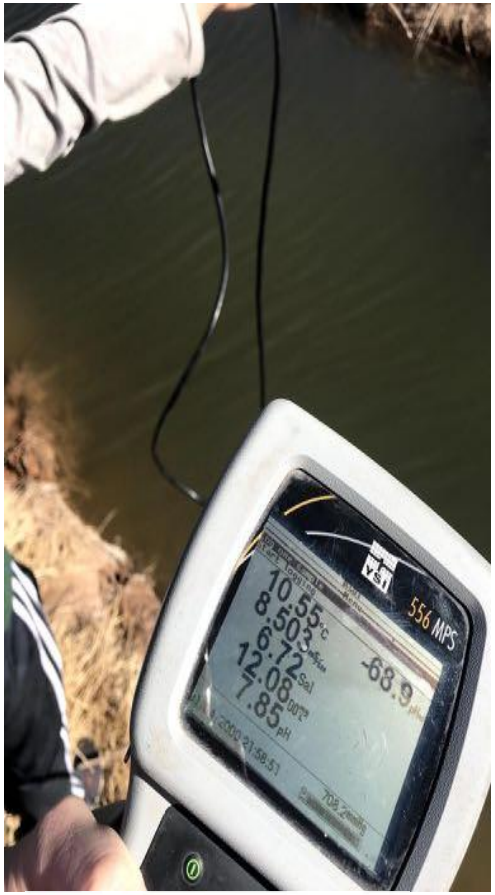


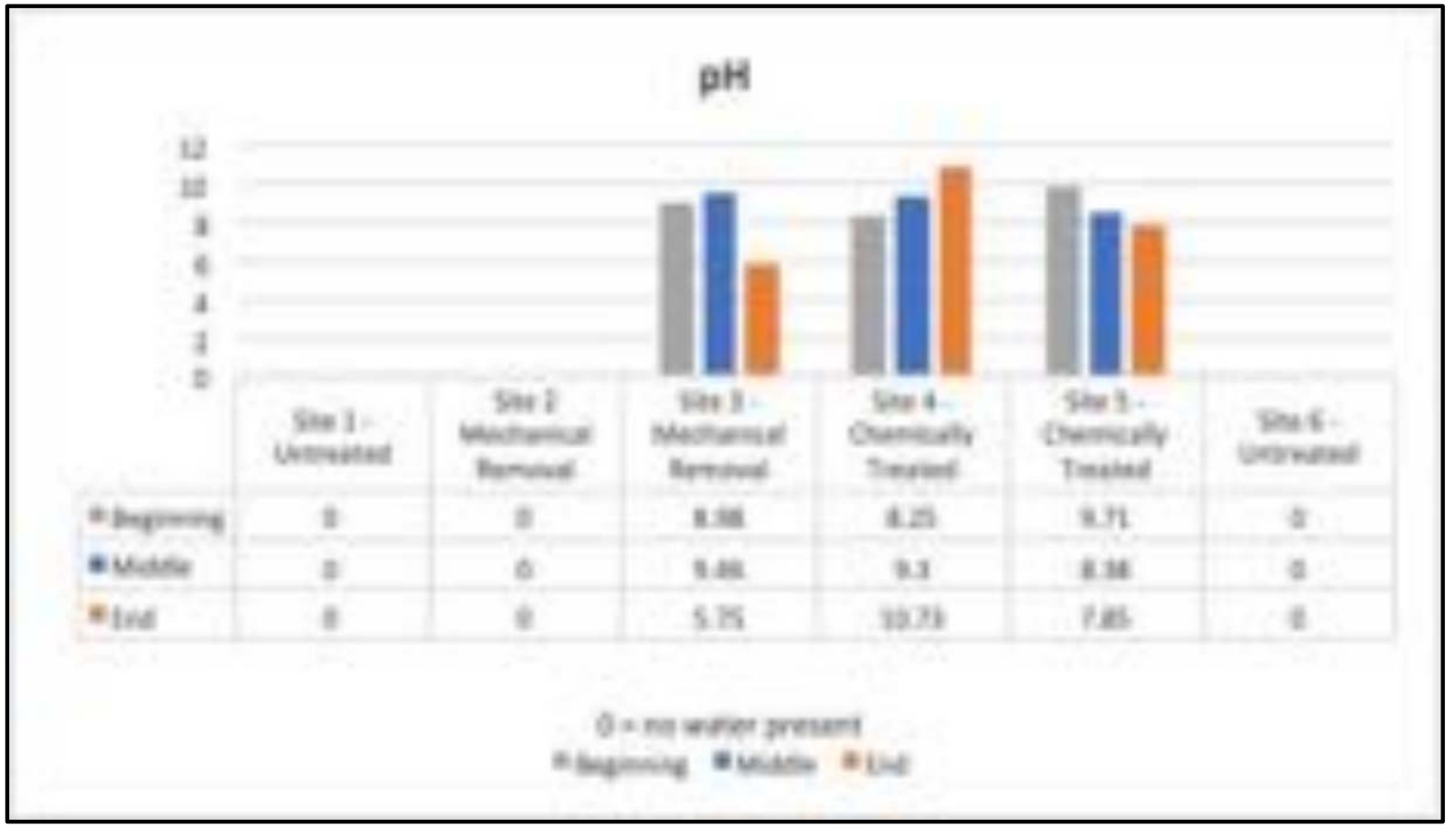
Salinity is a measure of the amount of dissolved ions in the water. Typical freshwater systems have a salinity of 0.5 PPT% or less. As a point of reference, the ocean has an average salinity of 35 PPT% and the Dead Sea is 280 PPT%. McDonald Creek has a very high PPT%; this is affecting the integrity of the riparian system.

Cedar BUSTERS



Conductivity measures the ability of water to carry an electrical current. Because salt can conduct an electrical current, conductivity rises when salinity rises which is what our measurements have shown. This is why the measurements are almost identical to each other. The increasing levels of conductivity result in the increased levels of the pH.





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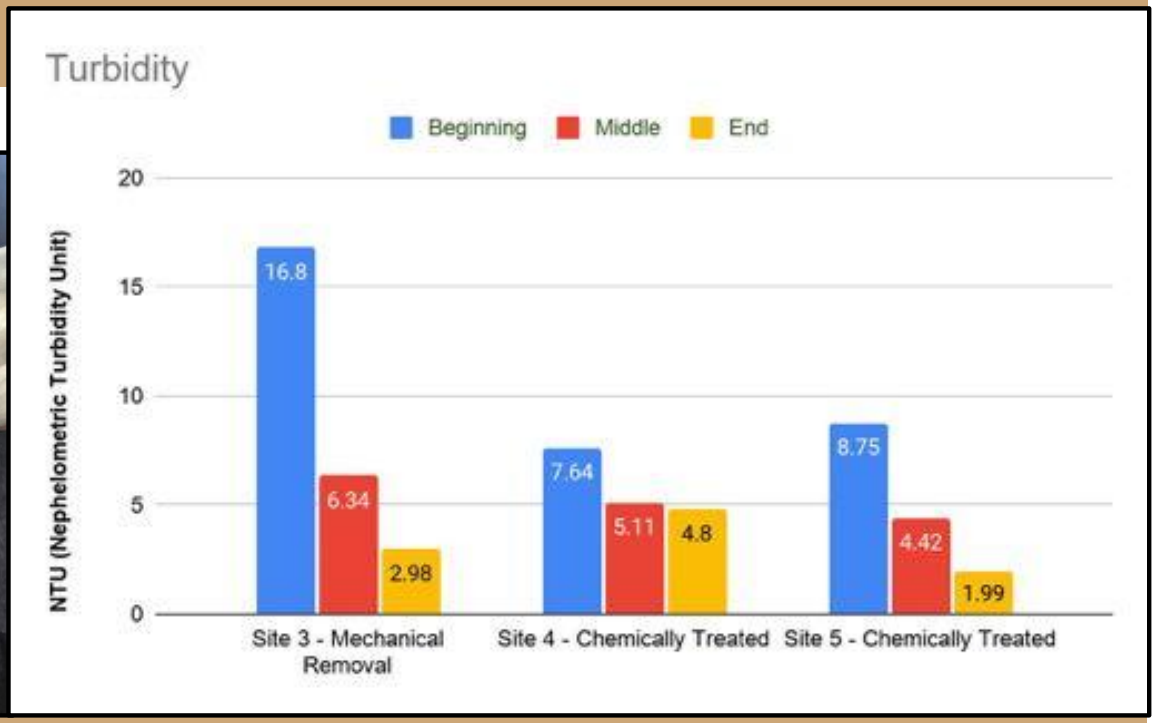
The pH measurement shows how acidic or basic the levels of the creek water are. The pH affects which organisms can survive within the creek system. Optimum pH of a freshwater river would be 7.4.
Fish can become stressed in water with a pH from 4.0-6.5 and 9.0-11.0.
Our results show that there is no clear effect on the pH with the 2 styles of treatments.

Turbidity

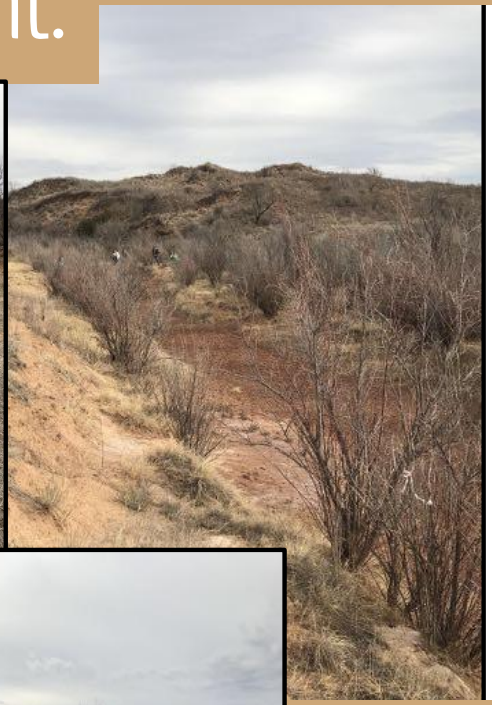


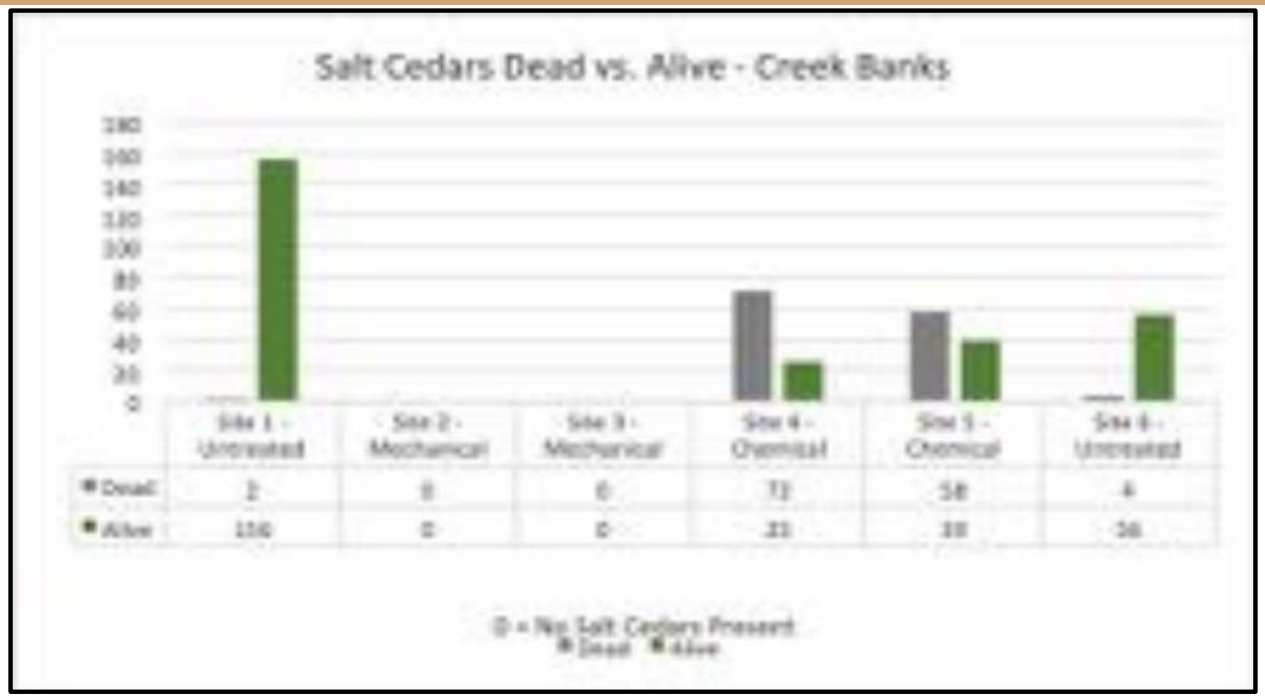
Cedar Busters

Turbidity measures the relative clarity of a liquid. It is a characteristic of water. Turbidity measures the amount of light scattered by material in the water when light is shined through it. When there is more salt in the water, it will be clearer. We used a tubidimeter to calculate our results.

Final Count:

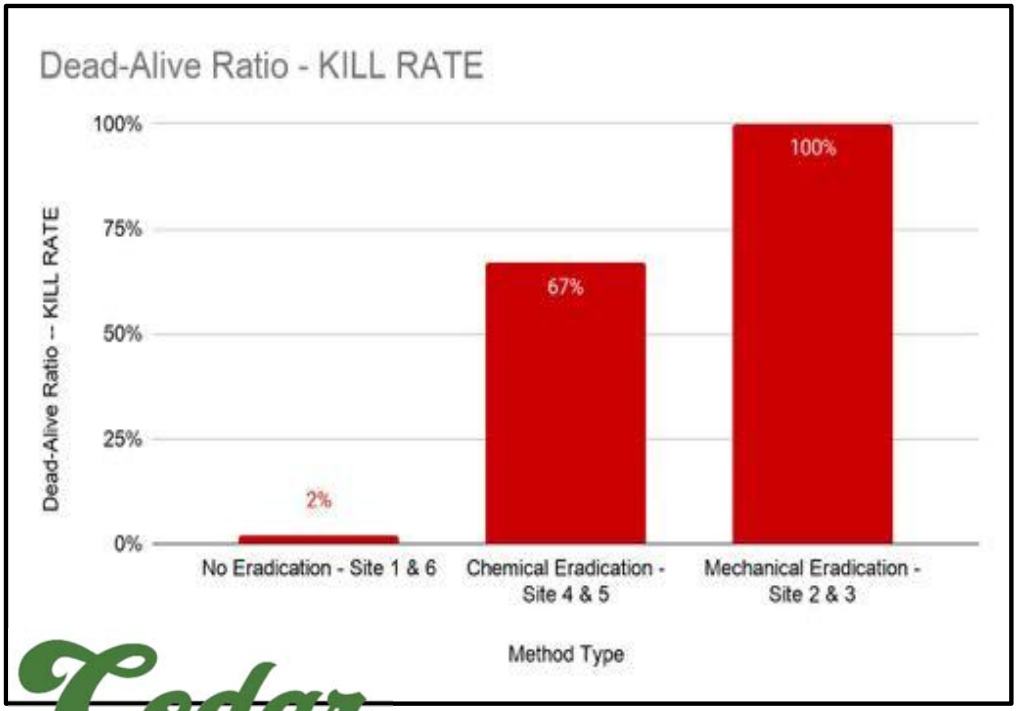
The mechanically grubbed area had perfect results, Duane Lucia said at least a 5% regrowth is typically seen after this treatment.

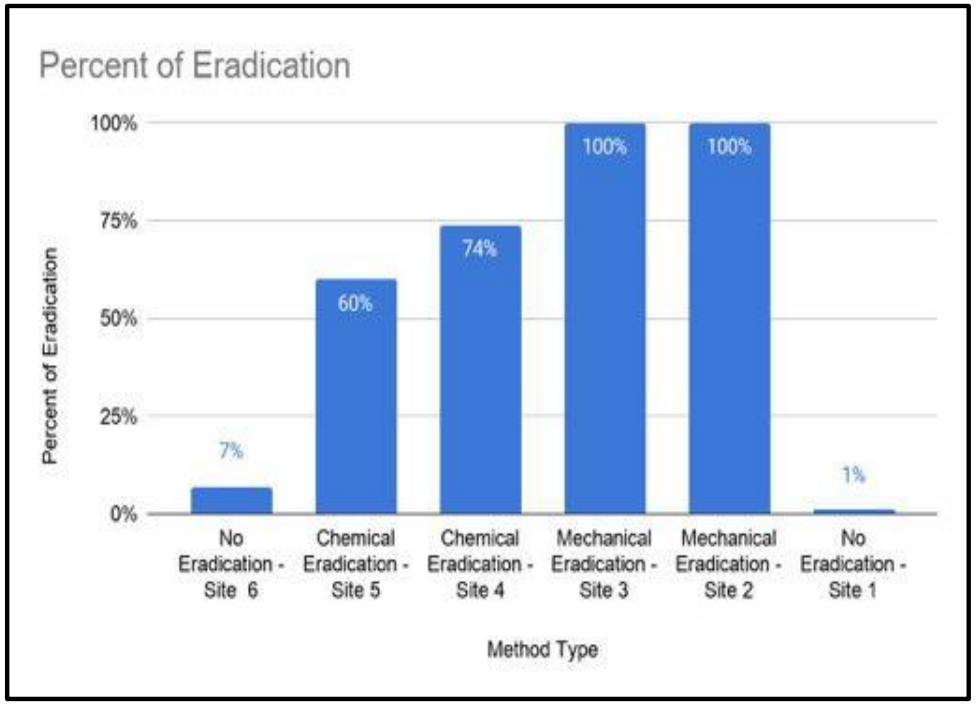




As a conclusion of this study, the Cedar Busters evaluated all six sites. Three groups counted the salt cedar growth along the 100m sampling area of McDonald Creek. An average was taken with each site's tallies of the dead/alive salt cedar thickets. Water samples were taken at each site, in triplicate, as a final analysis. This was listed as END on the bar graphs for turbidity, temperature, conductivity, salinity, dissolved oxygen, and pH.

After looking at the final count of Salt Cedar thickets on each site, the team was amazed with the mechanical eradication; 100% kill rate due to the grubbing removal.





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Is this the only factor to consider?

PROS vs CONS

Mechanical Eradication

Pros	Cons
• Immediately removes the salt cedar from the ground	• Very expensive *government funding can be used but an archeologist must come survey the land first
• There were absolutely no salt cedar on these sites *this is rare - typically there will be at least 5% regrowth	• Land is distrubed and has lots of exposed soil- this is more intensive to the system
• Opens up the land and helps the vegetation grow immediately	• Leaves tire tracks and piles of salt cedar on the bank, this harms the waterflow

Chemical Eradication

Pros	Cons
• Less expensive option - typically $109 per acre	• Poor penetration- did not reach all of the parts of the salt cedar *this due to the dense thickets
• Government funding is available and the process is simple *Contact Duane Lucia	• Kills native vegetation, and can create soil pollution
• Quick application - 10 gallons applied per acre (helicopter) *Other applications available: buggy, airplane, backpack	• A portion of the Salt Cedar is still thriving and a follow up application is necessary *crunching and spot spray

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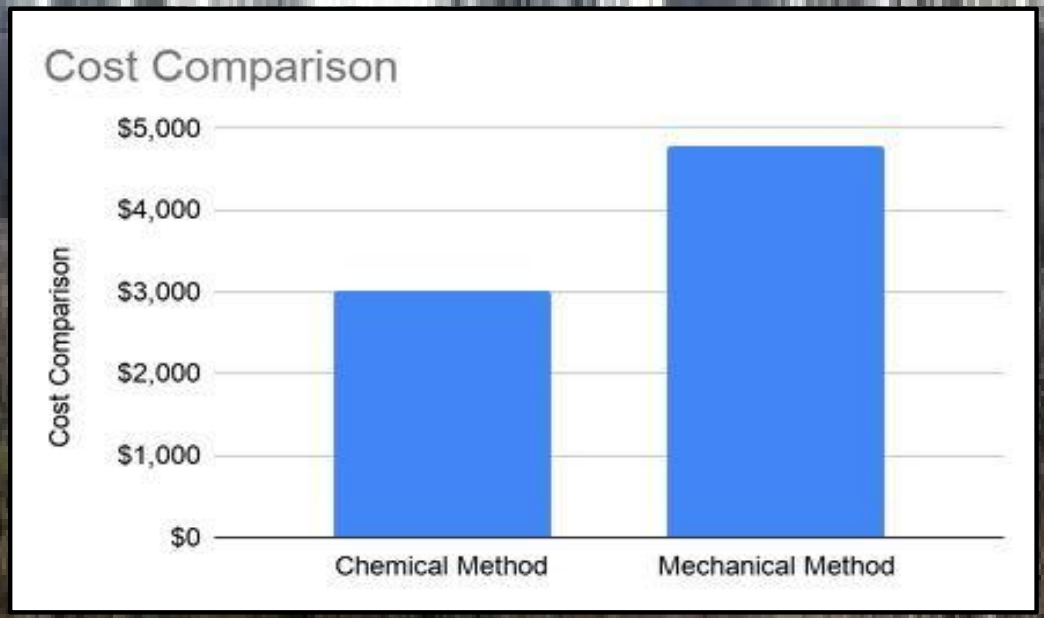
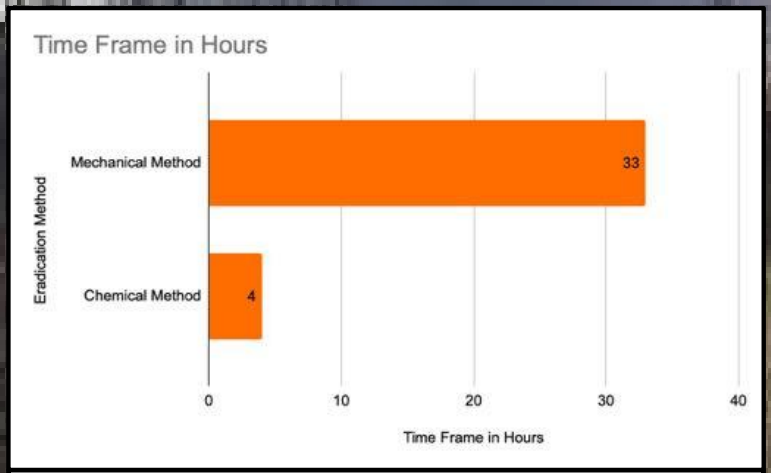
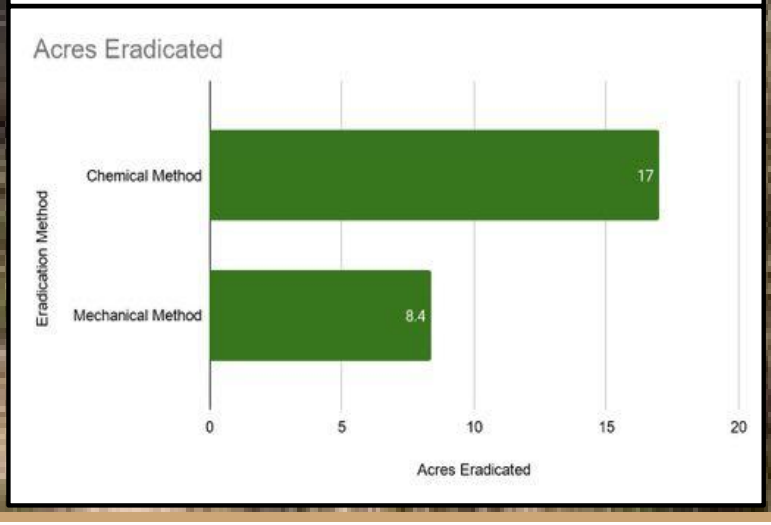
Eradication cost, time, and acres covered must be factored in too...







When evaluating the kill rate, financial cost, time involved, and acres eradicated, the Cedar Busters agree that the **mechanical** method of eradication is the best choice.

Conclusion:

Many different elements were evaluated over the course of this study. With a kill rate of 100%, mechanical grubbing worked best in terms of removal; however, the chemical eradication has more water flow. **Overall, our hypothesis of mechanical grubbing proved correct as a more effective eradication method.** When looking at the water quality in the 2 eradicated areas, these results were found:

Dissolved Oxygen (DO): Site 5 (**chemical**) has an average of 6.42 mg/L, and this measurement is best for growth and survival. The average of both chemical sites is 8.08 mg/L.

Conductivity: Overall, data is strongest in site 3 (**mechanical**), but the high spike in site 4 (chemical -mid point measurement) was a result from extreme temperatures. There were 11 days in a row of triple digit temperatures. This was an interesting measurement that we want to continue evaluating in the future.

Salinity: High salinity might be correlated to any kind of precipitation. Looking back on the times of measurements this is what was found: Beginning - 9 days before the measurements were taken, the area received 0.02" of rain. Middle - early to mid-July brought the heat. Highs reached the triple digits 11 days in a row. End - there was very little precipitation in January. 19 days before the measurements were taken, the creek had 0.1" of moisture. Salinity will be diluted if there is a large rainfall, but there was not. Sometimes there may be a hyper-saline event if there has only been a little bit of rainfall which would be caused by the salt on the shores being washed into the creek. This is a slight possibility. The clear winner is **mechanical** with and average of 3.81 PPT%; the chemical average was 5.105 PPT%.

Cedar BUSTERS

Conclusion continued:

pH: Nothing stands out as super consistent with this data. It appears that the chemical application may not have a negative effect on the creek. The mechanical average is 8.06 and chemical average is 9.02. The ranges are close, but **mechanical** is the winner. It does make us wonder how much the results would change if site 2 contained water over the study period. The water in site 2 is there, but it is underground.

Turbidity: The water collected during the study showed that the **chemical** sites had the optimum turbidity average of 5.45 NTU. The saltier the water means clearer water. Precipitation can also affect the results.

The drought played a significant role in the water quality tests.

Percent kill rate: Our team went to each site and counted dead and alive trees within a 100 meter sampling area.

- **Control sites** (1,6) Alive trees were present. Dead trees found were due to the life cycle. The thickets in site 6 were much larger than any other site.
- **Mechanical sites** (2,3) Grubbing was very effective. 100% Kill Rate in the counting radius.
- **Chemical sites** (4,5) The 67% kill rate is a success with the first application. There will be follow-up steps of spot spraying, crunching, and burning.

While looking for a consistent pattern that would show major differences with the 2 types of eradication treatments, the data is varied and many factors must be considered. The Cedar Busters, at this point of the study, would recommend the **mechanical** eradication method.

Future Plans:

- To repair the riparian system while keeping the salt cedar to a minimal.
- Bring back the native vegetation to improve the water quality and decrease the salinity in the creek.
- Continue this project with a prescribed burn of the chemically eradicated portion with US Fish & Wildlife. This must be completed 2-3 years after the aerial spray of the herbicide.
- Contact US Fish & Wildlife about eradication plans for the two neighboring ranches (control sites) about future eradication of the saltcedar.
- Introduce new independent chemicals to help increase the pH to try to help the survival of the fish in the creek.

Salt Cedar

and Termite Resistance

Problem

Is salt cedar resistant to termites?
Will termites eat salt cedar or is the salinity too high for their liking?

Background

Cedar Busters was invited in by the Three Gringos Ranch to study the effectiveness of salt cedar eradication and the effects on water quality after the eradication process was complete. The ranch had previously made an effort to eliminate salt cedar along the McDonald Creek bed in hopes of restoring and expanding surface water. The ranch was divided into four sites, two of which (sites 4 & 5) were treated chemically via helicopter by US Fish and Wildlife Service. Salt cedar was mechanically grubbed out at two other sites (3 & 4). Adjoining ranch owners with untreated land allowed for a comparison of two other sites (sites 1 & 6) as a control for the project and for comparison purposes.

Hypothesis

We believe that salt cedar is termite resistant. If salt cedar is resistant to termites, then the wood could be mulched and used as ground cover or could be used as a building material. This would be a good way to use the otherwise wasted material from eradication. It could also be used for furniture or tools.

The pictures on the right are of the termite trap we planted initially near a pile of wood.

Materials

Salt cedar log, termite bait station, termites, and shovel

Safety Precautions

Appropriate clothing should be worn to protect team members from harsh weather conditions while burying and checking the termite station.

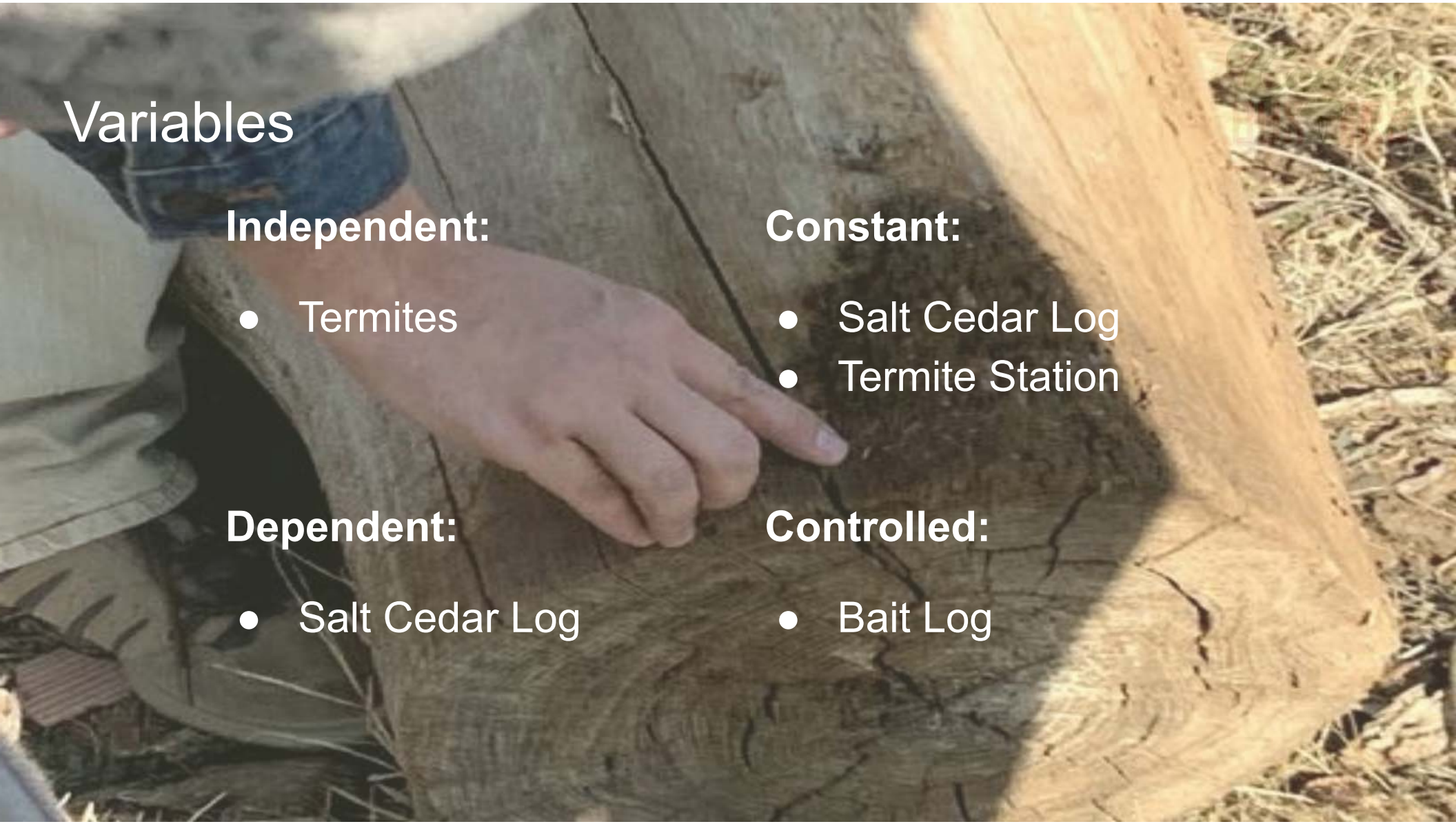
Team members should be aware of surroundings and use caution when turning over logs while looking for termites.

The band saw to be used to remove bark from the salt cedar log will be operated by a skilled adult.

Care will be taken when removing the salt cedar log from the station in case arachnids or other insects are present.

Procedure

We will test if salt cedar is resistant to termites. We will place a salt cedar log in a termite station buried in the ground near a wood pile. We will check to see if the termites eat the salt cedar. We will record our results during the procedure.



Variables

Independent:

- Termites

Constant:

- Salt Cedar Log
- Termite Station

Dependent:

- Salt Cedar Log

Controlled:

- Bait Log

Timeline

November 21, 2020	Cedar Busters met with Mr. William Marshall of Terminix to learn to identify termites, the damage they cause and learn more about their behavior. Mr. Marshall provided the team with a termite station so we could test our hypothesis.
November 26, 2020	Termite station was planted near a woodpile at site #1
January 16, 2021	Cedar Busters met to check for termite damage on the salt cedar log inside of the termite station - no damage was observed
January 25, 2021	Termite station removed from site #1
January 30, 2021	Cedar Busters met Mr. William Marshall to replant the termite station at site #2
February 13, 2021	Travel to site to check termite station for damage to the salt cedar log
February 20, 2021	Travel to site to check termite station for damage to the salt cedar log

Qualitative Observations - Results

January 16, 2021	No damage to salt cedar log observed at site #1
January 25, 2021	Termite station is removed from original location for replanting since no activity was observed in initial location
January 30, 2021	Cedar Busters met Mr. William Marshall to replant the termite station where the team had met initially to observe active termites
February 13, 2021	No termite damage observed at site #2
February 20, 2021	No termite damage observed at site #2

1/16/2021

1/30/2021

2/13/2021

2/20/2021

Conclusions

Our hypothesis that termites would not feed on salt cedar because of its high salinity holds true so far. The termite station has been planted near a wood pile on the ground since November 26, 2020. Since that time, no termite damage has been observed on the log at site #1 or site #2. We did have a severe freeze unlike what is typical in our area from February 14 -18, 2021. This has the potential to impact our data if termites were dormant or died during this time.

Future Plans

Mr. Marshall has graciously accepted our request to leave the station at its current location so that our team can continue to check for damage. We are hopeful our hypothesis continues to hold true so that we might be one step closer to confidently identifying salt cedar as a strong candidate for termite resistant wood.

A REPURPOSING PROJECT

Chipping Salt Cedar to be used as Garden Mulch

Cedar BUSTERS

Problem:

Dead salt cedar is usually discarded after being eradicated.

- **Is there a way to successfully repurpose salt cedar after being eradicated?**

Cedar Busters is trying to find a way to repurpose the eradicated salt cedar thickets.

Hypothesis:

This is the shredder we used to make the salt cedar mulch. A kind neighbor let us borrow his chipper for the experiment.

If salt cedar is disposed of after eradication, then garden mulch is a successful way to repurpose it.

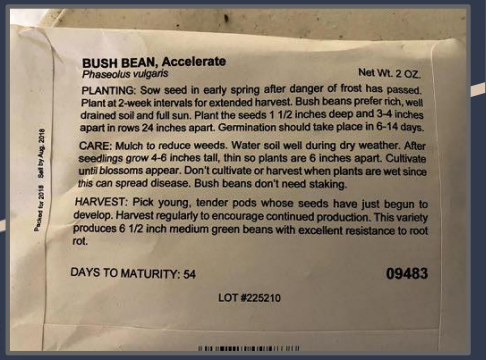
Cedar BUSTERS

Safety Precautions:

There was very low risk involving this experiment but all of the research and conducting of this experiment was done under adult or under a guardian's supervision. Eye and Ear protection was worn while chipping the branches. All lab procedures were followed when examining the wood chip in the school's lab. Masks were worn in the classroom.

Cedar BUSTERS

Materials:



Cedar BUSTERS

- Salt cedar branches
- Red Oak branches
- Sears/Craftsman 9HP Shredder
- Galvanized buckets
- Trash cans
- Safety goggles
- Ear protection
- Ziplock bags
- Computer
- Microscope
- Microscope slides
- Scale
- Growing tent
- Controller for the tent (to control heat humidity etc..)
- Berger BM7 bark mix
- Red oak wood mulched
- Salt cedar mulched
- Bean seeds
- Water
- Measuring Cup
- Planter Boxes

Variables:

Constants:

- Same amount of bean seeds planted
- Same amount of mulch in grams added
- Same amount of time the beans were grown
- Same amount of water added to each planter
- Same amount of humidity, heat, and moisture throughout the experiment

Independent:

- Different kind of wood chipped
  - Salt cedar
  - Red Oak

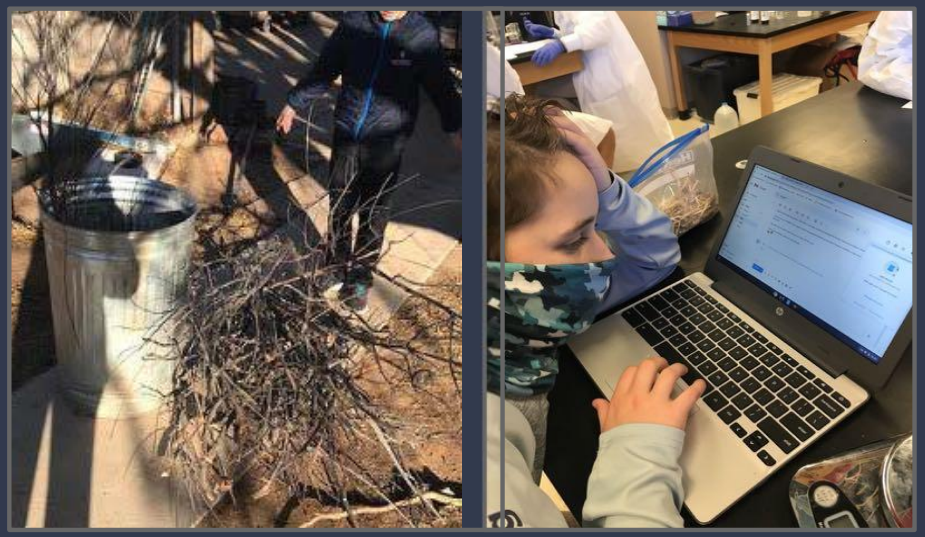
Dependent:

- Amount of bean grown (in triplicate layout)
- Number of sprouts per container

Controlled:

- Same Plant
- Amount of Water
- Soil
- Container

Procedure:



The salt cedar thickets were excavated manually in 2019 and have been piled along the side of the creek.

Cedar BUSTERS

1. Gathered salt cedar branches from the ranch.
2. Cut down red oak branches from front yard tree.
3. Brought both types of wood to neighbor's house to chip the branches with the Sears/Craftsman 9HP Shredder. Eye and ear protection were both worn.
4. As the wood was being shredded, the wood chips would fall in the designated galvanized bucket.
5. Separated the red oak mulch and the salt cedar mulch in two different galvanized trash cans.
6. Put the salt cedar and red oak in labeled ziplock bags and delivered them to the Cedar Busters team.
7. The team analyzed the salt cedar and red oak mulch in the science lab making notes of the properties of each style of wood chips..
8. Team examined both kinds of wood chips through a microscope while taking notes. Team members placed a small amount of the wood type on the microscope slides.
9. Team weighed the salt cedar as another comparison.

Procedure Continued:

Cedar BUSTERS

10. Team set up planter boxes, a growing tent and controller to regulate heat and humidity.

11. Soil was added to box #1 with bean seeds. 1” of water was added to this first section.

12. Saltcedar mulch was added to the soil and bean seeds in the box #2. 1” of water was added to this second section.

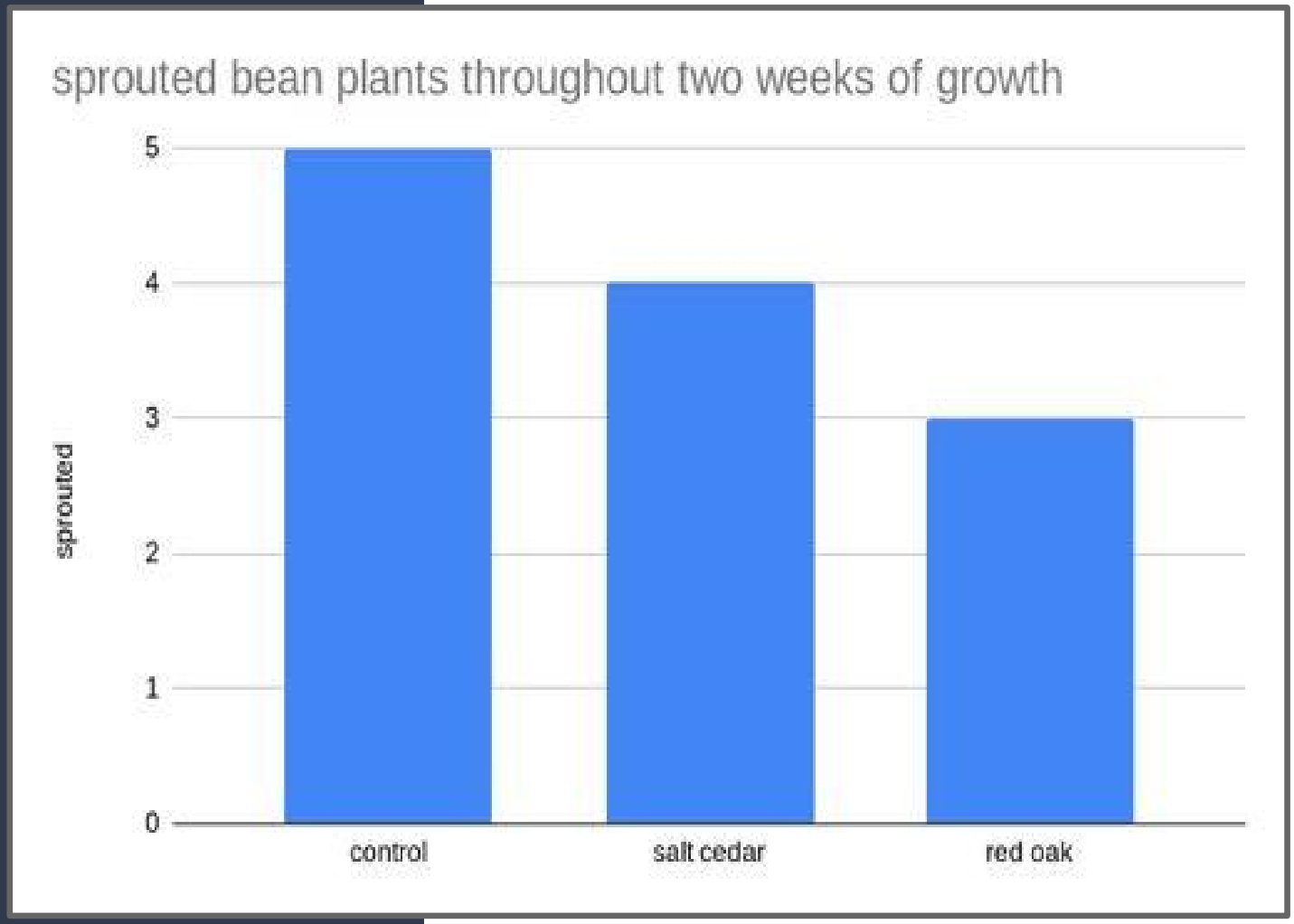
13. Red oak mulch was added to the soil and bean seeds in the box #3. 1” of water was added to this second section.

14. After 2 weeks, we observed how many bean sprouts were in each planter.

15. Finally, we recorded the data we learned.

Data:

The data shows that the control (just soil and plant) had 5 bean sprouts throughout 2 weeks. Salt cedar in a mulched state with soil and a bean plant produced 4 sprouts over the span of 2 weeks. Finally, red oak in a mulched state with soil and a bean plant produced 3 sprouts over a span of 2 weeks.



Conclusion:

In conclusion, our hypothesis was refuted because the control had more sprouts than the salt cedar mulch.

The results were:

- Five sprouts in the control planter
- Four sprouts in the salt cedar planter
- Three sprouts in the red oak planter

Salt cedar mulch had more sprouts than the red oak mulch, however, the control (just the soil) is better than both salt cedar and red oak.

Cedar BUSTERS

Future Plans:

Cedar BUSTERS

Do more testing with the salt cedar mulch now that we know the beans were able to germinate.

A future concern would be that the salt may come out in the fibers and harm the plant. We would want to expand this experiment.

- Test potted plants, vegetables, and wheat.
- Combine wet leaves with the wood chips to make a more efficient mulch.

If the plants dies, then an alternate experiment would be conducted.

- The wood chips could be used as trail material that would discourage vegetation growth.

Oil absorption

A Salt Cedar Repurposing Project

Cedar BUSTERS

PROBLEM

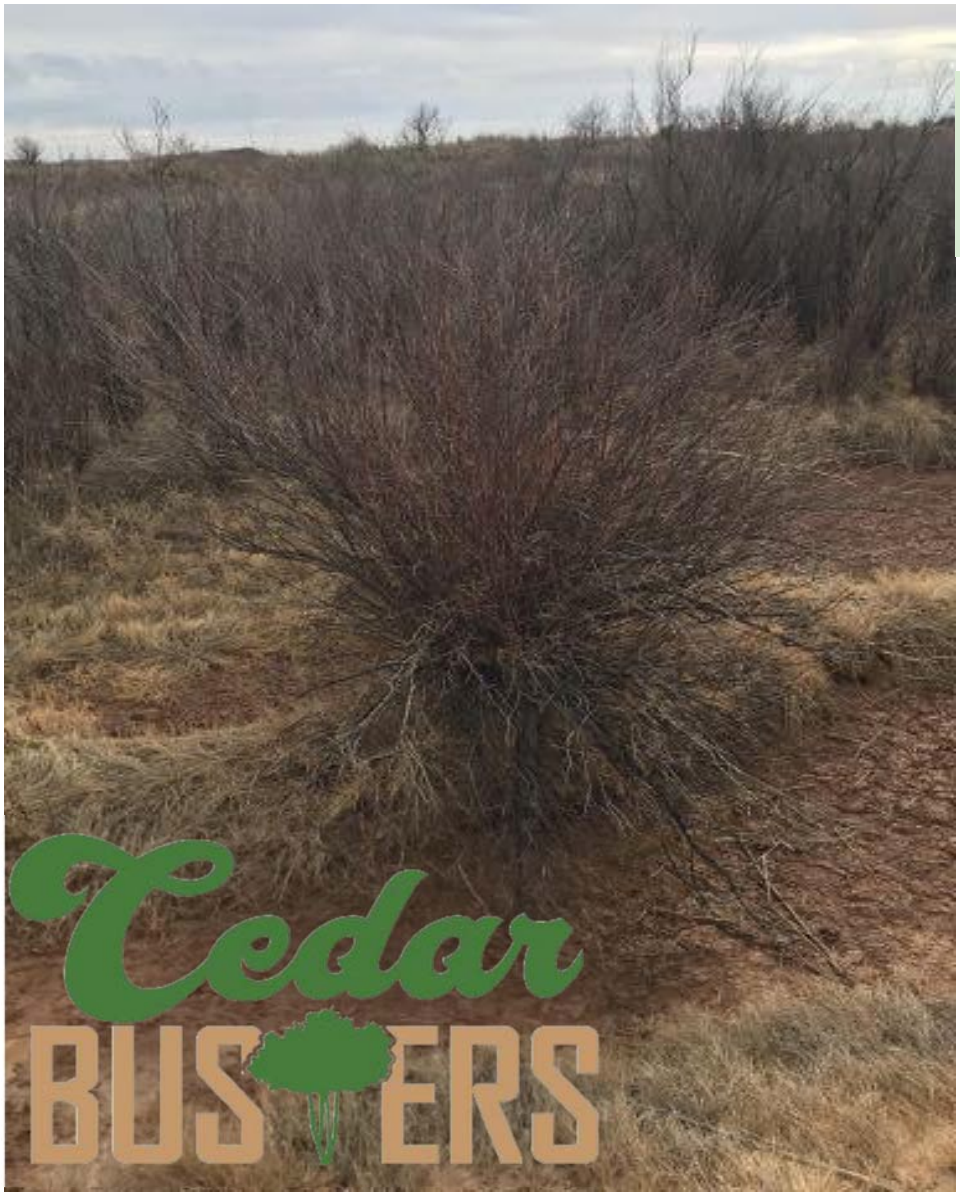
Salt cedar is very dangerous for wildlife ecosystems due to its ability to out-compete native vegetation, and it's need for tremendous amounts of water. As a result, it is burned, grubbed, mechanically removed, and chemically sprayed by land managers to eradicate them. When eradicated, it is disposed. **Is there a way to successfully repurpose salt cedar?**

Cedar BUSTERS

Our plan

Our plan is to create uses for salt cedar following eradication because it is otherwise a waste. The Cedar Busters team will be conducting an experiment that will test if oil can be absorbed by salt cedar. If it does, it can create a way to stop oil spills from ruining water/ocean life and water/ocean ecosystems. Salt cedar is absorbent in other areas, therefore, we believe it could be designed for application in the petroleum industry. There was very low risk involving this experiment, but all of the research and conducting of this experiment was done under a parent's or a guardian's supervision.

Cedar BUSTERS



Question

Salt cedar uses its tap roots to absorb water deep underground.

Could salt cedar be used to absorb oil from oil spills?

Our team thinks that salt cedar will be able to absorb oil efficiently.

Hypothesis

If salt cedar can be used to stop oil spills, then it would be a successful way to repurpose the salt cedar thickets.

Materials

- Castrol GTX Oil
- Solo Cups
- Salt cedar (mulched)
- Scale (g)
- Beaker (ml)
- Food processor
- Sheets of paper to record information
- Strainer

CONSTANTS

Same amount of oil (50 ml per cup)

Same amount of salt cedar sawdust (15g per cup)

Same type of cup

Same scale measured in grams

All test conducted for same period of time and in triplicate

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Dependent and independent variable

Dependent:

Amount of oil will be absorbed by the salt cedar based on amount of oil remaining in cup

Independent:

Amount of oil put into the cups and how much salt cedar mulch was used to absorb the oil

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PROCEDURE

1. Using the salt cedar chips from the mulch investigation, the team used a food processor to chop the wood chips into a fine dust.

2. First, we took six empty cups and filled them with the same amount of oil. (47.35 grams or 50 ml)

3. Then, we took salt cedar sawdust and put 15 grams into three of the cups. (test group)

4. Next, we took the remaining three cups and used them as a control which contained just oil. (Control group)

5. After 14 days, we poured oil through a strainer to remove the salt cedar and to measure the ending weight of the oil alone.

6. We compared the weight of the oil to our beginning weight to determine the amount of oil that the salt cedar had absorbed accounting for the weight of the cup.

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Data - quantitative

Starting weight of control:

- Cup 1 - start 48 grams, end 48 grams
- Cup 2 - start 49 grams, end 49 grams
- Cup 3 - start 52 grams, end 52 grams

Absorption test:

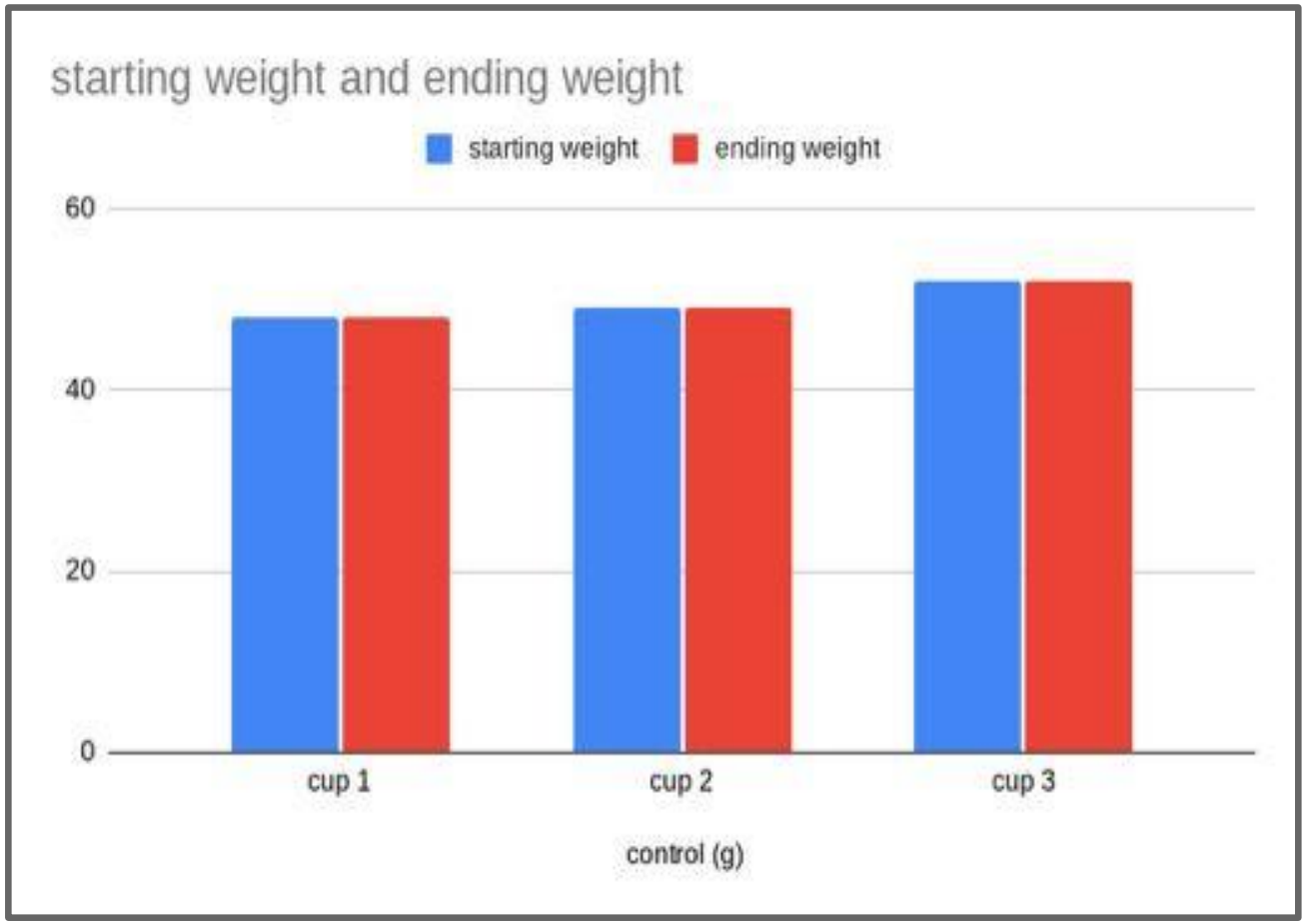
- Cup 1 - (23 g - 5 g SC) / 5 = 3.6 g
- Cup 2 - (18 g - 5 g SC) / 5 = 2.6 g
- Cup 3 - (20 g - 5 g SC) / 5 = 3.0 g

3.6 g + 2.6 g + 3.0 g = 9.2 g / 3 = 3.06 g of absorption per gram of salt cedar mulch.

Cedar BUSTERS

Data graph 1

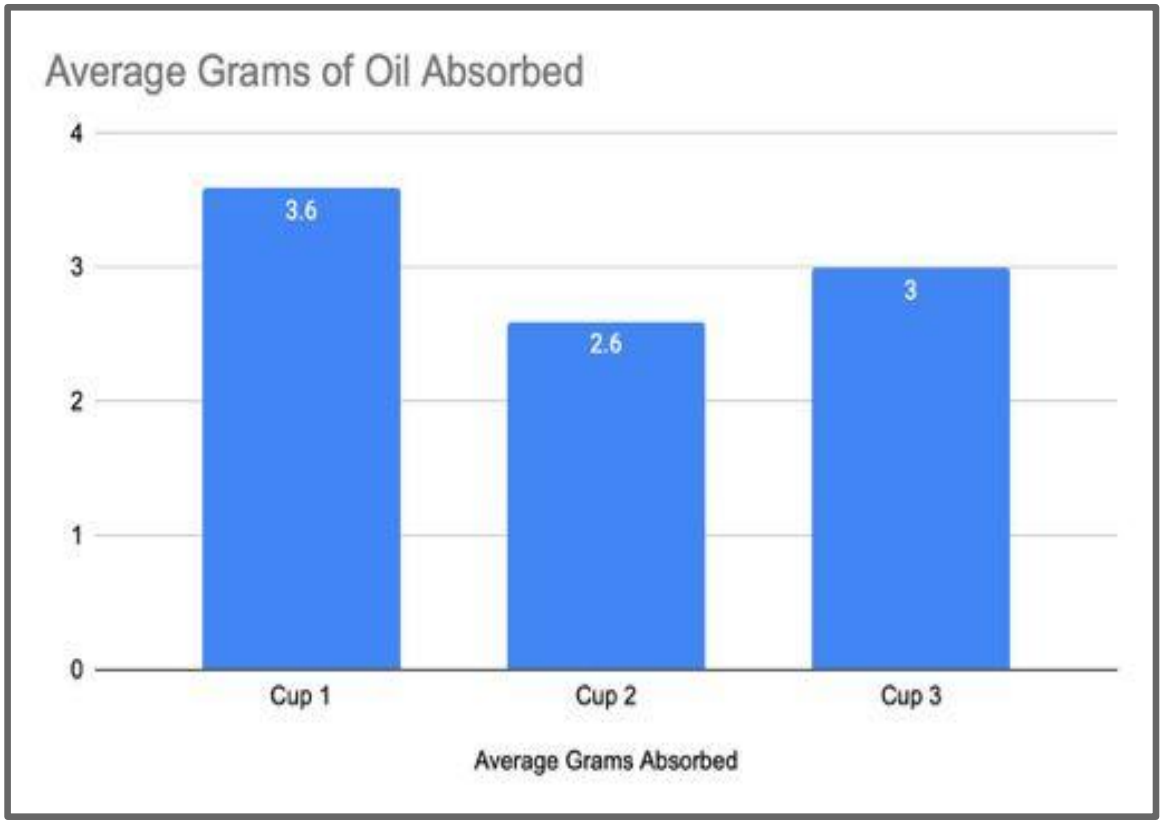
Data graph of control showing that oil does not evaporate because the starting weight is equal to the ending weight.



Data graph 2

Data graph of absorption experiment with salt cedar, resulting in:

- Cup 1 had an average of 3.6 grams of oil absorbed per gram of salt cedar.
- Cup 2 had 2.6 grams of oil absorbed per gram of salt cedar.
- Cup 3 resulted in an average of 3.0 grams of oil absorbed per gram of salt cedar.



Data- qualitative

Over the two weeks that this experiment was conducted, the team noticed that the salt cedar looked as if they were soaking up the oil, but it was very hard to tell if the oil was actually being absorbed. After a week, you could see the oil being absorbed slowly, but it was being absorbed by the salt cedar nonetheless. The very last day the experiment was conducted, we noticed the oil had not been completely absorbed, but a large portion of the oil had.

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CONCLUSIONS

The control had no change since oil cannot evaporate, but cup 1 would absorb 3.6 g of oil per gram of salt cedar. Cup 2 would absorb 2.6 g of oil per gram of salt cedar. Finally cup 3 would absorb 3.0 g of oil per gram of salt cedar. Making the salt cedar 66% effective to absorb oil. Meaning that 1 pound of oil (3785 grams) would take 1,237 grams of salt cedar to absorb. Concluding that our hypothesis was correct because salt cedar did absorb oil like it was predicted.

Cedar BUSTERS

Future plans

Because salt cedar can work as a way to absorb oil, then in the future we will test what other types of liquids salt cedar mulch can absorb. The Cedar Busters will experiment with a variety of liquids like chemicals and other solutions.

Salt Cedar Filtration Experiment

ECYBERMISSION

Problem

Cedar BUSTERS

Salt cedar is a problem for the ecosystems around it. It kills organisms with its high sodium content and consumes water all around it. As a result, landowners seek to eradicate salt cedar trees by burning, grubbing or chemically spraying them. When eliminated, it is disposed of, so what is a good way to repurpose salt cedar?

Our Plan

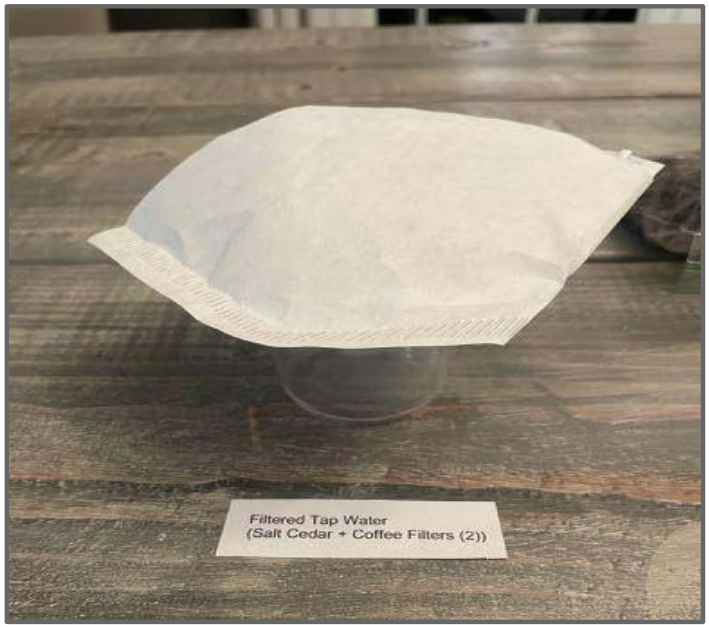
Cedar BUSTERS

We plan on building a water filter out of salt cedar to see if the sodium content of the bark can help filter out calcium & magnesium from tap water.

Hypothesis

Cedar BUSTERS

We believe that a salt cedar filter will work in filtering out calcium & magnesium from tap water.



Materials

salt cedar, coffee filters, tap water, bottled water, cups, water hardness test strips

Cedar BUSTERS

Safety Precautions

Cedar BUSTERS

Care was taken when filling coffee filters with salt cedar and when using the stapler.

Variables

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Dependent Variables

Water Hardness Test Strips

Independent Variables

Salt Cedar Mulch

Controlled Variables

Tap Water Bottled Water Coffee Filters

Constant

Cups

Procedure

Cedar BUSTERS

We measured the water hardness of the following:

1. Tap water
2. Tap water filtered with salt cedar mulch & coffee filters
3. Tap water filtered only by coffee filters
4. Bottled water only

Procedure Continued

STEPS

1. We dipped a water hardness test strip in plain tap water for 1 second, shook off the excess water and waited 30 seconds before reading the results.

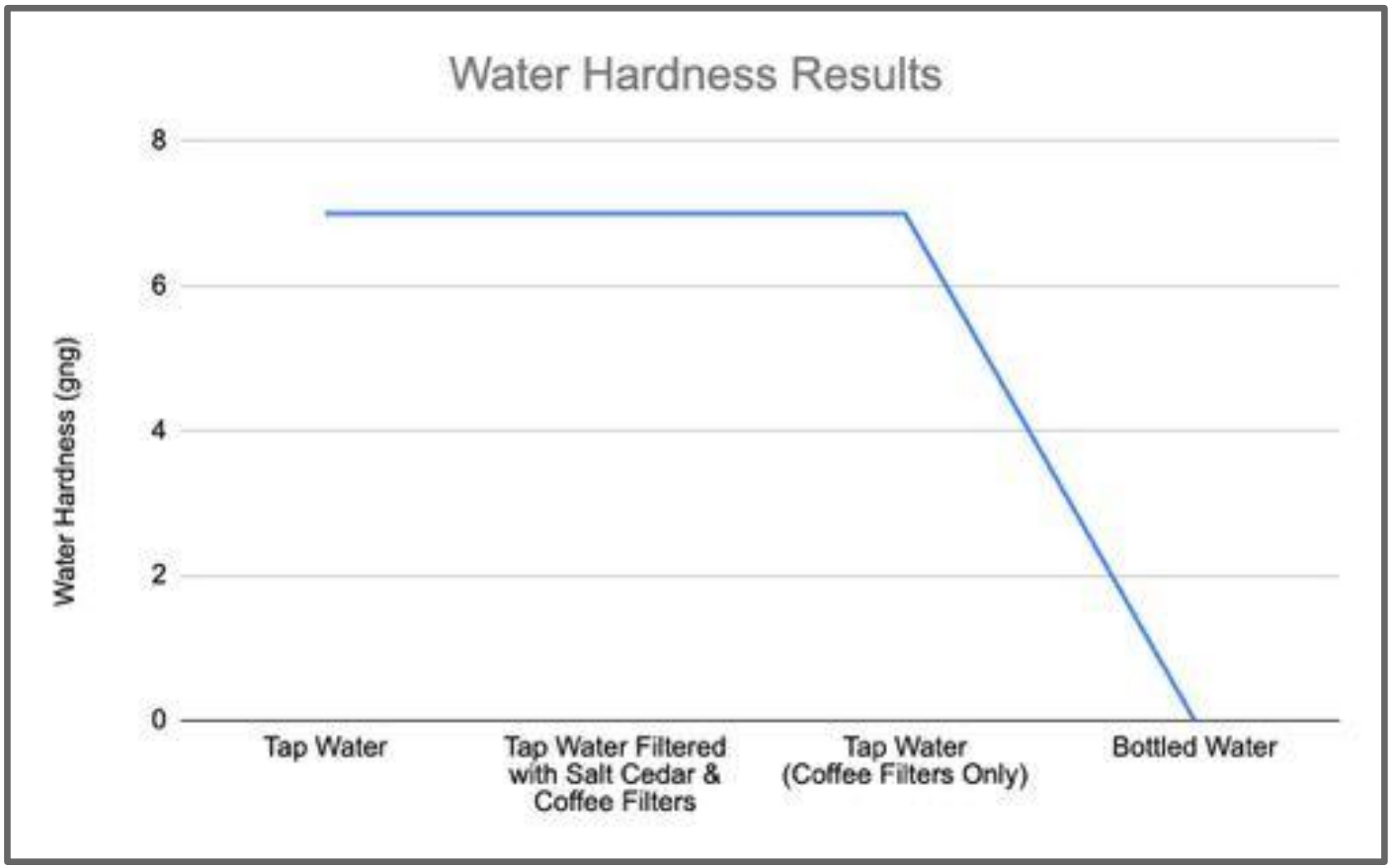
2. We placed salt cedar inside two coffee filters and stapled the top. We poured tap water over the coffee filters filled with salt cedar to collect a filtered water sample. We dipped a hard water test strip in the filtered water for 1 second, shook off the excess water and read the results after 30 seconds.

Procedure Continued

STEPS

3. We dipped a water hardness test strip in tap water filtered with 2 coffee filters for 1 second, shook off the excess water and waited 30 seconds before reading the results.
4. We dipped a water hardness test strip in bottled water for 1 second, shook off the excess water and waited 30 seconds before reading the results.

Quantitative Data



Quantitative Data

Tap Water Only

Water Hardness Reading
7 gpg / 120 ppm

Quantitative Data

Tap Water Filtered by Salt Cedar & Coffee Filters

Water Hardness Reading
7 gpg / 120 ppm

Quantitative Data

Tap Water Filtered with Coffee Filters

Water Hardness Reading
7 gpg / 120 ppm

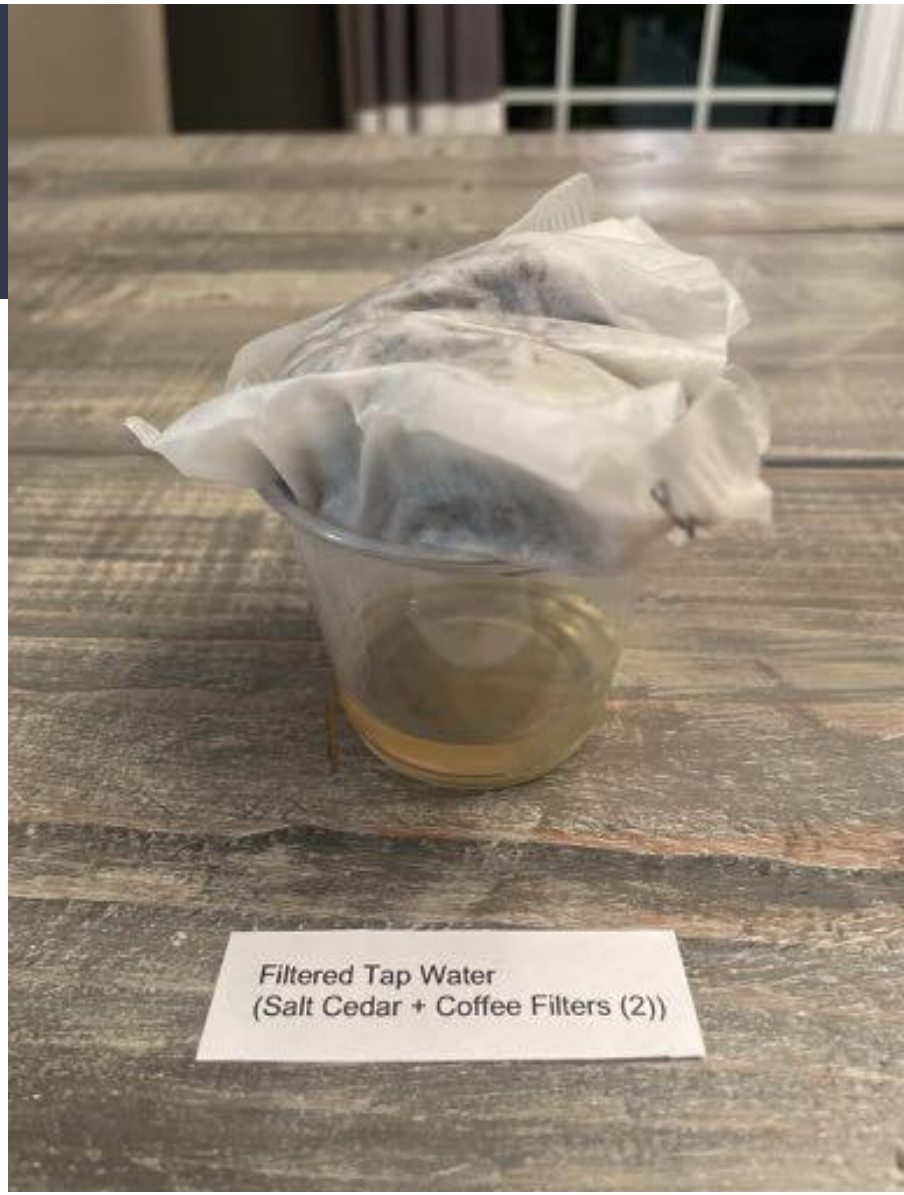
Quantitative Data

Bottled Water Only

Water Hardness Reading
0 gpg / 0 ppm

Qualitative Data

One thing we did not expect to see was the change in the color of the water that was produced as tap water was poured over the filters containing salt cedar. It turned the water a brown color. No other changes were observed.



Conclusion:

Our results showed that the salt cedar filter was ineffective in filtering out the dissolved calcium and magnesium in the water. The bottled water measured out to zero on the water hardness scale (gpg) while all tap water samples regardless of whether salt cedar or coffee filters were used to filter out calcium and magnesium resulted in NO change. All samples measured seven on the water hardness test strips which showed us that no calcium or magnesium were being filtered out by the salt cedar mulch.

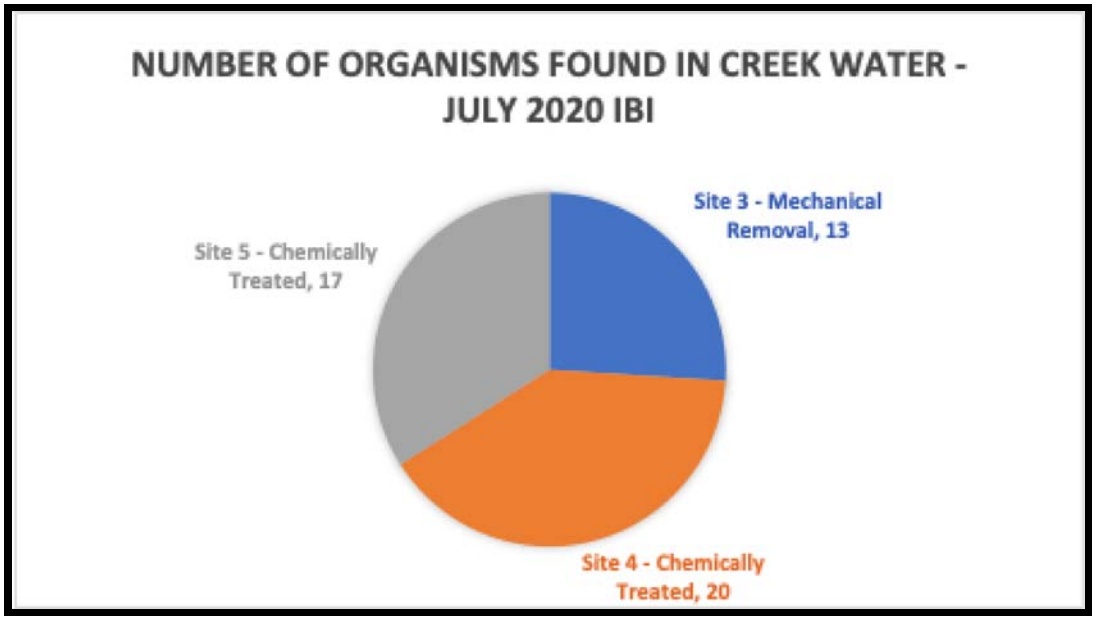
Future Plans

Our future plans are to continue to study salt cedar's resistance to termites, research how to restore the native vegetation of the ranch after eradication, and explore additional ways salt cedar can be repurposed to benefit the community.

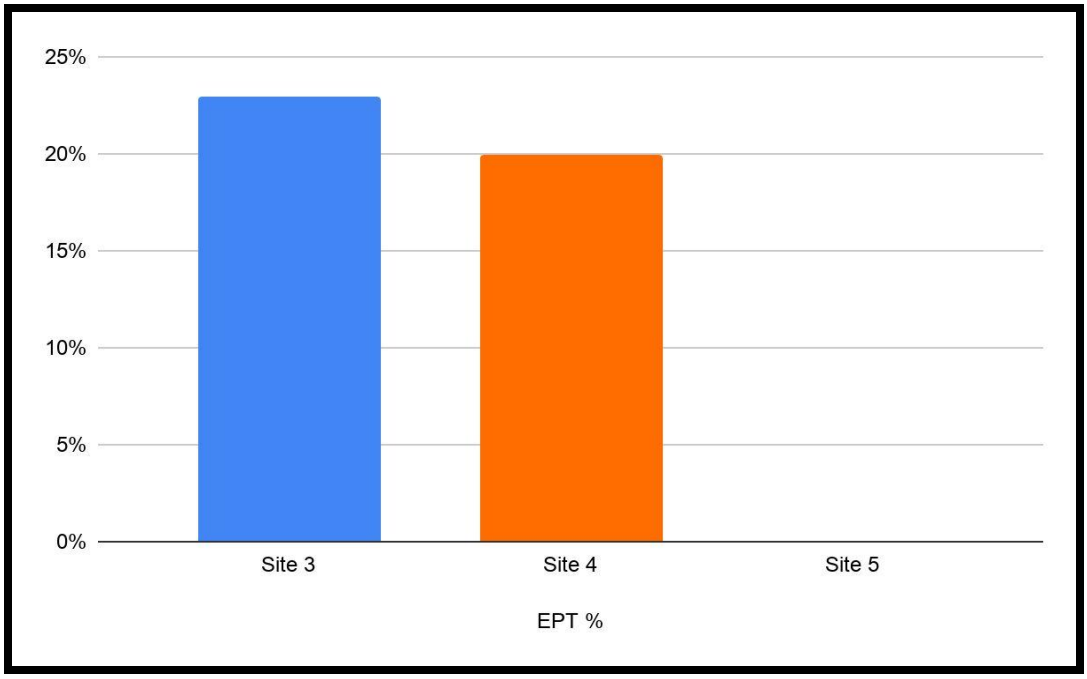
Also view the Google Slides (pdf) Presentation of this investigation.

Investigation 1: Cedar Busters in the Field: Eradication and Water Quality

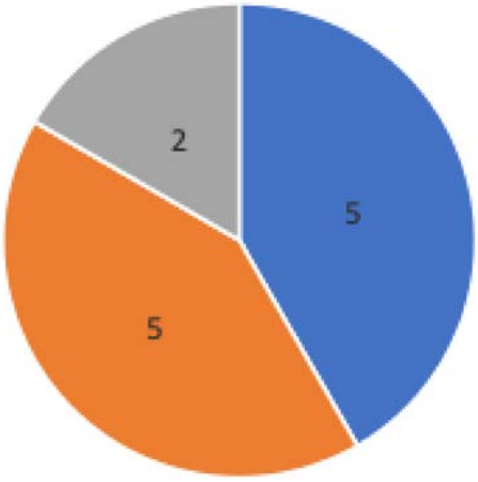
Hypothesis 1: If mechanical and chemical eradication of salt cedar are both applied to the intermittent spring-fed creek, then the mechanical grubbing area will be more successful with growth in the aquatic and riparian ecosystems along McDonald Creek.



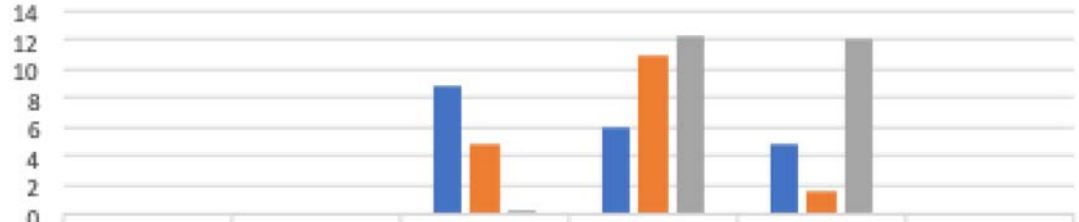
EPT% CHART (Ephemeroptera, Trichoptera, Plecoptera)



Number of Taxa Found in Creek Water - July 2020 IBI



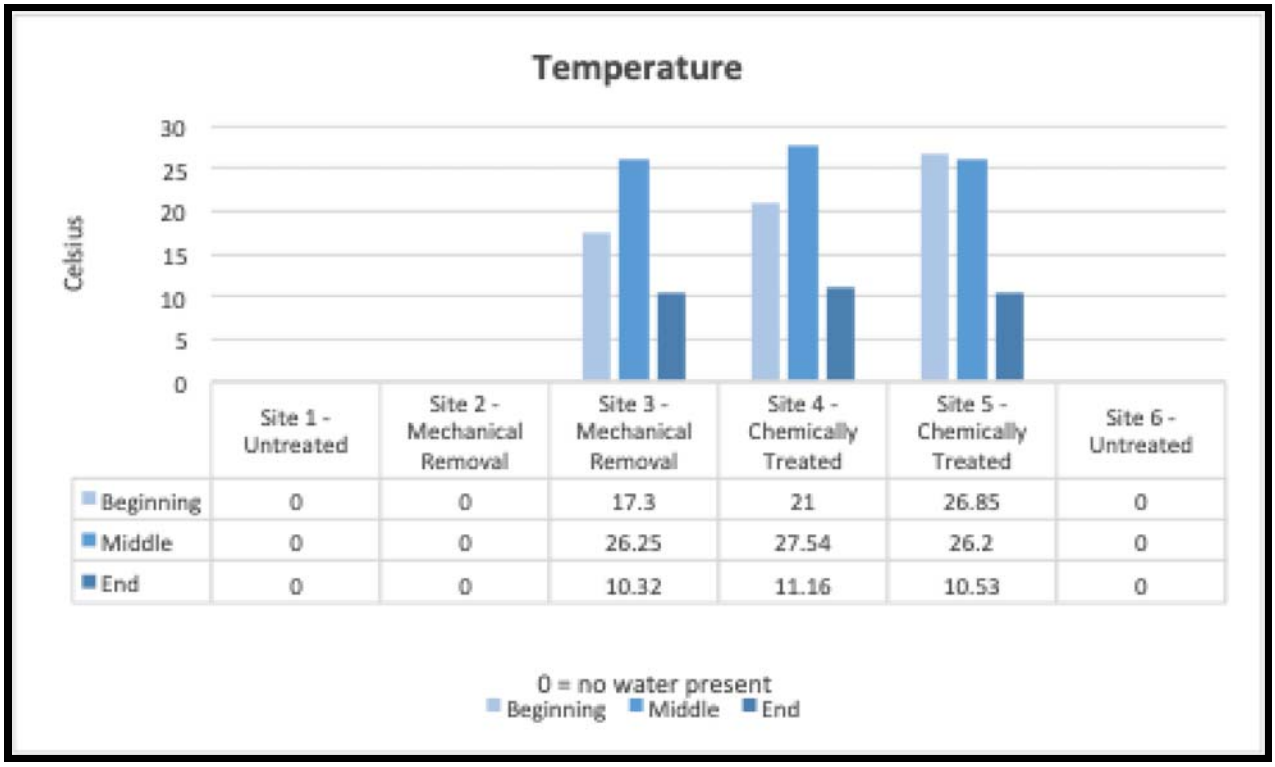
Dissolved Oxygen



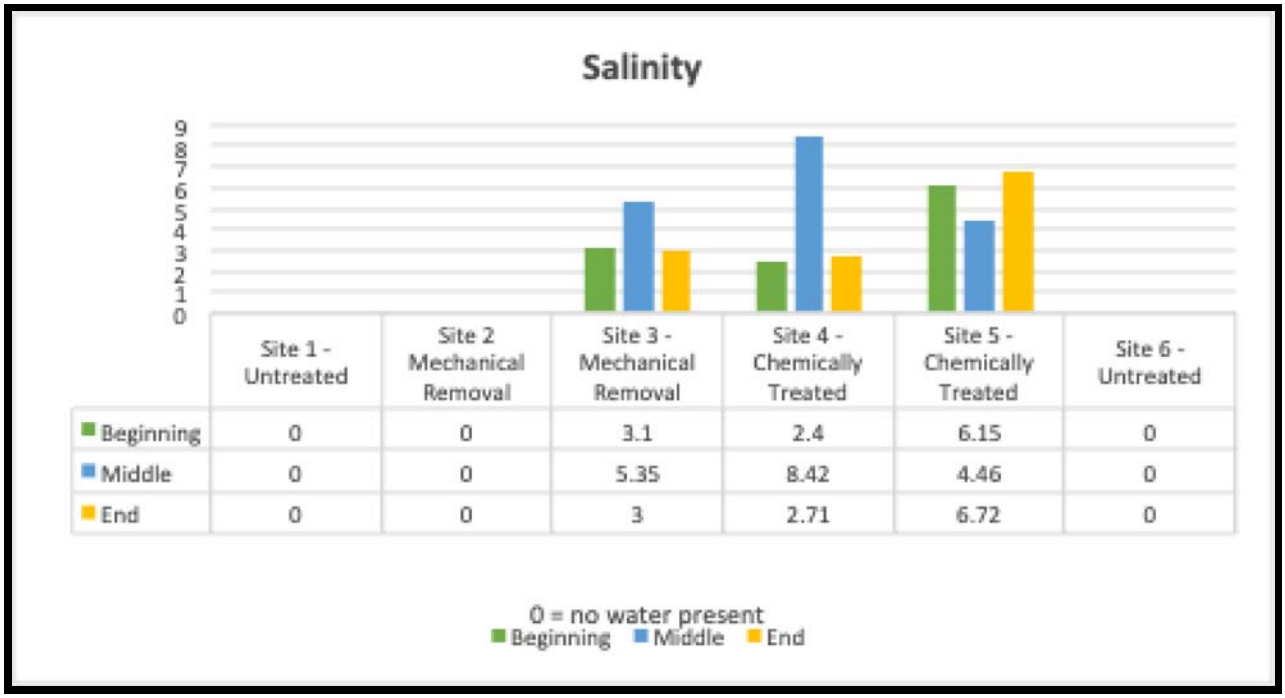
	Site 1 - Untreated	Site 2 Mechanical Removal	Site 3 - Mechanical Removal	Site 4 - Chemically Treated	Site 5 - Chemically Treated	Site 6 - Untreated
Beginning	0	0	8.89	5.97	4.75	0
Middle	0	0	4.75	10.98	1.54	0
End	0	0	0.07	12.27	12.08	0

0 = no water present

Beginning Middle End

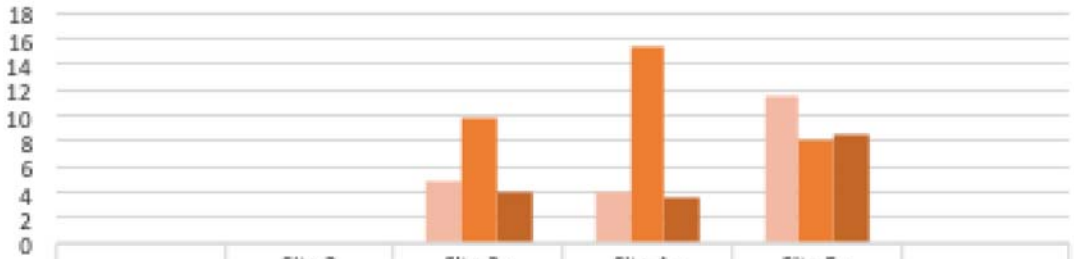


	Site 1 - Untreated	Site 2 - Mechanical Removal	Site 3 - Mechanical Removal	Site 4 - Chemically Treated	Site 5 - Chemically Treated	Site 6 - Untreated
Beginning	0	0	17.3	21	26.85	0
Middle	0	0	26.25	27.54	26.2	0
End	0	0	10.32	11.16	10.53	0



	Site 1 - Untreated	Site 2 Mechanical Removal	Site 3 - Mechanical Removal	Site 4 - Chemically Treated	Site 5 - Chemically Treated	Site 6 - Untreated
Beginning	0	0	3.1	2.4	6.15	0
Middle	0	0	5.35	8.42	4.46	0
End	0	0	3	2.71	6.72	0

Conductivity

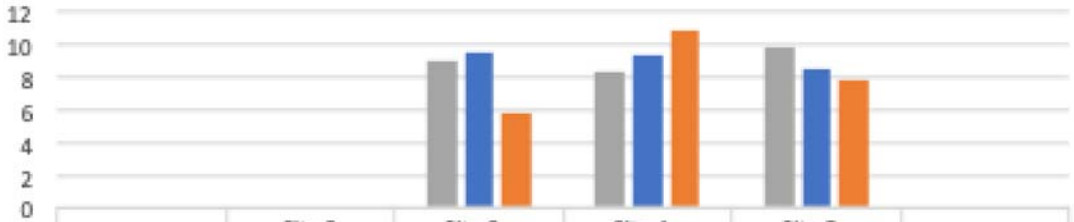


	Site 1 - Untreated	Site 2 Mechanical Removal	Site 3 - Mechanical Removal	Site 4 - Chemically Treated	Site 5 - Chemically Treated	Site 6 - Untreated
Beginning	0	0	4.916	4.1	11.5	0
Middle	0	0	9.827	15.31	8.12	0
End	0	0	3.98	3.63	8.54	0

0 = no water present

Beginning Middle End

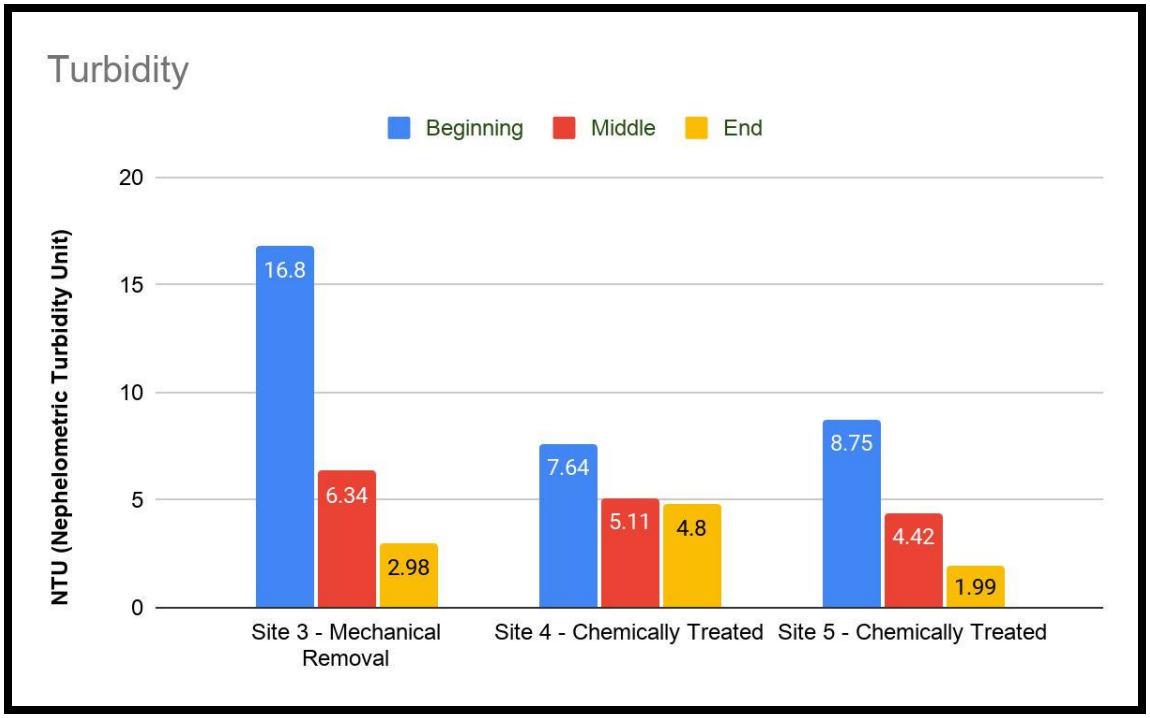
pH

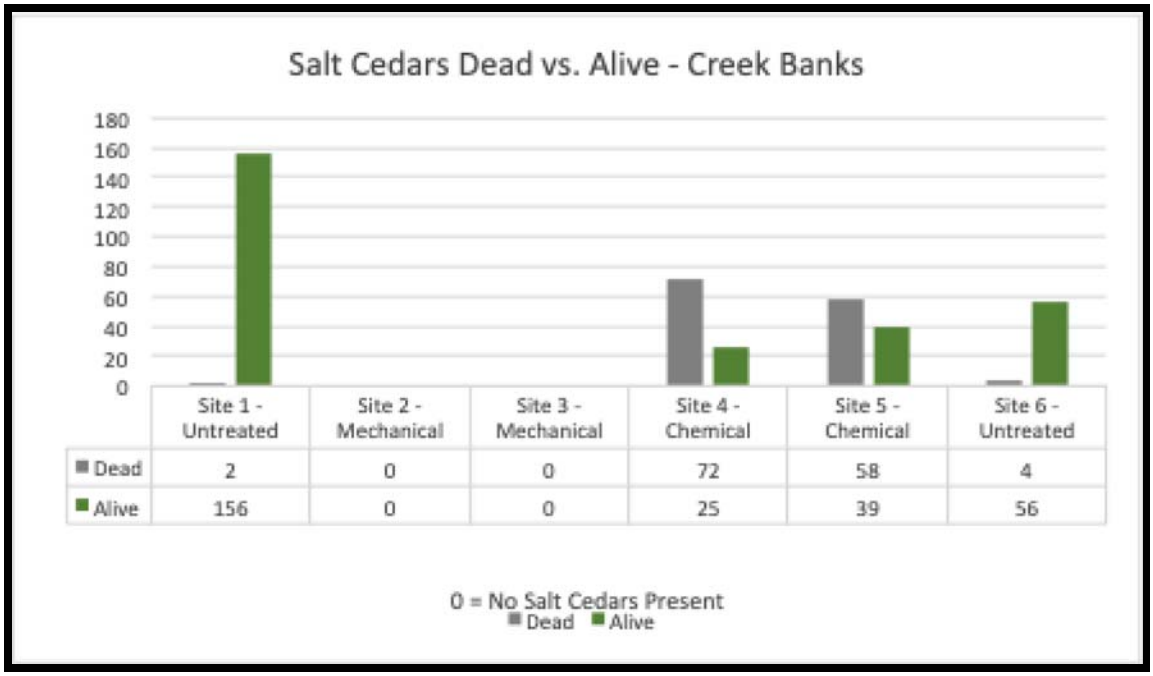


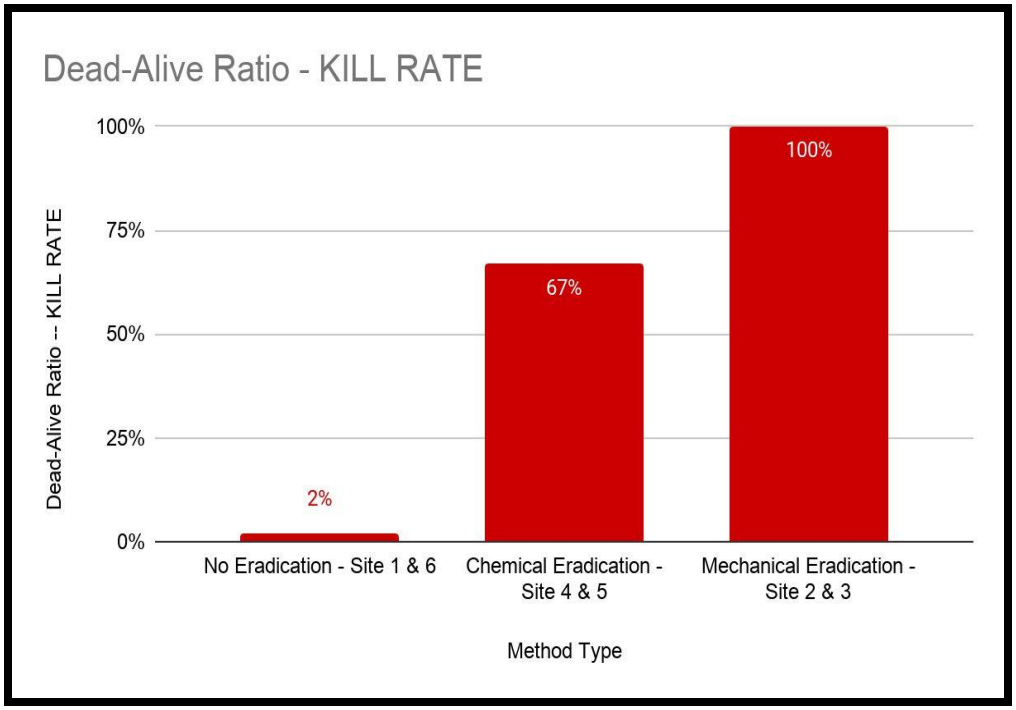
	Site 1 - Untreated	Site 2 Mechanical Removal	Site 3 - Mechanical Removal	Site 4 - Chemically Treated	Site 5 - Chemically Treated	Site 6 - Untreated
Beginning	0	0	8.98	8.25	9.71	0
Middle	0	0	9.46	9.3	8.38	0
End	0	0	5.75	10.73	7.85	0

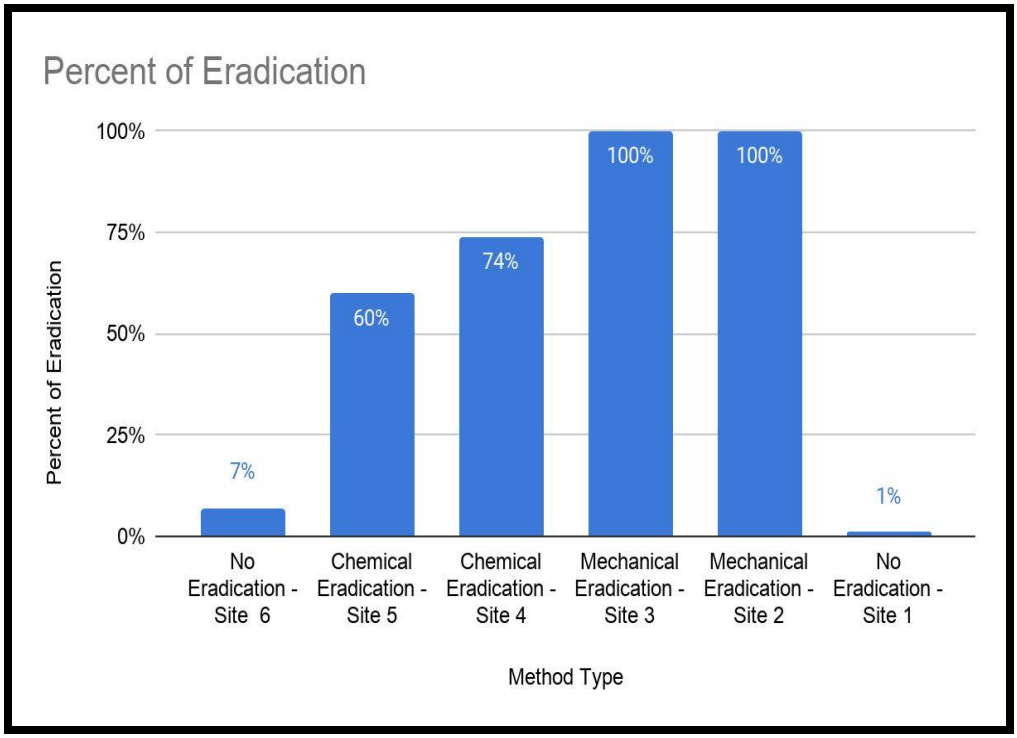
0 = no water present

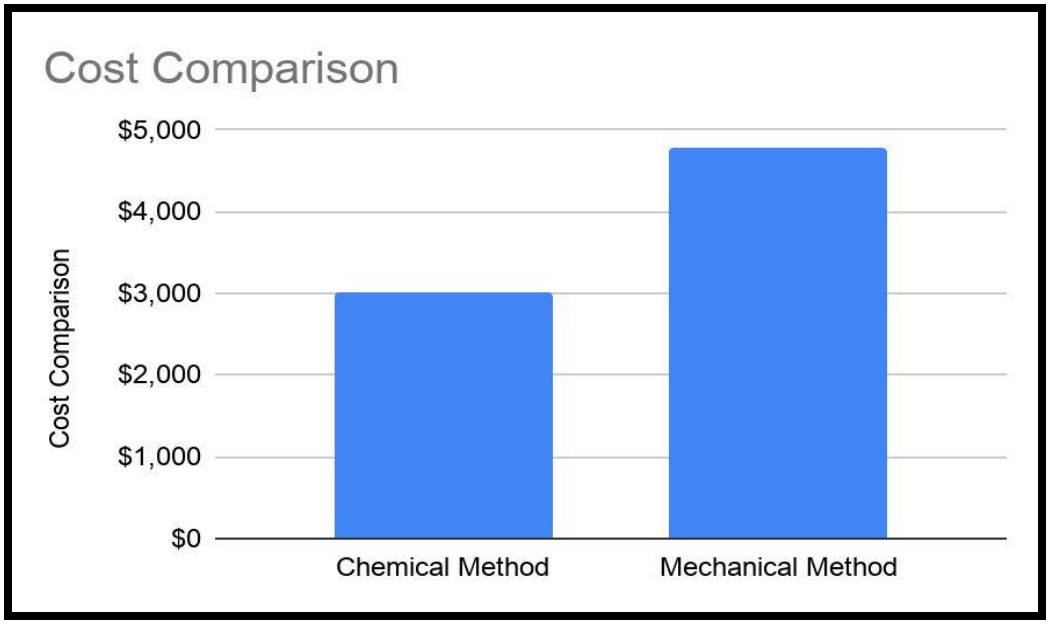
Beginning Middle End

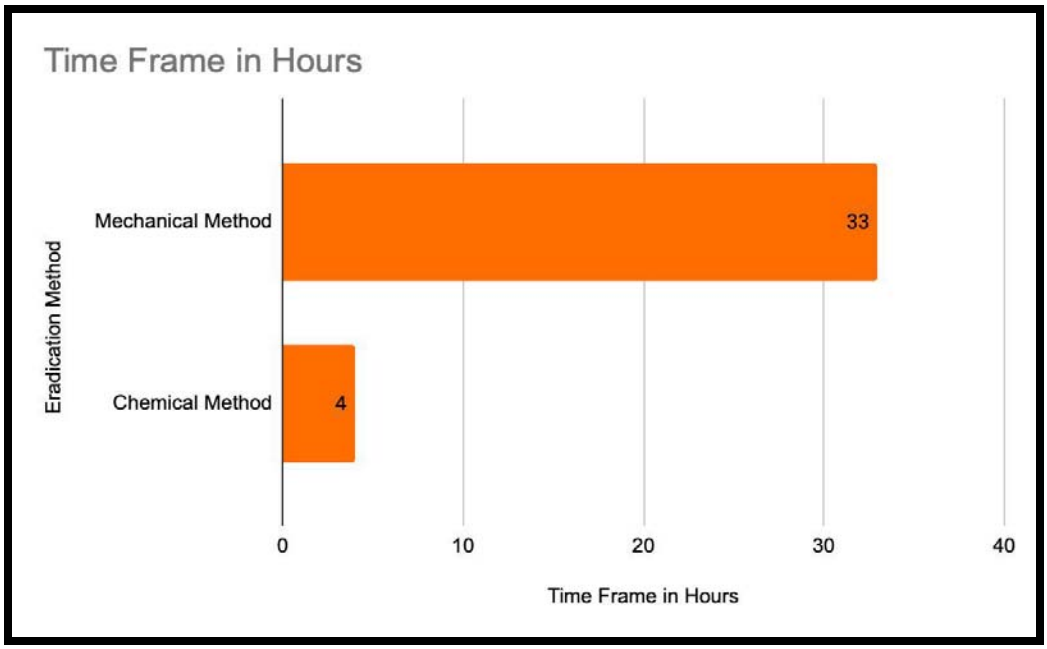

Turbidity
Beginning
Middle
End
NTU (Nephelometric Turbidity Unit)
20
15
10
5
0
16.8
6.34
2.98
7.64
5.11
4.8
8.75
4.42
1.99
Site 3 - Mechanical Removal
Site 4 - Chemically Treated
Site 5 - Chemically Treated

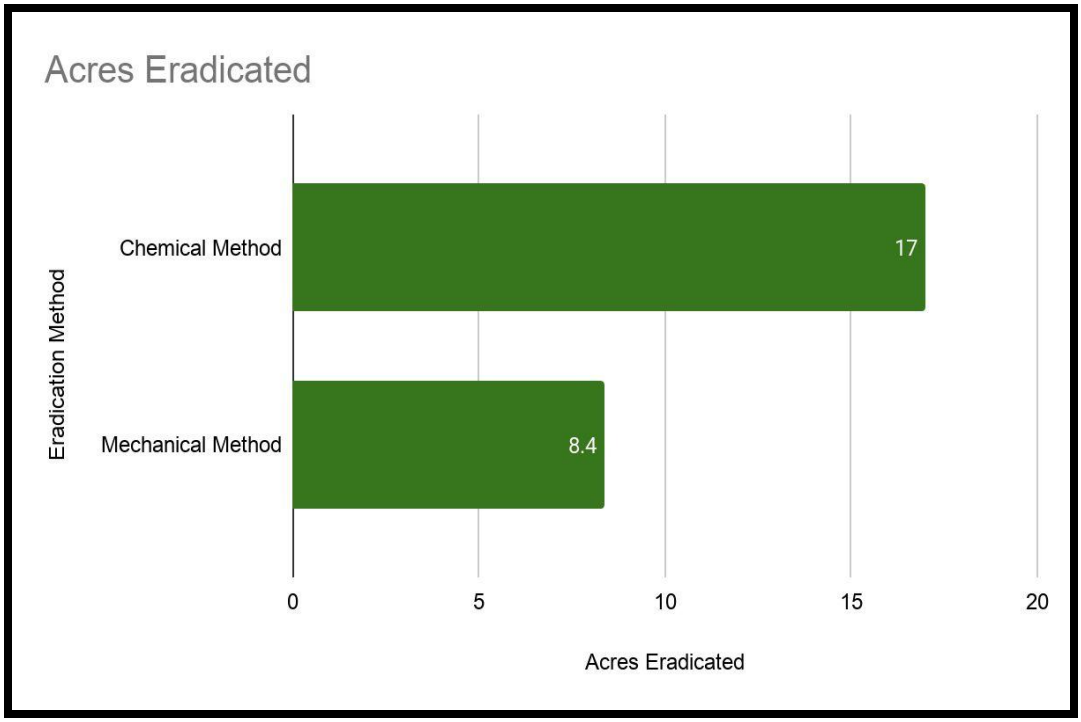

Salt Cedars Dead vs. Alive - Creek Banks
180
160
140
120
100
80
60
40
20
0
Site 1 - Untreated
Site 2 - Mechanical
Site 3 - Mechanical
Site 4 - Chemical
Site 5 - Chemical
Site 6 - Untreated
Dead 2 0 0 72 58 4
Alive 156 0 0 25 39 56
0 = No Salt Cedars Present
Dead
Alive


Dead-Alive Ratio - KILL RATE
Dead-Alive Ratio -- KILL RATE
100%
75%
50%
25%
0%
2%
67%
100%
No Eradication - Site 1 & 6
Chemical Eradication - Site 4 & 5
Mechanical Eradication - Site 2 & 3
Method Type


Percent of Eradication
Percent of Eradication
100%
75%
50%
25%
0%
7%
60%
74%
100%
100%
1%
No Eradication - Site 6
Chemical Eradication - Site 5
Chemical Eradication - Site 4
Mechanical Eradication - Site 3
Mechanical Eradication - Site 2
No Eradication - Site 1
Method Type


Cost Comparison
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Cost Comparison
Chemical Method
Mechanical Method

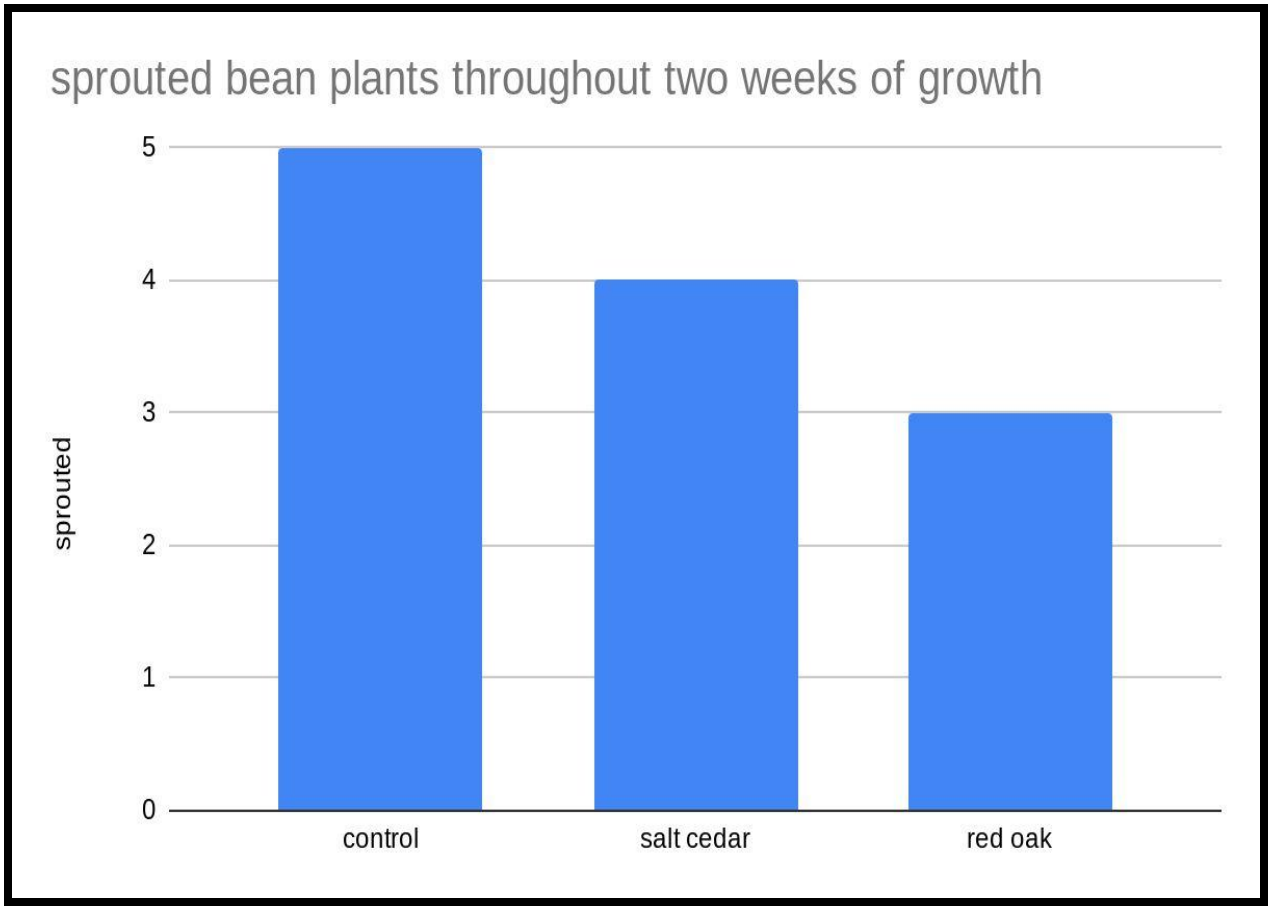

Time Frame in Hours
Mechanical Method
33
Chemical Method
4
Eradication Method
0
10
20
30
40
Time Frame in Hours


Acres Eradicated
Chemical Method
Mechanical Method
17
8.4
Eradication Method
0
5
10
15
20
Acres Eradicated

Also view the Google Slides Presentation of this investigation.

Investigation 3: Repurposing Salt Cedar as Garden Mulch

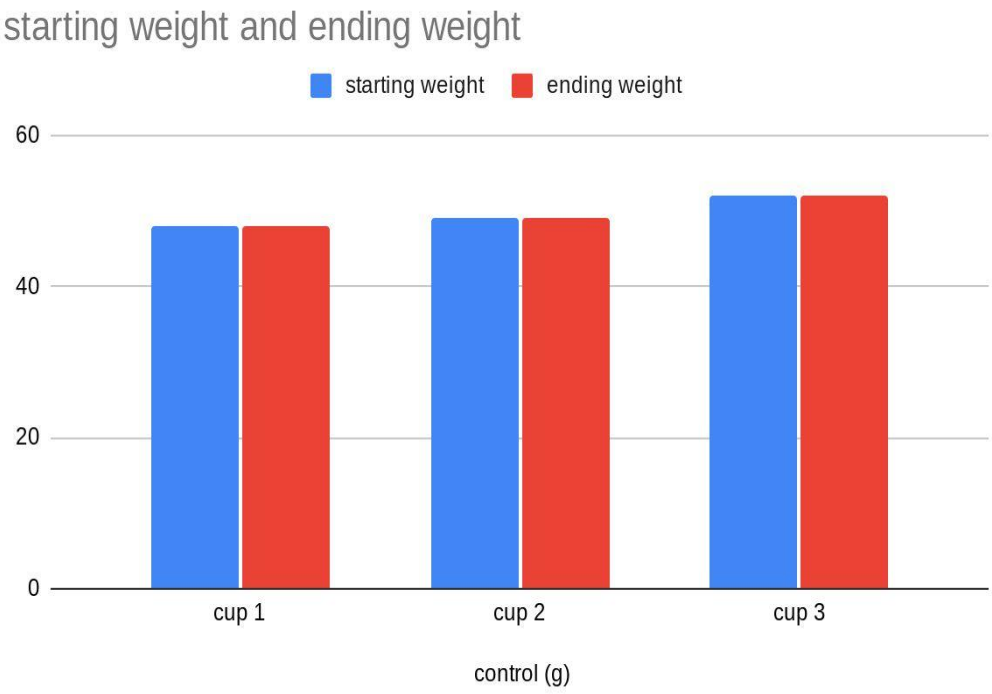
Hypothesis 3: If salt cedar is disposed of after eradication, then garden mulch is a successful way to repurpose it.

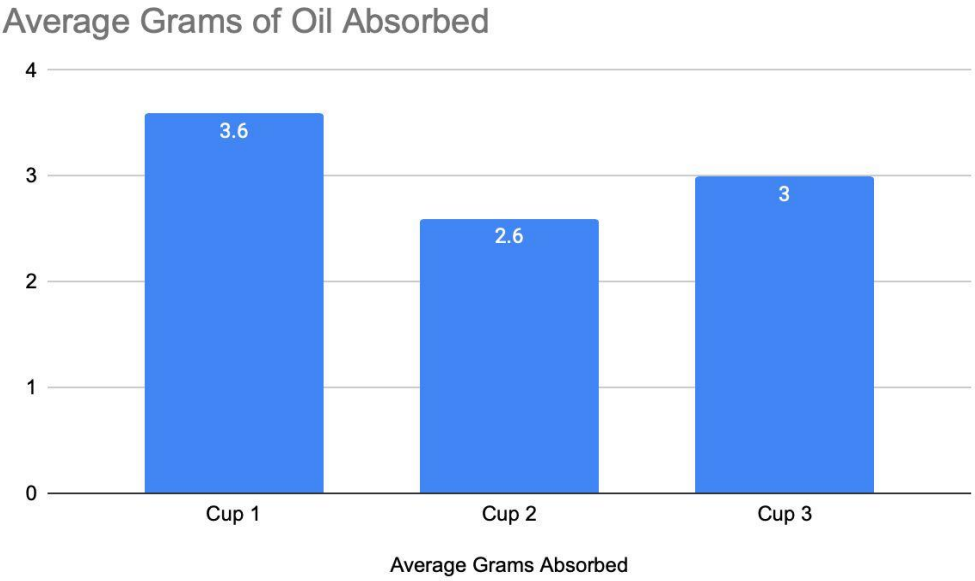


Also view the Google Slides Presentation of this investigation.

Investigation 4: Oil Absorption - A Salt Cedar Repurposing Project

Hypothesis 4: If salt cedar can be used to stop oil spills, then it would be a successful way to repurpose the salt cedar thickets.

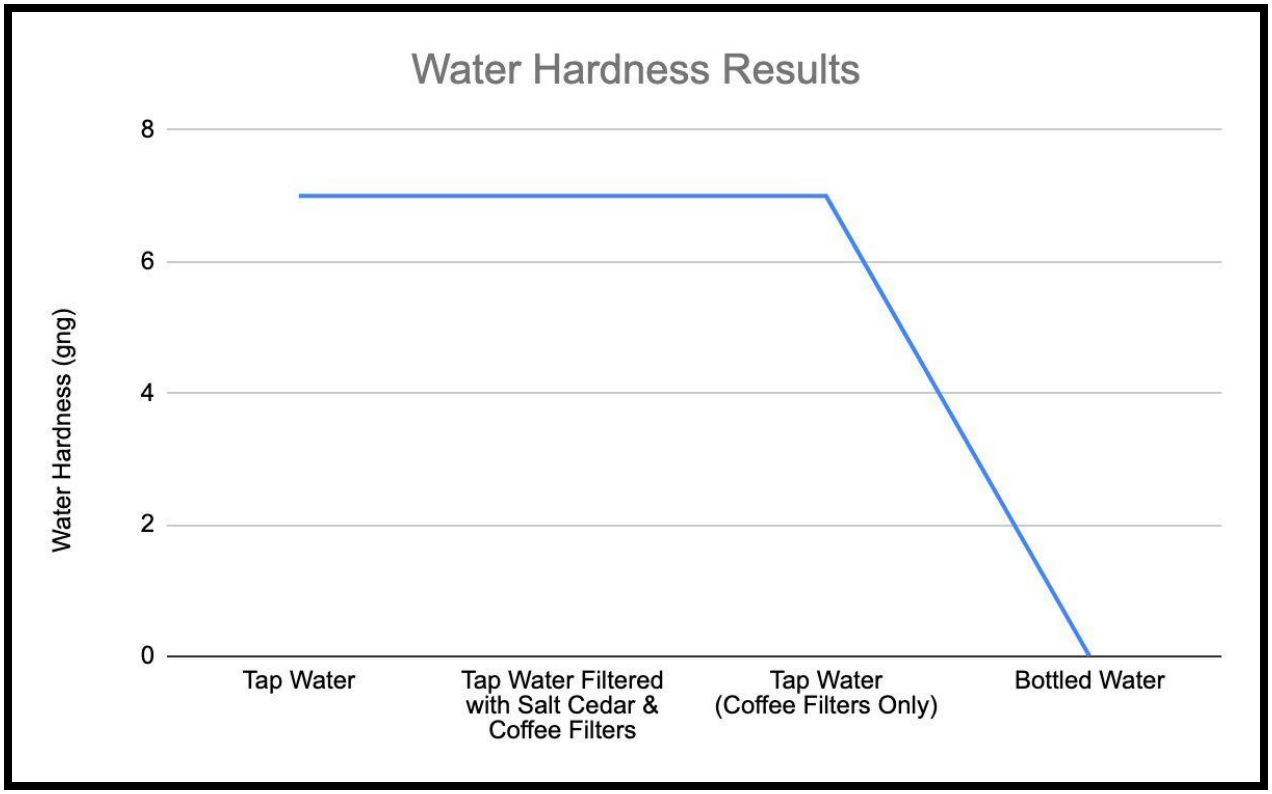




Also view the Google Slides Presentation of this investigation.

Investigation 5: Filtration

Hypothesis 5: We believe that a salt cedar filter will work in filtering out calcium & magnesium from tap water.



July 17, 2020
Location: Grassburr, TX
Prior Phone Meeting with Dr. Bart Durham
Participants: Jett Hurst, Sawyer Means, Justus Jacobus, Kelly Means, and Jill Jacobus

Index of Biotic Integrity (IBI) Report

Purpose: Compare the Index of Biotic Integrity (IBI) scores for McDonald Creek after chemical and mechanical salt cedar control.

Site Layout:

Six 100 m sampling sites were established on McDonald Creek, running north to south across the ranch property. The southernmost and northernmost sites will be reference sites located on neighboring ranches. Chemical control will be conducted on the northern section of the property, where salt cedar is more abundant. Mechanical control will be performed on the southern part of the property where salt cedar is less dense. Two sampling sites are located within the chemical control area, and two sites will be situated in the mechanical control area.

Sampling Protocol:

All macroinvertebrate samples will be taken with a 12'' D-frame kick net. A total of 10 linear meters of each site will be sampled. Samples will be pooled into a single site sample for identification and processing. All samples will be preserved in ethanol alcohol for transport to the Lubbock Christian University Laboratory to be processed. Dates of post-control sampling will be determined at a later date. Macroinvertebrates in each sample will be enumerated and identified to the lowest taxonomic level possible (most likely order or genus).

For each set of samples (6 total), upon discovery of any preserved specimens, the specimens were put in a glass jar of pure ethanol alcohol. Each of the sample jars was labeled according to its respective site number.

IBI Metrics:

Following is a list of the specific IBI metrics that we will be using for this project.

1. *Catch per Unit Effort (CPUE)*: total number of individuals collected per 10 linear meters of kick-net sampling
2. *Total Richness*: The total number of different taxa collected

3. *EPT%*: The percent of individuals in the total sample from the orders Ephemeroptera (mayflies),+ Plecoptera (stoneflies), + Trichoptera (caddisflies)

Timeline:

July 17, 2020, IBI#1

Experienced problems with the lack of water in the creek due to a drought
Site 1: no water present/hog and coyote prints

Site 2: no water present

Site 3: sandhill crane, grasshoppers, frogs, minnows, baby bass, water spiders, birds picking at fish were all seen (temp: 26.25, cond: 9.827 ms/cm, sal: 5.35, DO: 4.75, pH: 9.46)

Site 4: dragonfly, a covey of quail, turkey, deer bones on the shoreline, minnows were are present (temp: 27.54, cond: 15.31 ms/cm, sal:8.42, DO: 10.98, pH: 9.3)

Site 5: massive frog, dragonfly were are present (temp: 26.20, cond: 8.120 ms/cm, sal: 4.46, DO: 1.54, pH: 8.38)

Site 6: no water present/ dead from over-spray, bees, bunny, grasshoppers

No further IBIs were performed due to the lack of water in the creek.

Macroinvertebrate Identification Procedure:

Lab Work by Dr. Bart Durham at LCU

- Datasheets were made with the collected items.
- Benthic Macroinvertebrate Laboratory Bench Sheet- 6 sheets per each site
- Family and/or genus and species name was listed

The pH affects which organisms can survive within the creek system. Because salt based herbicides were used as an aerial application, the pH is affecting the creek's integrity. The optimum pH of a freshwater river would be 7.4. When comparing the pH of the creek as a whole, from 2018 to 2019, the results show that the average increase of pH is 0.5758.

Typical freshwater systems have a salinity of 0.5 PPT% or less. It is very noticeable that the portion of McDonald Creek, which is part of this study, has a very high PPT% and this is affecting the integrity of the riparian system.

EPT% (Ephemeroptera, Trichoptera, Plecoptera) represents the percent of sensitive aquatic and riparian insects, which consists of three categories. These categories give the scientist a good feeling of whether the creek is in equilibrium or chaos.

- The goal is to figure out the best way to eliminate salt cedar while preserving the riparian system.

- The IBI is calculated by adding the species richness + Catch Per Unit Effort + EPT%. Each average is sorted by treatment style.

The data collected over the course of 2020 was an initial starting point of the comparison of the two eradication processes along with the control sites. This is a long process and will be studied carefully next year to see what changes will occur between the mechanical and chemical treatment areas.i

i

Friday, January 29, 2020
Location: Three Gringos Ranch
Time: 4:15 PM
Meeting with students and mentors present - Justus, Tori, Sawyer, Jett, Mayah, Jill, Kelly, Sarah, and Kim

Evaluating Salt Cedar Growth and Final Measurements of Creek

Friday's trip to the ranch and what should be accomplished:

#1 Pictures of the eCYBER team

#2 We need pictures of all 3 sites (or 6 sites) but we need data on the one that is untreated (site 1 and 6, correct?); one that is treated chemically (site 4 and 5??), and ones that are treated mechanically (2 and 3??)

#3 Along with pictures ... we need the number of salt cedars in each of those areas - each child needs to do their own counts so we have 4 tests
Check the water and especially the salinity - and do this in triplicate for each of these areas.

#4 We need a conclusion as to whether chemical works best or mechanical - based on the numerical data collected

#5 What the team needs to do next:

Justus- Finish IBI Slide, Before, During, and After. Next steps. SC growth Update EPT % Wood Chipping Slides, Interview slide for Bart, Duane?

Sawyer- Update and create new IBI charts with new information and data collected Update termite Slides. Salt cedar filtering - Powtoon - voice-over, Interview slide - termites

Jett- Work on oil absorption experiment and slides in triplicate. Wheat experiment and slides All mission folders Questions.

Tori- Work on links for website, logo, slogan, QR code. Brochure, Video/Youtube, absorption with salt cedar log,

All- Update Work schedule on the doc

Results from today: Final Measurements - End of Project
Site 1-
No water
Average of salt cedar present in 100-meter area (done in triplicate)
156 alive - 2 dead = 158 total
No Eradication

Site 2-
No water
Average of salt cedar present in 100-meter area (done in triplicate)
0 alive - 0 dead = 0 total
Mechanical Eradication completed in 2019

Site 3-
Water evaluation with multiparameter - an average taken - done in triplicate:
Temp: 9.403
Conductivity: 3.835
Salinity: 2.96
DO: 14.8
pH: -5.846
Average of salt cedar present in 100-meter area (done in triplicate)
0 alive - 0 dead = 0 total
Mechanical Eradication completed in 2019

Site 4-
Water evaluation with multiparameter - an average taken - done in triplicate:
Temp: 8.853
Conductivity: 3.3
Salinity: 2.563
DO: 10.536
pH: -5.56
Average of salt cedar present in 100-meter area (done in triplicate)
25 alive - 72 dead = 97 total
Chemical Eradication completed in 2019

Site 5-
Water evaluation with multiparameter - an average taken - done in triplicate:
Temp: 7.554
Conductivity: 6.615

Salinity: 5.585
DO: 14.22
pH: -6.245
Average of salt cedar present in 100-meter area (done in triplicate)
39 alive - 58 dead = 97 total
Chemical Eradication completed in 2019

Site 6-
No water
Average of salt cedar present in 100-meter area (done in triplicate)
56 alive - 4 dead = 60 total
The salt cedar in this area was very mature and much larger than the other areas.
No Eradication, but there was overspray present

**pH Update **
pH Site 3 (5.75 End), Site 4 (10.73 End), Site 5 7.85 End)

Our team experienced systematic errors when measuring the pH levels with the multiparameter. On January 29, the Cedar Busters took (END) water quality levels, and in each site, the pH would read -6.75 to -4.88. We knew this was a potential source of error. We had learned that when pH levels move away from the optimum range (6.5-9.0), it can stress riparian systems and reduce the survival rates of the fish.

Justus contacted Dr. Bart Durham about the inaccurate measurement. Dr. Durham explained that the faulty calibration of the pH probe had developed a short in it. He recommended that Justus, under parent supervision, could carefully twist the cord and kink it slightly just below the base where it goes in the meter. The next day, Justus returned to the creek and was able to get accurate readings.

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United States Department of Agriculture NATURAL RESOURCES CONSERVATION SERVICE Invasive Species Figure 1. A Large-Scale Infestation of Saltcedar (Middle-Ground of Photo) with Fall Foliage on Hell Creek in the Draw-down Zone on Fort Peck Reservoir. 2007.

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Interviews conducted by the

Cedar BUSTERS

Dr. Bart Durham

Associate Professor of Natural Resources, Ecology, and Conservation
Lubbock Christian University

We appreciate your help educating us on the IBI process and allowing us to use your tools.

Cedar Busters

About Dr. Durham

Dr. Bart Durham is our mentor. He has visited McDonald Creek many times. He a professor at Lubbock Christian University and Texas Tech University. He is also known for his studies of the early life history stages of the Sharpnose Shiner and Smalleye Shiner in the Brazos River. This Texas project investigated the influence of streamflow and intermittency on the production of young.

Dr. Bart Durham instructed our team how to complete an Index of Biotic Integrity (IBI). The scores from McDonald Creek after chemical and mechanical salt cedar control would help the team determine which process was more effective.

He gave us our information back quickly and accurately. Dr. Durham played a key role in this project and will for the projects to come.

Cedar BUSTERS

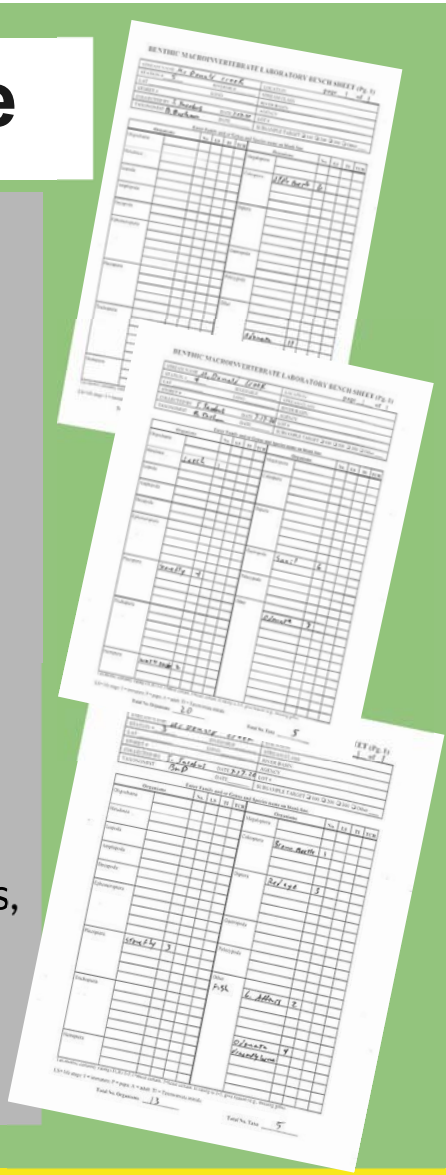
Macroinvertebrate Identification Procedure

Sampling Protocol:

All macroinvertebrate samples will be taken with a 12'' D-frame kick net. A total of 10 linear meters of each site will be sampled. Samples will be pooled into a single site sample for identification and processing.

For each set of samples (6 total), upon discovery of any preserved specimens, the specimens were put in a glass jar of ethanol alcohol. Each of the sample jars was labeled according to its respective site number. Then the team delivered the jars to Dr. Durham at the Lubbock Christian University Laboratory.

At that point, datasheets were made with the collected items, Benthic Macroinvertebrate Laboratory Bench Sheets were completed, and the family and/or genus and species name was listed.



Questions with Dr. Durham...

Cedar BUSTERS

- **What are the effects of last years drought on our water sampling?**

The amount of species found in the IBI is low. The drought definitely affects the insects of when things hatch, can they hatch, and how they hatch. For example, dragonfly larvae may not have emerged this year; they can stay there for years and wait for the conditions to be best. The lack of water has made the water sampling challenging because there was not enough water to be consistent in all six sites.

- **Is there anything you think we should pay closer attention to?**

Look at the weather patterns of when you took samples. Precipitation plays a large role in the salinity and conductivity. Salinity will be diluted if there is a large rainfall. Sometimes there may be a hyper saline event if there has only been a little bit of rainfall which would be caused by the salt on the shores being washed into the creek.

- **Based on our data, which eradication method do you think was more successful?**

The data shows no major effects on the water quality. This is actually a good thing. Mr. Lucia would be able to answer the question as to which method is more successful after studying the dead/alive ratio per site.

- **Are there any major patterns that are seen in the data due to the chemical or mechanical eradication?**

The eradication processes do not seem to be affecting the water quality. There is no clear effect on the pH with the two styles treatment. The salinity and conductivity spikes could be related to precipitation.

- **What do you think landowners, interested in eradication, would want to know about the two methods?**

Landowners would be interested in knowing the success rate of eradication. The cost analysis needs to be factored into this decision as well. Finally, I think the public would like to know which one physically looks better after yearly milestones.

Duane Lucia

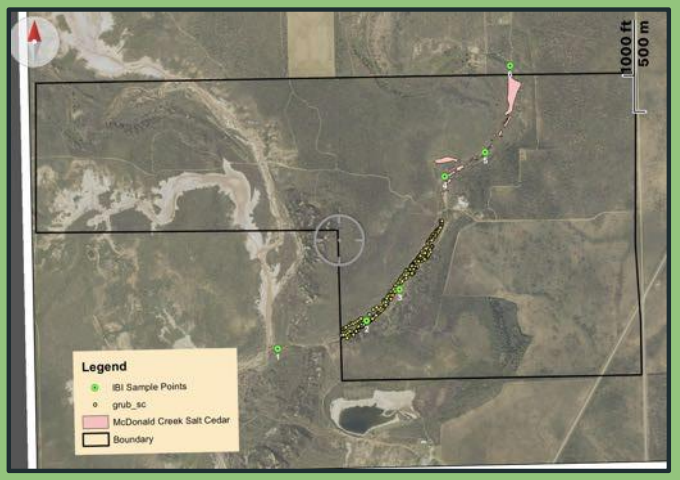
Fish and Wildlife Biologist at

US Fish and Wildlife Service (USFWS)

Cedar Busters

About Mr.Lucia...

Duane Lucia is our government contact. He is a Wildlife Biologist for the US Fish and Wildlife Services. In 2019, he assisted with the contract to receive chemical eradication over designated salt cedar infested areas.



Mr. Lucia has helped the Cedar Busters monitor the plant community on the riverbank, aquatic life in the river, and the shape of the river itself over time in response to the treatment. As chosen as a site for chemical eradication, the project included 17 acres of salt cedar along McDonald Creek and Lake Creek that eventually feed into the North Fork of the Double Mountain Fork of the Brazos River.

NO-COST Herbicide Treatment Contractors used a helicopter to apply an aquatic-approved herbicide containing imazapyr to control invasive saltcedar.

The landowner/Cedar Busters will work with the USFWS to restore and enhance the habitat and riparian system.

Cedar BUSTERS

Questions for Mr. Lucia:

- **The chemical eradication area has new growth, what is the next step to eliminate salt cedar?**

The next step is to spot spray the new growth. This can be done with a backpack sprayer or in a buggy. It all depends on the total area. Crunching (using a mechanical device to run over stands of salt cedar that has been chemically treated) is another way to kill salt cedar after chemical eradication. This also makes salt cedar easier to burn.

- **Will McDonald Creek be ready for a prescribed burn this summer in the treated area?**

No, the minimum is 2 years after eradication to burn. The chemical is still working in the bud zone so probably no burn until 2022.

- **When looking at the data, which eradication treatment do you think was most beneficial to McDonald Creek?**

Both eradication methods have pros and cons. Mechanical is more intensive with the system and stirs the ground up. Chemical is hard on non-targeted species. Overall, Mr. Lucia was pleased with both treatments.

Mr. Lucia is very knowledgeable with the ranch land and native vegetation. The information that he has taught our team is greatly appreciated. His time is valuable, but he enjoys working with young scientists.

- **How can I get our neighboring ranches to eliminate salt cedar? What are the steps?**

First, reach out to neighbors. Then, Mr. Lucia will follow up with them with an on-site visit, and project contract. Mr. Lucia is very interested in working with many of the ranches in Garza County.

- **What is Hydrological Monitoring and would it benefit McDonald Creek?**

Hydrological monitoring will help us learn more about how saltcedar management helps the riparian system. It influences groundwater availability and the flow of the river that it is being used in. Hydrological Monitoring will calculate conductivity, temperature, soil moisture , salinity, turbidity, all in one shallow test. Hydrological monitoring installation of three groundwater wells help in conducting all of our water tests in one test.

Mr. Lucia thinks this is a good tool; however, a single device cost $2,000 each. It is too expensive and would not be beneficial to McDonald creek.

- **What native trees/grasses would you suggest to plant by the creek so it can once again thrive?**

It would benefit McDonald Creek if we planted a wheat crop in the southwest side of the creek. Yes, it would be eaten by deer, but would give the seed a place to stick.

We could also add some herbaceous cover such as cottonwood. This would be a good start to regrow the native vegetation. The Web Soil Survey website (USDA) is great resource to see what would thrive in the ecosystem. Suggestions from the site are: Hopia, Sideoats Grama, and Western Wheatgrass.

William Marshall
Termite Expert (Terminix)

Cedar Busters
From left to right
Jett Hurst, William Marshall (Terminix), Sawyer Means, Tori Hay

William Marshall
Termite Expert (Terminix)

ABOUT

Mr. Marshall is employed by Terminix and actively works in the field helping to eradication termite infestations in homes and businesses in the Lubbock and surrounding areas. Terminix has been in business for more than 90 years, becoming the world's largest termite and pest control company in the world in the 90s. Terminix was the first company to obtain a termite control patent. Terminix employs eradication specialists and graduate and PhD-level entomologists that help keep them on the forefront of the industry.

How *Mr. Marshall assisted Cedar Busters*

1. **Helped us locate & identify subterranean & western desert termites so we could test our hypothesis**
   We hypothesized that termites would not feed on salt cedar because of its high sodium content

2. **Guided us on the habits of termites**
   We learned how they typically cause damage and what they feed on

3. **Helped us identifying damage caused by termites**

Questions for Mr. Marshall

- **How can we test whether termites would feed on saltcedar if it was mulched and placed in flower beds or other places mulch is used?**

  I've brought a termite station and key for you guys to plant near a wood pile. We can replace the wood Terminix would typically use to bait a station with your saltcedar log. Your team can check the station monthly for damage to see if termites are feeding on the log. When it is cold, you should check the bottom of the log as termites may not come as close to the surface as they would in the summer months.

- **What types of damage can we expect to see on the saltcedar if termites feed on the wood?**

  Subterranean termites are the most destructive termites. When they feed on wood, they often leave grooves in the wood that appear as lines. The Western Desert Termite is less destructive. It feeds on sticks that may be laying on the ground. The wood they feed on can be easily flaked off.

Questions for Mr. Marshall

- **How long does it take before you can see visible termite damage?**

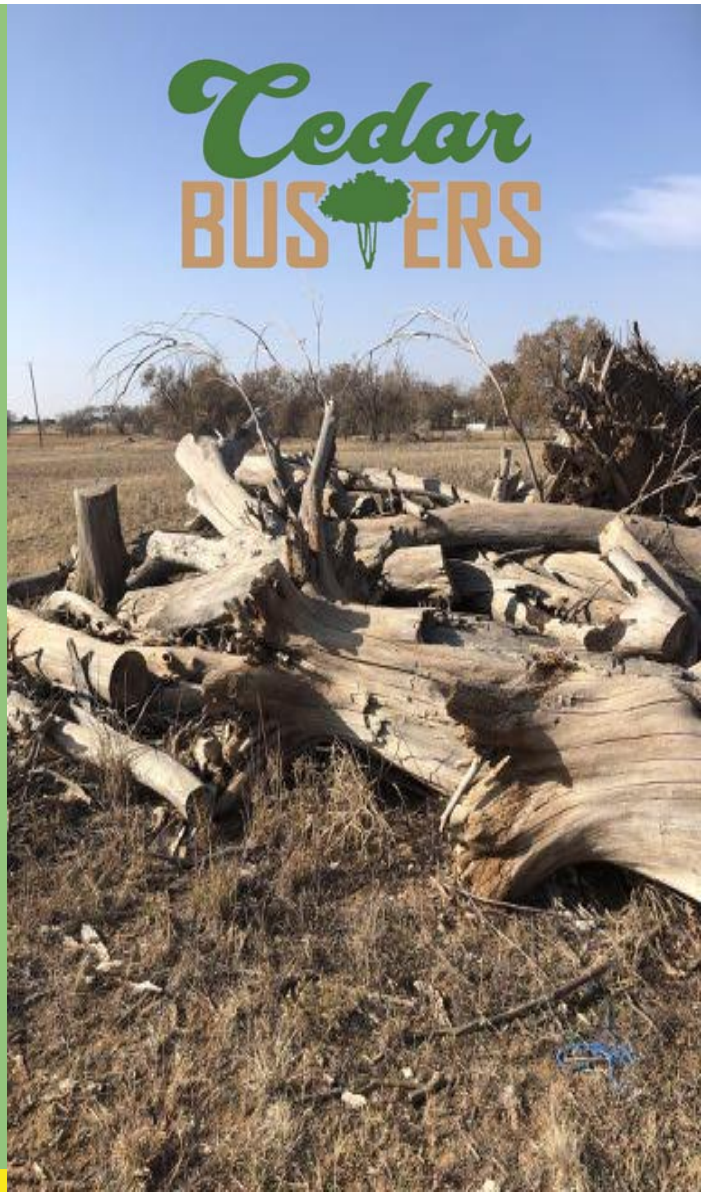
  I've seen termites hit our stations very quickly, within a months time. I've also seen it take a little longer for them to find and begin feeding on the bait log. Terminix checks for damage once every three months.

- **Where can we find termites to help test our hypothesis?**

  Termites can often be found where water condensation or leakage comes from pipes. They follow the water trail to enter homes and begin feeding on the wood. They can also be found in piles of wood that are left on the ground.

- **Do you see less termite activity in the winter months?**

  Since subterranean termites live underground, it typically doesn't get cold enough in the Lubbock area to cause termites to be inactive in the winter. Up north that can be the case, but in Lubbock, TX, Terminix treats infestations throughout the winter months.



Termite Damage

Subterranean termites leave behind lines in the wood as seen on the wooden spool

Less destructive Western Desert Termites live on the surface

Cedar BUSTERS

Relocating termite station

Saltcedar log

Termite station replanting

New location

Saturday, April 18, 2020
Location: Three Gringos Ranch
Time: 4:15 PM
Beginning Measurements



Results from the beginning of the project

Site 3-
Water evaluation with multiparameter:
Temp: 17.3
Conductivity: 4.916
Salinity: 3.1
DO: 8.89
pH: 8.98
Mechanical Eradication completed in 2019

Site 4-
Water evaluation with multiparameter:
Temp: 21
Conductivity: 4.1
Salinity: 2.4
DO: 5.97
pH: 8.25
Chemical Eradication completed in 2019

Site 5-
Water evaluation with multiparameter:
Temp: 26.85
Conductivity: 11.5
Salinity: 6.15
DO: 4.75
pH: 9.71
Chemical Eradication completed in 2019

Termite Report

Saturday, November 21, 2020
Location: 9417 4th Street Lubbock, TX
Time: 10:00 am
Meeting with Mr. William Marshall, Terminix

Cedar Busters met with Mr. William Marshall of Terminix on Saturday, November 21st.
Cedar Busters is currently researching whether termites would feed on salt cedar if mulched and placed on the ground. Our team is looking for a resourceful way to use dead salt cedar, and mulch is an option we are exploring. If we find that termites feed on salt cedar, it won't be favorable to use in flower beds around houses as we don't want to attract the pest. Mr. Marshall lent us his expertise and years of experience for the morning, helping the team learn more about termites, where they can be found, and how the team could determine whether termites would feed on dead salt cedar wood.

Mr. Marshall is employed by Terminix. Terminix has been in business for more than 90 years, becoming the world's largest termite and pest control company in the world in the 90s. Terminix was the first company to obtain a termite control patent. Terminix employs eradication specialists and graduate and PhD-level entomologists that keep them on the cutting edge of the industry.

Mr. Marshall was excited to share with the group that he had actually attended his continuing education (CEU) training yesterday and was able to pose the team's question to a number of high ranking Terminix officials in the Houston area regarding their stance on whether termites would feed on salt cedar given the high salt concentration. He said it really got them all talking and very interested in the outcome of the study. Mr. Marshall requested the team follow up with him on what we found.

Mr. Marshall mentioned that termites don't generally care about the sodium content in soil or a high pH level but he is very interested in knowing whether termites would feed on the salt cedar due to its high salt concentration.

He discussed how regular cedar is known to deter termites because of a naturally occurring chemical in the wood, but over time, cedar loses the chemical and termites will eventually eat through cedar as well. Many people will use agfabric to deter termites, but he said they will eat through the fabric as well. Termites do not typically feed on live trees, just dead wood.

Termites can often be found where water condensation or leakage comes from pipes. They follow the water trail to enter homes and begin feeding on the wood. They can also be found in piles of wood that are left on the ground. He suggested that wood should not be left in contact with the ground. Wood should be stored on a rack outdoors.

Mr. Marshall took the team around an old wood pile and showed them active termites. We found subterranean termites under a wood log. He explained that these types of termites were the most prevalent and caused the most damage for homeowners. He also showed our team an example of western desert termites. These termites live on the surface of the ground. We found them in small sticks of wood laying directly on the ground. He flakes off the wood to reveal the termites. He mentioned they can also be found in mounds of dirt on grass. He said the western desert termite does much less damage than the subterranean termites we saw under the log.

Since subterranean termites live underground, it typically doesn't get cold enough in the Lubbock area to cause termites to be inactive in the winter. Up north that can be the case, but in Lubbock, Terminix treats infestations throughout the winter months.

Mr. Marshall showed the team how we could identify termite damage. Termites leave lines in the wood where they have eaten a path through it. We can always check for damage by looking for those lines they create. We found a great example of this in an old wooden spool that was

laying on the ground. It had severe termite damage from years of wood to ground contact. The lines termites create helps shelter them from the sun. Termites die in sunlight unless they are the jet black swarmer termites whose color protects them from the sun. Swarmers are responsible for mating and making new termite colonies. Worker termites are white in color and can have a gray abdomen. Yellowish-orange termites are known as soldier termites. Soldier termites peak out occasionally and help to protect the colony.

Mr. Marshall provided the team with a termite bait station and key to open it with. He showed us how wooden sticks are placed in the base station and stations are checked once every three months for damage to the wood. During our meeting, we replaced the wood Terminix uses in their stations with a salt cedar sample log from the Three Gringos Ranch. The team will plant the station near a wood pile and monitor for termite damage.

When Terminix finds evidence of termite damage in their stations, they replace the wood with bait. The termites feed on the bait and take it back to the colony. This kills the colony.

He explained that termites don't really have many naturally occurring predators. Ants can sometimes go head to head with termites but termites usually win because of their larger mandibles. This is not always the case though if there is a larger colony of ants. Swarmer termites are often preyed upon by birds since they can be found fluttering around outside of the colony.

He discussed how land developers often buy land that has been used by cotton farmers where stalks are shredded and left on the ground. Overtime, as new houses are built on the land, termite problems arise due to the fact that shredded cotton stalks already had active termites in them.

While wood to ground contact is never ideal if you are trying to deter termites, Mr. Marshall recommended wood chips, if used, be replaced with new treated wood chips once a year. Mr. Marshall also brought up some other things the team could look into.

He suggested the team might be able to extract the salt content in the salt cedar just like the natural sweetener stevia is extracted from the stevia plant. As we have found in our research, he also mentioned the leaves of salt cedar leave salt deposits on the soil as they fall, making it hard for other plants to grow around it. He suggested looking at whether plants would actually

grow with salt cedar mulch around it. Would the salt content prohibit plants from growing in a flower bed?

Mr. Marshall discussed with the team how mesquite is also considered an invasive species but has since been used as fertilizer and in flavoring meats while cooking, so he definitely thought that would be another avenue to explore.

Ongoing Research

The team shared some of their research with the group during the meeting.

Jett Hurst has experimented with whether salt would leach from the salt cedar when soaked in water and has measured the salinity of the water after it had soaked.

Sawyer Means has experimented with whether ground salt cedar, used as a filter, could help to remove calcium in hard water much like how salt is used to make hard water soft.

Tori Hay shared how she had experimented with whether salt cedar would make water evaporate faster given the high salt content.

Justus Jacobus plans to use a wood chipper to make mulch with the salt cedar branches that were excavated last fall.
Experiments need to be conducted to see if:

- Resprouting begins once placed in a garden.
- It retains soil moisture.
- It regulates soil temperature.
- It stops weed growth.
- High salinity would deter the growth of the native plants.

If this mulch is acceptable, but not with the garden plants, could this mulch be used in a playground setting to absorb the shock?

Justus will also interview Jake Jacobus and type up notes regarding the eradication process completed in 2019.

None of the team members had favorable results to report at this time but will continue to experiment.

Potential Research

It was also mentioned that the team could look into whether salt cedar could be used on roadways as an ice melt or whether it could be used as a natural herbicide if plants can't grow because of the salt content.

Saturday, January 16, 2021
Location: 1602 N CR 1660 Lubbock, TX
Time: 1:00 pm
Cedar Busters Team Meeting

Cedar Busters met to check for damage on the salt cedar log planted near a woodpile. No damage to the wood was observed. Cedar Busters discussed next steps to see whether wheat would grow if salt cedar mulch was planted on top and whether or not salt cedar could be used to absorb oil spills. The team planned another trip on 1/22/21 to the Three Gringos Ranch to measure the temperature, salinity, conductivity, dissolved oxygen, and pH of the creek water and will work to compare data from the July measurements.

Saturday, January 30, 2021
Location: 9417 4th Street
Time: 10:00 am
Cedar Busters Meet to Re-Plant Termite Station

Cedar Busters team members Justus Jacobus and Sawyer Means met with Mr. William Marshall of Terminix to replant the termite station with the salt cedar log. Mr. Marshall helped us plant in a place with known active termite activity and showed us a wood piece with fresh damage. We will observe the station over the next month to check for damage. Before replanting, Mr. Marshall looked over the log which had been planted near a wood pile near Jett's house to see if there was any evidence of damage. Although some granular dirt was on the log, there didn't look to be damage. He has seen termites hit bait quickly within a month, but other times it takes a little longer. The team will need to check the bottom of the log for damage since it is cold and they may not come close to the surface.

Saturday, February 13, 2021
Location: 9417 4th Street
Time: 2:15 pm
Termite Station Check

Today was a station check to observe for any damage to the salt cedar log. There was no damage observed.

Saturday, February 20, 2021
Location: 9417 4th Street
Time: 2:15 pm
Termite Station Check

Today was a station check to observe for any damage to the salt cedar log. There was no damage observed.

Cedar Busters

Invasive Species Summary Project

Salt cedar is a tree that absorbs lots of water every day. Eradicating this harmful tree can help the ecosystem. A single salt cedar tree can absorb 200 gallons of water a day. That certainly creates a community problem. If there is a salt cedar tree close to a lake, river, or creek, you may see the water levels drop. There are many ways to kill salt cedar. The first is to flood the tree which requires a lot of water. The next is to spray it with a certain herbicide. About 2-3 years after spraying, you burn the tree. Burning alone will only cause the tree to become healthier and larger. The last is called mechanical grubbing. Mechanical grubbing is when a bulldozer comes in and scoops the root crown out of the soil up onto the ground.

A Tree and a Beetle

Tamarisk is another word for salt cedar and there are over 50 different species. There are a couple of forms of salt cedar eradication. Biological eradication uses living organisms to suppress the growth of tamarisk. Two types of beetles have been approved for control in Texas.

Beetles like to eat the salt cedar trees; they can chew through 94% of the tree. The beetles, if they were going to try to kill the salt cedar tree, would take 5-7 years to chew through the salt cedar tree. This form of eradication began in the early 2000s, and it does reduce the salt cedar problem.

Texas Invasive Species

The salt cedar (tamarisk) tree seeds spread rapidly. A salt cedar tree has branches with pink blooming flowers. These flowers bloom in the spring. The salt cedar trees line up by the shoreline so they can get the water from the lake, creek, or river. At times, the lake will have no more water because the salt cedar tree will absorb the water. The salt cedar tree uses its taproots to soak up water that is deep underground. The tamarisk will not allow other plants to grow; it overtakes the native species. People are trying to control the salt cedar trees by cutting them and trying to burn them. This helps the native vegetation get water because the salt cedar tree is taking all of the water.

Problems with Salt Cedar

The salt cedar trees can create a lot of problems for people. The salt cedar is creating the same problem for many ranches containing water, and ranchers are wondering what can be done with this invasive species? The water level is dropping because salt cedar trees are soaking up too much water. Eradication is needed to help people, native vegetation, wildlife, and the riparian system.

Tamarisk

Eliminating tamarisk may seem easy, but even if you chainsaw the tree down to its trunk the seeds it produces will make more tamarisk plants. The best way to eliminate tamarisk is to chop the tree down and spray the plant with a herbicide bacterial spray. The deciduous trees form dense thickets. Scientists have discovered that most tamarisk plants come from the American west and live on inhospitable rivers and lakes since the tamarisk plant changes the soil quality.

Researchers argue about the negative effects of tamarisk and how it positively affects the habitat of some plants. It's very hard to get rid of the invasive tamarisk plant. The best way is by using a new species, a leaf-eating beetle. Scientists have also discovered that most salt cedar trees have pinkish reddish to greenish yellowish seeds and mature salt cedars can produce 500,000 seeds a year.

Scientists and national parks are working together to eliminate tamarisk in the parks because it sucks up hundreds of gallons of water a day. This is one reason most places suffer from drought. Helicopters spray a type of herbicide over a group of salt cedars because the tamarisk plants are poisoned.

Salt Cedar Eradication Begins at Lake Meredith

Most cattle and goats will eat tamarisk. Usually, chemical sprays are used on salt cedar, but you need a permit to do so. The biological way of eradicating salt cedars is the tamarisk beetle. It eats the tamarisk's leaves which dehydrates the plant so it dies.

Tamarisk is dangerous because it lowers the hydrology in lakes and bodies of water. Tamarisk eradicates other plants by making the habitat inhabitable. Nicholas Rice has helped eradicate 200 acres of tamarisk-infested ground to save our water. In the Colorado River, tamarisk sucks up 325 billion gallons of water.

The tamarisk beetle is a great way to eradicate salt cedars, but the beetle has been sidelined by the endangered southwest willow flycatcher. The southwest willow flycatcher has adapted to the obstructed environment. They are used to living in willow trees, but since tamarisk has shown up, they adapted to bird's nests being elsewhere. Sadly the tamarisk beetle is going back to Europe where it is originally found. Scientists are arguing whether or not the tamarisk beetle will only target tamarisk. People are worried that the beetle will adapt to native plants.

Saltcedar Overview: A Beetle Can Save Our Water

The tamarisk problem has become extremely bad, and people are saying the tamarisk beetle will be a problem for other plants, not just tamarisk. “The tamarisk is bad enough that we’re willing to take some risks with the solution,” Dan Bean says. After a decade tamarisk beetles were loose in the west.

In 2001, 1400 beetles were slowed down in lovelock and this is the reason why people were saying the tamarisk beetle is not any help. After a while, the Beetles sped up and since the success in Lovelock, the tamarisk beetle has been set free into Colorado. After a few months, the water usage by salt cedars has decreased by 90%!

Scientists have discovered that the tamarisk beetles have a weakness. If the day is under 15 hours they migrate and eventually die by hunger. Scientists desperately searched for a secondary beetle and finally found one. The Cretan beetle had adapted to cold winters and shorter days. Now Cretan beetles are used in parts of Texas like Big Spring.

Is Tamarisk Useful?

The french tamarisk is used for astringent qualities and the galls contain 40% tannin. It's been used to treat diarrhea and dysentery. The invasive species that are taking over native vegetation prove to be useful.

Most tamarisk trees are very fast-growing and can tolerate any type of weather, but tamarisk prefers sandy loam soil. Tamarisk works well with erosion control and likes saline environments. The most important thing is that tamarisk absorbs salt from the ground, but it does deposit it back just in high enough quantities that it's harmful. Tamarisk is very hard to control because it spreads from the roots.

Places Infested by Tamarisk

Tamarisk is classified as a noxious weed in South Dakota, Texas, and Wyoming. Most tamarisk plants endanger the southwestern willow flycatcher. Scientists thought the salt cedar problem was over until 2006 when a 100-year flood came and brought a lot of seeds and water causing tamarisk to come back. Phytoremediation and more certainly phytoextraction is a restoration strategy for rivers with highly metal-infested soil. Now phytoextraction will not be successful if the plant colonizes the area or environment that is contaminated or infected. extract the substances that accumulate them in tissue. Salt cedar has been studied and researched, the research started by growing tamarisk plants in light and ambient conditions. Further research and not letting the tamarisk plant get rained on and over a 10 week period resulted in white crystals forming on the leaf. After extensive research, scientists concluded that the tamarisk excretes cadmium. Tamarisk excretes cadmium then deposits it into the soil around the salt cedar plant. This causes the “ph” of the river to increase and become inhabitable by plants and animals.

The Main Problem with Tamarisk

Tamarisk has been a concern to native villages and other small towns because it blocks small rivers and sucks up all the water. Landowners are also concerned, because of eradication. They are afraid the lack of water will kill all the plants in the habitat. The main problem is that when tamarisk invades a riparian area it creates monocultures that alter the native location. This increases flammability and increases the chance of forest fires. The increase of flammability increases sediment deposition and hydrology intensification. Combined with the salt glands changes the PH of the water killing off most of the fish and other land animals that use the lake as a source of water. Tamarisk is not a good food source since its leaves don't have much protein and nutrition. Most animals have adapted to living in infested lakes and rivers where tamarisk have invaded. Tamarisk reduces the natural creation of cobble bars that are vital to fish environments.

Tamarisk Problems and Methods of Eradication

Most tamarisk environments are picnic places, parks, and campsites. This is a problem because without these places wild animals lose environmental space which causes less vegetation in more areas. Some tamarisk can invade houses or ranches, this is a big problem because if a tamarisk tree invades a river ecosystem, it can destroy the entire ecosystem by secretion of salt. You should cut the stump then add 12 ounces of water to the stump. Apply triclopyr, This kills tamarisk.

What Gets Rid of Saltcedar?

Salt cedar appended in spring in late summer and the salt cedar tree is covered with pink and white flowers. The salt cedar tree can grow 5 to 20 feet tall. Salt cedars have been given the identity of California because they have more salt cedar trees than every other state. There are many different plants that are called salt cedar. Here are some of them- gallic, ramosissima, and Chinensis. They are called those too but are commonly called salt cedar trees. They all grow smaller than 26 feet tall with scales like leaves which all come right back to the name salt cedar. They have a really smooth stem that is a reddish brownish color that is less than an inch diameter in the ground. Salt cedar does not stop soaking up water from the lakes so it is not an inactive plant from water. Salt cedar came from Eurasia and Africa. Salt cedar started to grow in the 1800s and it was threatened by humans in the 1920s. A salt cedar tree has pale green leaves and a brown stem and many many branches on it.

Tamrix's Problems to the Environment

The salt cedar tree can disrupt a plant from a North American native plant. A lot of people need to replace the native plants because the salt cedar has done something that is not good like taking away water from them so they died. Other tree seeds can grow higher than a salt cedar tree seed. Salt cedar's specimens died after 1-2 years 98% shade. In the 1930s when the great depression many of the salt cedar trees were planted by the great plains shelterbelt and many other trees too. The larger species in the inter-family of salt cedar is the Tamarix aphylla. Another cool thing about this plant is that it looks like a really big brush and not a tree but it is a tree and not a brush. The Tamarix Chinensis a species that is known by its 5 names that it is called by all the time. On the salt cedar tree, the leaves are like scales just like that junipers.

There are many different types of salt cedar trees and many different ways we all can look at them. Salt cedar is a non-native plant that soaks up 200 gallons of water a day. Salt cedar trees are so common in Colorado rivers and they are all lined up by the water so they get the water for the day. There are more than 120,000 salt cedars in the region. If all the salt cedar trees were moved and replaced they would get 860,000 of water back in that the salt cedar trees had soaked up. If you set a salt cedar tree on fire it will not die it will only make the fire spread to about 500 feet tall. If the fire is still going, the fire will endure 13% of the trees but none of the salt cedar. Flycatchers use Tamarix so they can make an impact on other species.

Salt cedar is a small tree that's in the Tamarisk family. The more proper name of salt cedar is Tamarix ramosissima. Salt cedar usually grows 5 - 20 feet tall; it has small and skinny branches. It produces scaly small leaves that are a green-greyish color and pink and white leaves too. It can go through a mild winter without losing any leaves. Young salt cedar shrubs have reddish-brown bark and the older salt cedar bark is a bluish purple.

Eight species of salt cedar are in the United States of America and Canada. Salt cedar originated in Eurasia; it was introduced into America in the 1800s, and in the 1920s, salt cedar was seen as a serious threat. Salt cedar was originally used as an ornamental; it was used all over America.

Salt cedar is known for its ability to withstand a drought. It usually grows in salt deserts and mountainous areas. It has roots that go far into the soil that suck up water.

Information About Salt Cedar

Salt cedar is a plant that is most commonly found in America's southwestern states. Salt cedar is also known as Tamarix or tamarisk and is considered to be an invasive plant that is dangerous to the environment. It usually decreases the habitat quality and is harmful to the plants around it. It can also positively affect some organisms. It can provide a nesting place for birds and is able to provide pollen to bees. Fast multiplication of salt cedar growth usually happens when a flood occurs. The salt cedar seeds float on water which spreads the seeds around the area. Salt cedar has tiny scaly bluish-green leaves and reddish-brown colored branches. The branches are skinny and smooth. During October, many pink and white flowers bloom on salt cedar. Salt cedar is a small tree or shrub that usually grows 5 to 25 feet tall. It has tiny seeds resembling pepper. Salt cedar originated from Eurasia and was brought over to America and used as an ornamental plant.

More Salt Cedar Information

Salt cedar leaves can stay on the plant in a mild winter. Salt cedar produces large amounts of nectar from March to September which attracts bees. Salt cedar has a firm root system that can stop the erosion of the soil because of its strong roots. It can even get to the water that's very far down in the soil unlike some other plants. Each plant can consume 200 gallons of water a day. Salt cedar has the ability to tolerate saltwater through absorption. The plant eliminates excess salt through its leaves which can also be used for the harvesting of salt. The leaves harbor the salt and shed the salt each winter, leaving deposits in the soil that prohibit other plants from growing. Salt cedar competes with other plants for water and sunlight eventually making it hard for other plants to grow nearby. The wood from salt cedar can be used for things like firewood or for carpentry work. There are 54 species of salt cedar worldwide. Salt cedar is sometimes called a smoke tree. Salt cedar that grows in New Mexico originated from Afghanistan.

The best time to try and contain salt cedar is during the fall when the plant is dormant for a few weeks because, during that time, the plant is pushing all of its nutrients down to the root. For that reason, using a herbicide during that time can be more effective. This is one way to quickly get the poison to the roots to kill the plant.

Saltcedar Information

Salt cedar is an invasive plant that lives in the USA but it's not native to America. There are a few types of salt cedar that came from Africa. Salt cedar does well in droughts because of its great and strong roots. Salt cedar can change the hydrology in the soil and affect underground water sources negatively. This can lead to fewer water sources being available which is quite unlikeable for some people. When salt cedar was introduced it was okay for a long time until the late 1800s. During the late 1800s, Americans stopped trying to cultivate salt cedar only to find it started to spread rapidly across the country on its own. Salt cedar stems are skinny and are usually curved or bent and can be as tall as 20ft or 4.5m tall. After the leaves of the plant fall off, it gets leaf scars. Salt cedar is able to achieve fast stem growth and the stems can grow 10 to 13ft tall in a single season. Adult plants can live approximately seventy to ninety-eight days in flood conditions!

Information About Tamarisk

Salt cedar has a life expectancy of 20 years and its leaves change to a grey-green color during the summer. During the fall the color changes to gold. Salt cedar leaves usually fall off during October and sometimes salt crystals will form on the leaves from drinking saltwater. Its leaves usually grow to about 1.5mm long or 1\16 of an inch. Salt cedar's roots are very firm; they go very deep into the soil and its roots grow fast. Its great to root system lets salt cedar reach for water sources far away with ease. Salt cedar roots will drink up large quantities of groundwater during their adult life. Salt cedar has adapted to flood and drought conditions making it easier for fast spread. When salt cedar fruits reach adult life they form a capsule containing thousands of salt cedar seeds. And the plant has pink and white flowers that grow in clusters. They usually bloom around May to September; they have been seen blooming in October as well.

Salt Cedar Information

Salt cedar trees use around 200 gallons of water a day for one tree. Some people call salt cedar the unkillable invader. Salt cedar doesn't help farmers because its roots suck up too much water and out-competes native vegetation to survive. It takes up space where grass could grow to feed cattle. After eradication of a salt cedar plant, it usually grows back again. Salt cedar is an invasive plant. An invasive plant is a plant that is not native to the area. Salt cedar was also used for preventing soil erosion when it was first brought into America. Salt cedar processes the salt in the soil and will deposit the salt in the water. It does this to kill other plants so it can set up a bed for itself and its offspring to live. Salt cedar outcompetes other plants for water. Salt cedar has no natural predators in the USA.

Possible Uses For Salt cedar

Studies on salt cedar have revealed that it is quite dense. Salt cedar is in the hardwood category and is inelastic. It has a modulus lower than other hardwoods. Its strength and hardness rates are uncommonly high, so it could be hard to cut. If you were to cut salt cedar with a knife it would most likely dull the blade fast. Salt cedar could serve as a filler in wood-plastic composites or it could be used as a material in particleboard. There are other possible uses for it like pedestrian bridges, signboards, and other structures. If salt cedar was used in wood-plastic composites without the use of an ultraviolet radiation protectant, the sun could cause the salt cedar's color to change. It is also a possibility that salt cedar could be used as raw energy for bioenergy or biofuel. Why is Salt Cedar/Tamarix a Problem? How Does Tamarix Affect the Environment?

Tamarix, salt cedar, can harm the environment by destroying native vegetation like willows and cottonwood. The dense thickets provide poor habitat for wild animals, birds, and larger animals like deer and elk. The blooms and leaves offer little food value for species that rely on nutrient-rich native plants. The salt cedars increase wildlife hazards and limit the use of waterways. A mature salt cedar tree can use up to nearly 200 gallons of water from lakes, rivers, and streams every day. Native trees in wet riparian areas can use a similar amount of water but do not grow as quickly or densely as the salt cedar. Tamarix takes up so much water because its leaves and stems release high amounts of salt into the ground. People from Eurasia in the 1800s brought it to America because it was an ornamental plant for landscaping.

Salt Cedar Seeds and Management

The salt cedar tree produces thousands of seeds between April and October. The seeds spread by wind or water. The seeds start to grow within one day of finding water. Once the seeds are grounded, they grow at an extremely alarming rate. They grow up to one foot a day during spring! The salt cedar can endure a very harsh environment. They can survive in conditions like high salinity, drought, and even being submerged. There are several eradication methods to remove salt cedar. Mechanical grubbing has proven to be unsuccessful because salt cedar can regrow by roots alone. New Mexico has sprayed salt cedar with two different chemicals. The active ingredients in aerially spraying are glyphosate and imazapyr. This method has been proven effective. California also has a successful method. California's method is cutting the plant down to the stump, then spraying with Roundup and Garlon 4.

The Damage of Salt Cedar on the Ecosystems

Salt cedar has done much damage to the environment. This species, which is tolerant of high salinity, secretes high salt amounts into the soil around it. In riparian systems, salt cedars provide fuel for fires because of the dead leaves and branches. Afterward, salt cedars quickly sprout. Salt cedars are known as fire-adapted species because of the long taproots. These roots allow them to locate deep water tables and ruin natural aquatic systems. The salt cedar pushes out the native vegetation, and many species are affected. With the spread of salt cedar, several threatened or endangered species are also affected. A threat to agriculture is present with salt cedar due to its high water use and its tendency to clog irrigation canals. Something must be done to stop this ecological problem.

Salt Cedar Eradication and Management

Salt cedar is an invasive species that arrived from a foreign ecosystem. It can take over native species in their natural environment. There are two main ways to eradicate salt cedar.

First, there is the manual method, which includes removal by hand or machine. Another term for this is grubbing. This process is with a tractor with a tool mounted on a tractor's hydraulic system. The blade drives into the soil to sever roots below the root crown and force them to the surface. To prevent re-rooting, grubbed salt cedar should be piled, dried, and then burned or mulched rather than left on the surface.

Next, the use of herbicides is a chemical approach to eradicate salt cedar. Aerial applications are successful if the aircraft is equipped with the proper spray system. Areas must be pre-mapped to apply the herbicide to the treatment areas. Late summer is the best time to apply this method by aircraft.

Identifying Salt Cedar

Salt cedar is in the tamarisk family. This long-lived tree is deciduous, which means that it sheds its leaves annually. The leaves are scalelike and arranged alternatively on stems. On the underside of the leaf are glands that secrete salt. The stems are smooth, woody, reddish-brown, and can grow up to twenty feet tall. With age, the stem becomes stiff and chiseled. Salt cedar can live up to 100 years old and grow up to 26 feet tall. The white or deep pink flowers are formed in clusters with five petals. A single salt cedar plant can produce 500,000 seeds in a single season and can germinate in one day. Salt cedars can grow in a variety of habitats. These include wetland areas, flood plains, salt flats, and lakes, streams, and rivers.

Tamarisk Taproots

Tamarisk, salt cedar, is one of the top ten nefarious weeds. This small tree has many adverse effects on the environment. Displacing the native vegetation in the ecosystem is a top concern.

The salt cedar seedlings need a moist environment, so tamarisk uses their taproots. A taproot is a root of a plant growing straight down. Salt cedars are quick to lay down taproots deep underground to find groundwater. Mature tamarisk's taproots can go below the soil down to thirty meters. Salt cedar uses the taproot to suck up water deep beneath the soil. Once established, salt cedar can survive extreme drought and prolonged flooding. Salt cedar will resprout after burial, cutting, or burning.

From Weed to Wood

Tamarix, known as salt cedar, is a tree native to the old world. It can survive in salty and alkaline conditions. Tamarix was introduced to North America in the eighteen hundreds. It was used as windbreaks, soil stabilizers, and also ornamentals. Tamarix is composed of fifty-four different species. Six of these species are in the United States. Salt cedar is not a true cedar. Salt cedar displaces native vegetation. The top two things it displaces are cottonwood and willow trees.

Surprisingly, salt cedar is like many hardwoods. The wood is close-grained, hard, heavy, and has a rich pink color. Salt cedar's physical properties are similar to the Sugar Maple tree in density and hardness but have a low elasticity modulus, which means that the wood may be prone to tear-out. The straight grain typically splits well. When working on a salt cedar project, it is crucial to let the wood season properly and not rush the process. Even though this wood has adverse effects on the environment, it can be repurposed for quality wood projects.

Monday, November 23, 2020
Location: 6811 Rochester Ave. Lubbock, TX
Time: 4:15 PM
Meeting with Jacobus Family

Research on Ranch Report

Background of the ranch:

The location of the 3 Gringos Ranch is in the northeastern portion of Garza County, approximately fifteen miles northeast of Post, Texas. This ranch has water features that are very unique to the area. McDonald Creek has live water year-round and runs through the center of this ranch, entering the northeast side and exiting the south-central side. Bobwhite quail, Whitetail deer, turkey, dove, and wild hogs are the wildlife frequently seen year-round. The creek has holes of water that hold bass, catfish, and bluegill. The ranch's diverse terrain ranges from mesquite flats to rough elevated ridges. The brush canopy seen throughout the land fluctuates from mesquite, shinnery oak, large Hackberry, Elm, Cottonwood, and salt cedar. The grass found on various portions of the property is blue grama, side-oats grama, vine mesquite, little bluestem, Arizona cottontop, plains bristlegrass, sand lovegrass, Indian grass, sand bluestem, and switchgrass.

Tamarisk (Tamarix pentandra), commonly called salt cedar, is found along McDonald Creek's banks.

Three Gringos Ranch's goal is to create a sustainable ecosystem in McDonald Creek through river expansion, as well as the eradication of salt cedar. Salt cedar (*Tamarix pentandra*) grows as dense thickets and is causing an ecological threat by replacing native vegetation, altering the ecosystem, and impacting the availability of water. In Garza County, there are approximately 3800 acres infested with salt cedar.

Background Timeline:
2018-2019

The expansion of McDonald Creek began June-September of 2018, which included excavators. (private pay contractors) The creek was widened, and the salt cedar around the expansion area was removed mechanically. In November of 2018, the stream was stocked with bags of fish from www.stockmypond.com: 200 basses, 100 hybrid basses, 100 red gills, 200 bluegill, 5.5 kilograms of minnows. This led to the question of whether the ecosystem could support the addition of unacclimated marine life. Five sample sites along the McDonald Creek were identified, and water and soil testing began to determine what substances were present in the system. The 2018-2019 information tested is a component of a more extensive study that will be useful to the long-term project over the next few years. (Justus Jacobus was involved in this data collection and experiment.)

The results for the soil and water samples reflected high amounts of sodium, calcium, magnesium, alkalinity, and hardness. The water is not suited for irrigation, and the soil is not suitable for crops either. The results look typical of an intermittent spring-fed stream in this region of West Texas. There are large deposits of chloride, magnesium, and calcium salts in the geology of the entire area. When creeks of this type are present, they often produce varying types of brine water from the underlying geology and bring the salts to the surface soils. The water and resulting evaporative sediments on the bank are particularly concentrated when there have been long periods of drought. Such that when precipitation is not available to dilute the salts produced from the spring, the stream becomes a vault of salt.

The spring water is also unusually high in pH, hardness, and TDS (total dissolved solids), as was the case with the water samples tested. Other characteristics of the water that were measured did not show any potential chemical problems: nitrates, ammonia, and phosphates were all low, indicating that there is a stable bacterial breakdown of nitrogen and phosphorous compounds within the water. Arsenic results concluded that an absence of Arsenic was present.

The groundwater tested is loaded with sodium and hardness. The max amount of hardness for irrigation use is 180 mg/L $CaCO_3$. All the samples tested are higher than 180 mg/L especially location 1. Location 1 has a concentration of 675 mg/L. Experts believe the optimum hardness range for most pond fish would be between 100 - 300 mg/L $CaCO_3$.

Fish have an average blood pH of 7.4, so pond water with a pH close to this is optimum. An acceptable range would be from 6.5 to 9.0. Fish can become stressed in water with a pH ranging from 4.0 to 6.5 and 9.0 to 11.0.

Alkalinity is water’s ability to resist changes in pH and is a measure of the total concentration of bases in pond water, including carbonates, bicarbonates, hydroxides, phosphates, and borates. Total alkalinity of at least 50 to 150 mg/L is necessary for good pond productivity. Once again, the creek water is very high in alkalinity.

Some waters may have many contaminants like high alkalinity, high hardness, high pH, high sodium, etc., and still fish survive. Many other streams in the region have similar chemical profiles. I believe

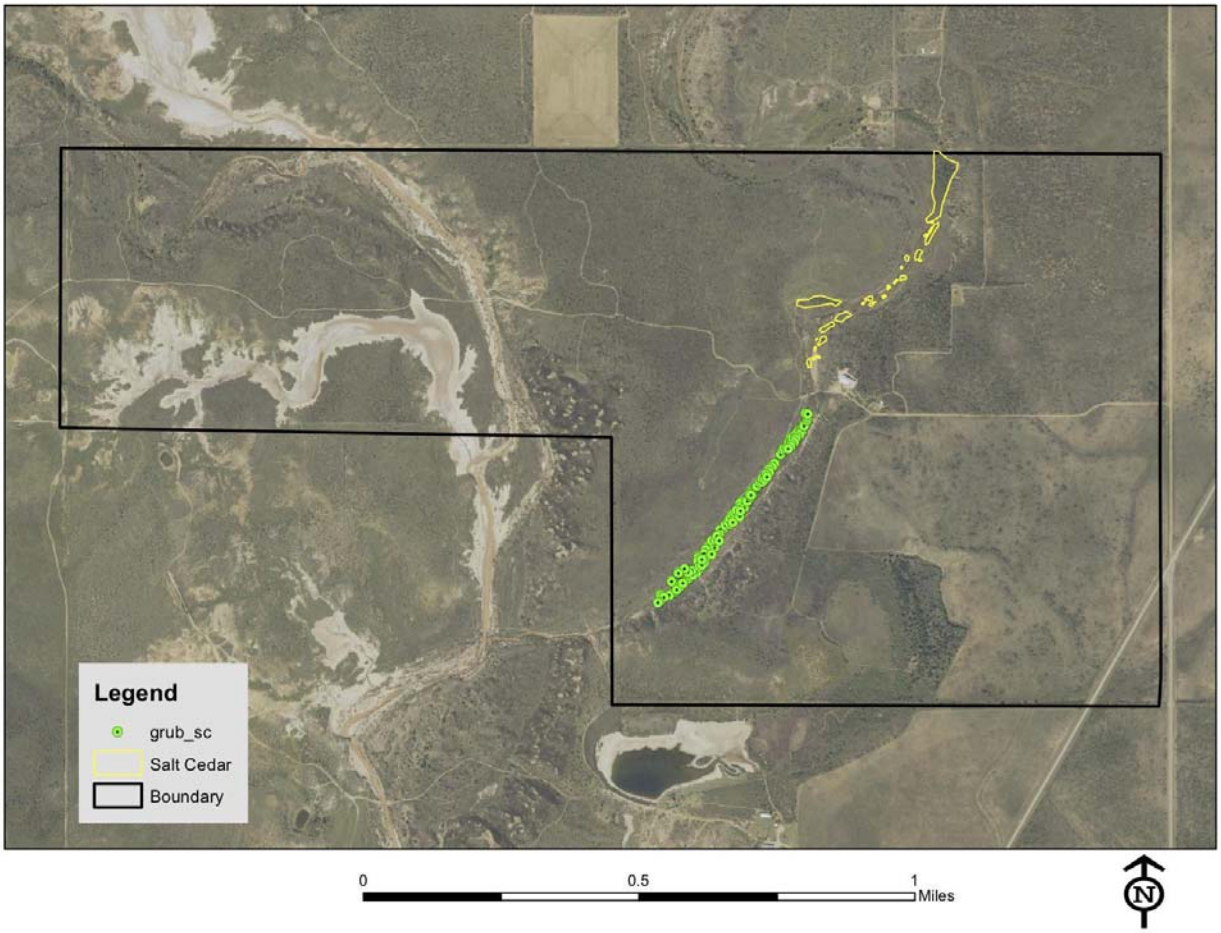
that the water quality is a reflection of the underlying geologic salt deposits and lack of freshwater (precipitation) to dilute the very salty and hard water coming from the springs.

Although the results do not confirm that salt cedar density has affected the creek's water quality, it is evident that the levels of alkalinity are very high in every location. There is a gradient from more dense salt cedar to less dense salt cedar from north to south. The results were compared to the quality control values that were obtained through a local water testing facility. Each location contained a wide variety of salt cedar densities.

The 2018-2019 results led to the question of whether a salt cedar eradication project, chemical or mechanical, would improve the riparian system along McDonald Creek. During the salt cedar eradication process, observations of the geological, biological, and geographical effects on the native vegetation, aquatic plants, fish, mammals, insects, and wildlife, in general, would be a vital pathway to improving the ecosystem.

2019-2020:

Plot the area for chemical/mechanical eradication



Purpose: To determine the line on the property (mechanical/chemical)

1. Mapping Software Meeting/Tutorial with Duane Lucia to determine the line of separation between chemical vs. mechanical - April 5, 2019, at Texas Tech University

2. Complete canopy measurement with aerial (topographic) imagery

3. Looked for historical imagery in this area, and the oldest found is 2004-2005 at no charge.

4. Classification of canopy via GIS software

Figure 1.

Avanza maps were used to plot the area for chemical/mechanical eradication. This app allows maps to be viewed on a smartphone. This also correlates with the chemical herbicide being sprayed from the helicopter. The helicopter uses the mapping software to control over-spray.

https://www.avenzamaps.com/maps/features.html

July 9, 2019

- Met with mechanical contact and chemical contact to discuss their availability to begin the eradication processes.
    - A time frame of August-September was mutually agreed upon.
- Map updated using the topographic software program.
    - Took GPS points where the sample sites are and added them to the map.
    - Projected acres:
- Chemical: 4.5 acres (spray part of the eradication)
- Mechanical: 8.4 acres

September 8, 2019

- US Fish & Wildlife/ Provine Helicopter Service, Inc. sprayed 4.5 acres of the invasive salt cedar along McDonald Creek at two sites. (site 4,5)
- Aerial application of herbicide by helicopter with a 1% solution
    - 1 gallon of chemical to 100 gallons of water & a 1/2% of surfactant
    - The active ingredient is 1% imazapyr and the .5% non-ionic surfactant.
- Application time began in the morning and finished by lunchtime.

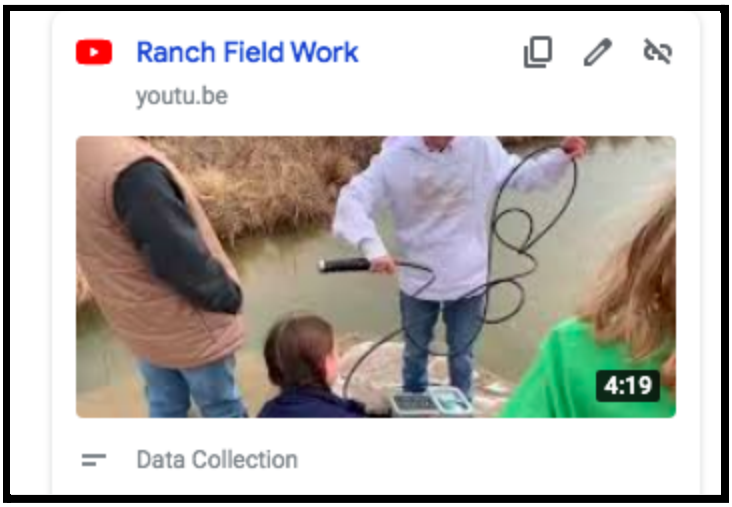
October 18, 2019

- Joe Marts Construction, based out of Post, manually completed the grubbing process.
- It took 33 hours to finish an area of 8.4 acres.
- Two sites grubbed. (site 2, 3)

Video of the Ranch Field Work

A video was made to show some of the ways we tested water quality and worked on the ranch by McDonald Creek.

https://youtu.be/gPEIlYixUZw



Contact List

Many people played a vital role in mentoring us during this project.
Some of our most important contacts are listed here and
we are grateful for their continued support.

Community Partners	Duration of Mentorship	Major Contribution to the Cedar Busters
Dr. Bart Durham **Associate Professor of Natural Resources, Ecology and Conservation** Lubbock Christian University Lubbock, TX 806.720.7709	April 2020 - ongoing	Taught us how to identify macroinvertebrates in creek water and use those to determine water quality and effects of salt cedar; allowed his graduate students to assist us in conducting the IBI.
Mr. Duane Lucia **Wildlife Biologist** U.S. Fish & Wildlife Service Lubbock, TX 806.445.6477	April 2020 - ongoing	Taught us to survey salt cedar along McDonald Creek; grant support in mechanical and chemical removal methods of salt cedar.
Mr. William Marshall **Pest Control Agent** Terminix Lubbock, TX 806.787.7881	November 2020 - February 2021	Taught us how to identify species of termites; showed us damage to wood and how to trap termites; donated traps to our team for use near salt cedar.
Joe Marts **Construction** LLC Post, TX 806.789.0221	April 2020 - ongoing	Taught us about grubbing the salt cedar thickets - mechanical removal methods of salt cedar.

Friday, January 29, 2020
Location: Three Gringos Ranch
Time: 4:15 PM
Meeting with students and mentors present - Justus, Tori, Sawyer, Jett, Mayah, Jill, Kelly, Sarah, and Kim

Evaluating Salt Cedar Growth and Final Measurements of Creek

Friday's trip to the ranch and what should be accomplished:

#1 Pictures of the eCYBER team
Pictures of the Lexus team with Mayah

#2 We need pictures of all 3 sites (or 6 sites) but we need data on the one that is untreated (site 1 and 6, correct?); one that is treated chemically (site 4 and 5??), and ones that are treated mechanically (2 and 3??)

#3 Along with pictures ... we need the number of salt cedars in each of those areas - each child needs to do their own counts so we have 4 tests
Check the water and especially the salinity - and do this in triplicate for each of these areas.

#4 We need a conclusion as to whether chemical works best or mechanical - based on the numerical data collected

#5 What the team needs to do next:

Justus- Finish IBI Slide, Before, During, and After. Next steps. SC growth Update EPT % Wood Chipping Slides, Interview slide for Bart, Duane?

Sawyer- Update and create new IBI charts with new information and data collected Update termite Slides. Salt cedar filtering - Powtoon - voice-over, Interview slide - termites

Jett- Work on oil absorption experiment and slides in triplicate. Wheat experiment and slides All mission folders Questions.

Tori- Work on links for website, logo, slogan, QR code. Brochure, Video/Youtube, absorption with salt cedar log,

All- Update Work schedule on the doc

Results from today: (Title this end of the project)
Site 1-
No water
Average of salt cedar present in 100-meter area (done in triplicate)
156 alive - 2 dead = 158 total
No Eradication

Site 2-
No water
Average of salt cedar present in 100-meter area (done in triplicate)
0 alive - 0 dead = 0 total
Mechanical Eradication completed in 2019

Site 3-
Water evaluation with multiparameter - an average taken - done in triplicate:
Temp: 9.403
Conductivity: 3.835
Salinity: 2.96
DO: 14.8
pH: -5.846
Average of salt cedar present in 100-meter area (done in triplicate)
0 alive - 0 dead = 0 total
Mechanical Eradication completed in 2019

Site 4-
Water evaluation with multiparameter - an average taken - done in triplicate:
Temp: 8.853
Conductivity: 3.3
Salinity: 2.563
DO: 10.536
pH: -5.56
Average of salt cedar present in 100-meter area (done in triplicate)
25 alive - 72 dead = 97 total
Chemical Eradication completed in 2019

Site 5-
Water evaluation with multiparameter - an average taken - done in triplicate:
Temp: 7.554
Conductivity: 6.615

Salinity: 5.585
DO: 14.22
pH: -6.245
Average of salt cedar present in 100-meter area (done in triplicate)
39 alive - 58 dead = 97 total
Chemical Eradication completed in 2019

Site 6-
No water
Average of salt cedar present in 100-meter area (done in triplicate)
56 alive - 4 dead = 60 total
The salt cedar in this area was very mature and much larger than the other areas.
No Eradication, but there was overspray present

Results from the beginning of the project: (Title this beginning of the project)

Site 3-
Water evaluation with multiparameter:
Temp: 17.3
Conductivity: 4.916
Salinity: 3.1
DO: 8.89
pH: 8.98
Mechanical Eradication completed in 2019

Site 4-
Water evaluation with multiparameter:
Temp: 21
Conductivity: 4.1
Salinity: 2.4
DO: 5.97
pH: 8.25
Chemical Eradication completed in 2019

Site 5-
Water evaluation with multiparameter:
Temp: 26.85
Conductivity: 11.5
Salinity: 6.15
DO: 4.75

pH: 9.71
Chemical Eradication completed in 2019

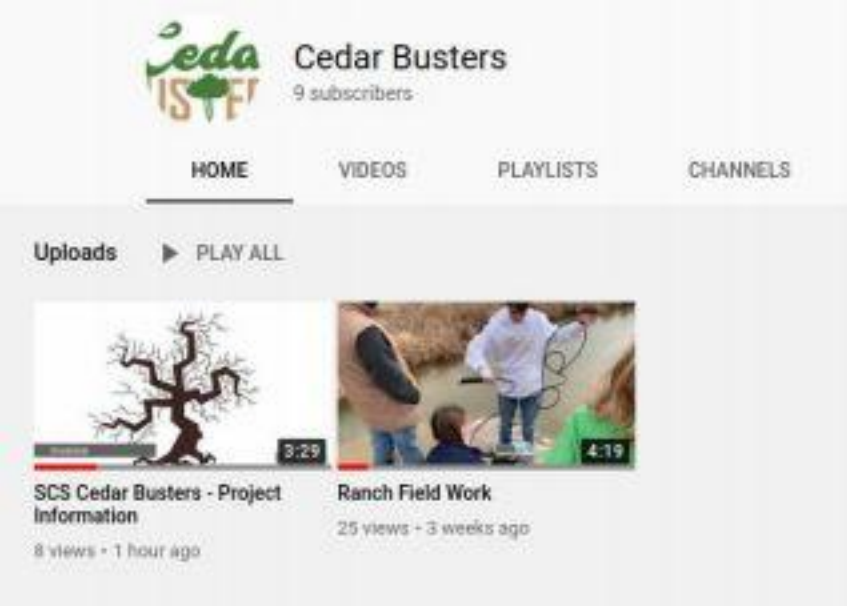
CEDAR BUSTERS Website

https://cedarbustersscs.wixsite.com/site

CEDAR BUSTERS YouTube Channel

SCS Cedar Busters - Project Information - project info

Ranch Field Work - field work video



REPURPOSING IDEAS

Termite Bait

Since salt cedar will work as a building material and the termites will not try and eat it because of its saltiness and alkalinity. If termites will not eat the salt cedar, then this kind of wood could be repurposed by the construction industry as an effective deterrent to termites.

Mulch

If salt cedar is disposed of after eradication, then garden mulch is a successful way to repurpose it. Future plans with growing a variety of plants, herbs, vegetables with salt cedar mulch. Possible mixing it with leaves (wet and dry) for a more successful mulch.

Oil Absorption

Because salt cedar is otherwise a waste of a natural resource. If oil can be absorbed by salt cedar. If it does, it can create a way to stop oil spills from ruining water/ocean life and water/ocean ecosystems. Salt Cedar is absorbent in other areas, therefore, we believe it could be designed for application in the petroleum industry.

Every year certain states and countries suffer due to droughts and loss of water in lakes and ponds. One of the reasons why there is a loss of water is salt cedar (tamarix), salt cedar sucks up about 757 liters of water per day and can destroy lakes and ponds in months which is a serious problem. This is what we are working to stop, for a few years different people have been working on this project and this is the third year that this project has been in the works

Additional Resources:

http://counties.agrilife.org/ector/files/2011/07/bbsaltcedar_5.pdf
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5410127.

This information brochure present by:

Cedar BUSTERS
cedarbusters.scs@gmail.com
cedarbustersscs.wixsite.com/site

Scan to visit our website:

2020-2021

SALT CEDAR

INFORMATIONAL BROCHURE

How to Eradicate & Repurpose Tamarisk (Salt Cedar)

Cedar BUSTERS

ABOUT SALT CEDAR (TAMARISK)

Salt cedar is one of the most invasive, hard-to-control woody plants in the world. Introduced from Eurasia into the western United States in the early 1800s, this plant rapidly spreads along rivers, lakes and streams. Most important, saltcedar can draw water from underground aquifers—as much as 200 gallons per plant per day.

Here are two three-step ways to control saltcedar. They are easy, environmentally responsible, and effective.

Each involves spraying a small but potent concentration of herbicide directly on each plant. With these methods you will be able to kill saltc edar with little damage to desirable vegetation.

Keep in mind that controlling saltcedar is not a onetime job. Seeds are easily spread by wind and water, so you will need to check your land regularly to find and get rid of unwanted seedlings.

HOW TO ERADICATE SALT CEDAR

Chemical Removal

Herbicides are a primary method of saltcedar control and can be applied by a number of ways including fixedwing aircraft, helicopter, tractor, truck or ATV-mounted boom sprayers, power sprayers, backpack sprayers, and carpet rollers. Treatment success depends on care taken during herbicide application. Most compounds available for saltcedar control have postemergence activity and provide limited preemergence control.

Mechanical Removal

Grubbing with a tractor-mounted implement is particularly useful for control of scattered individual trees. A grubbing tool mounted on a tractor's hydraulic system drives a blade into the soil to sever roots below the root crown and force the root crown onto the surface. To prevent rerooting, grubbed saltcedar should be piled, dried, and then burned or mulched rather than left on the surface.

BENEFITS OF ERADICATION

• Increase Water Resources

Salt Cedar removal can help everyone because salt cedar lowers the ogallala aquifer's water level significantly. Removal helps people that have ranches, lakes, ponds, etc. People who don't have a water source above level in their area still are benefited by the water because less water will be removed from the aquifer, helping the local environment and all wildlife affected by salt cedar.

• Animal Wildlife

Animals and native wildlife would have a better chnace of survival because there would be more water available.

• Native Vegetation

Native vegetation would be able to survive better because salt cedar destroys other plant life that it is around, so it's removal would help native landscaping grow.

Sunday, December 6, 2020
Location: 6811 Rochester Avenue Lubbock, Texas
Time: 4:00 pm
Meeting With Bill Morgan
Purpose: To Chip Salt Cedar to be Made Into Mulch

Salt Cedar Mulch Meeting Report

Many mounds of salt cedar, like this photo, are piled around the ranch along the creek. How can this invasive species, which was excavated over a year ago, be repurposed?

On Sunday, December 6th, Justus Jacobus, Jay Jacobus, Jill Jacobus, and Bill Morgan shredded about 20 thin salt cedar branches.

Wearing eye and ear protection, the branches were inserted into a Sears Craftsman 9 HP Shredder. This took a total time of 30 minutes from prep to the finished product.

The shredded wood chips were placed in an empty, dry, metal trash can.

On December 9th, Justus Jacobus brought bags full of salt cedar mulch to share with the team. The Cedar Busters started conducting experiments on December 10th. We are conducting experiments on salt cedar mulch and its absorption of water. We are trying to figure out if salt cedar mulch will absorb more water than regular mulch. We are also making sure that the salt cedar cannot resprout after being placed in the ground and used as mulch.

Student Safety Contract

School Name Southcrest Christian School **Teacher** Laura Stary

PURPOSE

Science is a hands-on laboratory class. You will be doing many laboratory activities which require the use of hazardous chemicals. Safety in the science classroom is the #1 priority for students, teachers, and parents. To ensure a safe science classroom, a list of rules has been developed and provided to you in this student safety contract. These rules must be followed at all times. Two copies of the contract are provided. One copy must be signed by both you and a parent or guardian before you can participate in the laboratory. The second copy is to be kept in your science notebook as a constant reminder of the safety rules.

GENERAL RULES

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before proceeding.
3. Never work alone. No student may work in the laboratory without an instructor present.
4. When first entering a science room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
5. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
6. Perform only those experiments authorized by the instructor. Never do anything in the laboratory that is not called for in the laboratory procedures or by your instructor. Carefully follow all instructions, both written and oral. Unauthorized experiments are prohibited.
7. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory.
8. Never fool around in the laboratory. Horseplay, practical jokes, and pranks are dangerous and prohibited.
9. Observe good housekeeping practices. Work areas should be kept clean and tidy at all times. Bring only your laboratory instructions, worksheets, and/or reports to the work area. Other materials (books, purses, backpacks, etc.) should be stored in the classroom area.
10. Keep aisles clear. Push your chair under the desk when not in use.
11. Know the locations and operating procedures, where appropriate, for all safety equipment including first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. Know where the fire alarm and exits are located.
12. Always work in a well-ventilated area. Use the fume hood when working with volatile substances or poisonous vapors. Never place your head into the fume hood.
13. Be alert and proceed with caution at all times in the laboratory. Notify the instructor immediately of any unsafe conditions you observe.
14. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water and those solutions designated by the instructor. Solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink. Check the label of all waste containers twice before adding your chemical waste to the container.
15. Labels and equipment instructions must be read carefully before use. Set up and use the prescribed apparatus as directed in the laboratory instructions or by your instructor.
16. Keep hands away from face, eyes, mouth and body while using chemicals or preserved specimens. Wash your hands with soap and water after performing all experiments. Clean all work surfaces and apparatus at the end of the experiment. Return all equipment clean and in working order to the proper storage area.
17. Experiments must be personally monitored at all times. You will be assigned a laboratory station at which to work. Do not wander around the room, distract other students, or interfere with the laboratory experiments of others.
18. Students are never permitted in the science storage rooms or preparation areas unless given specific permission by their instructor.
19. Know what to do if there is a fire drill during a laboratory period; containers must be closed, gas valves turned off, fume hoods turned off, and any electrical equipment turned off.
20. Handle all living organisms used in a laboratory activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly.
21. When using knives and other sharp instruments, always carry with tips and points pointing down and away. Always cut away from your body. Never try to catch falling sharp instruments. Grasp sharp instruments only by the handles.
22. If you have a medical condition (e.g., allergies, pregnancy, etc.), check with your physician prior to working in lab.

CLOTHING

23. Any time chemicals, heat, or glassware are used, students will wear laboratory goggles. There will be no exceptions to this rule!
24. Contact lenses may be worn provided adequate face and eye protection is provided by specially marked, non-vented safety goggles. The instructor should know which students are wearing contact lenses in the event of eye exposure to hazardous chemicals.
25. Dress properly for lab activities. Long hair, dangling jewelry, and loose or baggy clothing are hazardous. Long hair must be tied back and dangling jewelry and loose or baggy clothing must be secured. Shoes must completely cover the foot. No sandals allowed.
26. Lab aprons have been provided for your use and should be worn during laboratory activities.

ACCIDENTS AND INJURIES

27. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the instructor immediately, no matter how trivial it may appear.
28. If you or your lab partner are hurt, immediately yell out “Code one, Code one” to get the instructor’s attention.
29. If a chemical splashes in your eye(s) or on your skin, immediately flush with running water from the eyewash station or safety shower for at least 20 minutes. Notify the instructor immediately.
30. When mercury thermometers are broken, mercury must not be touched. Notify the instructor immediately.

HANDLING CHEMICALS

31. All chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so. The proper technique for wafting chemical vapors will be demonstrated to you.
32. Check the label on chemical bottles twice before removing any of the contents. Take only as much chemical as you need.

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Student Safety Contract
Continued

33. Never return unused chemicals to their original containers.
34. Never use mouth suction to fill a pipet. Use a rubber bulb or pipet pump.
35. When transferring reagents from one container to another, hold the containers away from your body.
36. Acids must be handled with extreme care. You will be shown the proper method for diluting strong acids. Always add acid to water, swirl or stir the solution and be careful of the heat produced, particularly with sulfuric acid.
37. Handle flammable hazardous liquids over a pan to contain spills. Never dispense flammable liquids anywhere near an open flame or source of heat.
38. Never remove chemicals or other materials from the laboratory area.
39. Take great care when transporting acids and other chemicals from one part of the laboratory to another. Hold them securely and walk carefully.

HANDLING GLASSWARE AND EQUIPMENT

40. Carry glass tubing, especially long pieces, in a vertical position to minimize the likelihood of breakage and injury.
41. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken or waste glassware in the designated glass disposal container.
42. Inserting and removing glass tubing from rubber stoppers can be dangerous. Always lubricate glassware (tubing, thistle tubes, thermometers, etc.) before attempting to insert it in a stopper. Always protect your hands with towels or cotton gloves when inserting glass tubing into, or removing it from, a rubber stopper. If a piece of glassware becomes "frozen" in a stopper, take it to your instructor for removal.
43. Fill wash bottles only with distilled water and use only as intended, e.g., rinsing glassware and equipment, or adding water to a container.
44. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be completely dry before touching an electrical switch, plug, or outlet.
45. Examine glassware before each use. Never use chipped or cracked glassware. Never use dirty glassware.
46. Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, and loose connections. Do not use damaged electrical equipment.
47. If you do not understand how to use a piece of equipment, ask the instructor for help.
48. Do not immerse hot glassware in cold water; it may shatter.

HEATING SUBSTANCES

49. Exercise extreme caution when using a gas burner. Take care that hair, clothing and hands are a safe distance from the flame at all times. Do not put any substance into the flame unless specifically instructed to do so. Never reach over an exposed flame. Light gas (or alcohol) burners only as instructed by the teacher.
50. Never leave a lit burner unattended. Never leave anything that is being heated or is visibly reacting unattended. Always turn the burner or hot plate off when not in use.
51. You will be instructed in the proper method of heating and boiling liquids in test tubes. Do not point the open end of a test tube being heated at yourself or anyone else.
52. Heated metals and glass remain very hot for a long time. They should be set aside to cool and picked up with caution. Use tongs or heat-protective gloves if necessary.
53. Never look into a container that is being heated.
54. Do not place hot apparatus directly on the laboratory desk. Always use an insulating pad. Allow plenty of time for hot apparatus to cool before touching it.
55. When bending glass, allow time for the glass to cool before further handling. Hot and cold glass have the same visual appearance. Determine if an object is hot by bringing the back of your hand close to it prior to grasping it.

QUESTIONS

56. Do you wear contact lenses?
    ☐ YES ☑ NO
57. Are you color blind?
    ☐ YES ☑ NO
58. Do you have allergies?
    ☐ YES ☑ NO

    If so, list specific allergies _____

_____

AGREEMENT

I, Justus, Tori, Sawyer Jett (student's name) have read and agree to follow all of the safety rules set forth in this contract. I realize that I must obey these rules to ensure my own safety, and that of my fellow students and instructors. I will cooperate to the fullest extent with my instructor and fellow students to maintain a safe lab environment. I will also closely follow the oral and written instructions provided by the instructor. I am aware that any violation of this safety contract that results in unsafe conduct in the laboratory or misbehavior on my part, may result in being removed from the laboratory, detention, receiving a failing grade, and/or dismissal from the course.

Justus, Tori, Sawyer Jett
Student Signature

Date 04-08-2020

Dear Parent or Guardian:

We feel that you should be informed regarding the school's effort to create and maintain a safe science classroom/laboratory environment.

With the cooperation of the instructors, parents, and students, a safety instruction program can eliminate, prevent, and correct possible hazards.

You should be aware of the safety instructions your son/daughter will receive before engaging in any laboratory work. Please read the list of safety rules above. No student will be permitted to perform laboratory activities unless this contract is signed by both the student and parent/guardian and is on file with the teacher.

Your signature on this contract indicates that you have read this Student Safety Contract, are aware of the measures taken to ensure the safety of your son/daughter in the science laboratory, and will instruct your son/daughter to uphold his/her agreement to follow these rules and procedures in the laboratory.

Jill Jacobus, Kelly Means, Hurst,
Parent/Guardian Signature

Sarah Hay
Date 04-08-2020

ISEF Guidelines for Biosafety Level 1
Laboratory Facilities & Operations

A Self- Assessment Safety Checklist

This form is intended to aid in assessing a laboratory as appropriate to do BSL 1 studies in locations such as water testing facilities, high schools or colleges teaching introductory microbiology classes. The following checklist is based on the Biosafety Level 1 section of "Laboratory Biosafety Manual", 3rd edition, World Health Organization, 2004.

Facility Name Southcrest High School **Room #** 2024

Address 3801 S. Loop 289
Lubbock, TX 79423

- **Name of Laboratory Supervisor/Teacher** Milene de Farias
  - This person must be educated, trained and qualified to supervise microbiological projects and maintain the criteria below.
  - Qualifications: (List or attach additional sheet if necessary. Qualifications should include general training in microbiology or a related science)

Analytical Chemistry, M.S.

I attest that I have the qualifications listed above (or attached).

I attest that there will be direct supervision of students when they are in the laboratory.

Laboratory Supervisor/Teacher Signature Milene de Farias

Date of signature 04-08-20

- **Name of Responsible Administrator** Susie Driscoll

I attest that this laboratory is a BSL 1 facility and complies with all procedures listed on this form and that the person named above is educated, trained and qualified to supervise microbiological projects and maintain the criterion below.

Administrator Signature Susie Driscoll

Title Southcrest Principal

Date of Signature 04-08-20

Check the appropriate box for each statement.

If you check any of the following boxes with "NO", you must make appropriate modifications before you can classify the lab as a BSL 1 facility. The safety of students and faculty must be your primary concern.

A. Laboratory Practices

Yes	No	
☑	☐	1. All personnel wash their hands after they handle viable materials and animals, after removing gloves, and before leaving the laboratory.
☑	☐	2. Eating, drinking, handling contact lenses, and applying cosmetics is forbidden in the laboratory.
☑	☐	3. Mouth pipetting is prohibited and only mechanical pipetting devices are used.
☑	☐	4. All procedures are performed to minimize the creation of splashes or aerosols.
☑	☐	5. Work surfaces are decontaminated with disinfectant when work is completed at the end of the day and after any spill of viable material.
☑	☐	6. All contaminated cultures, stocks, glassware, plastic ware and other biologically contaminated waste are autoclaved or decontaminated with a suitable disinfectant.
☑	☐	7. Culture fluids and other contaminated liquid wastes are autoclaved or decontaminated with a suitable disinfectant before disposal.
☑	☐	8. Materials to be decontaminated outside of the laboratory are placed in a durable, leak-proof container and closed for transport from the laboratory.
☑	☐	9. Insect and rodent control procedures are in effect.

B. Personal Protective Equipment

Yes	No	
☑	☐	1. Protective laboratory coats/aprons are worn while in the laboratory and left in the laboratory after use. These coats are never taken from the laboratory without prior autoclaving or disinfection.
☑	☐	2. Suitable disposable gloves (e.g., latex, nitrile, vinyl) must be worn.
☑	☐	3. Goggles are available and used when required.

C. Laboratory Facilities

Yes	No	
☑	☐	1. The laboratory has a sink for hand washing.
☑	☐	2. The laboratory is designed so that it can be easily cleaned and decontaminated. (Carpets and rugs are not appropriate)
☑	☐	3. Bench tops are impervious to water and resistant to moderate heat, acids, alkalis, organic solvents and chemicals used to decontaminate the work surface.
☑	☐	4. The laboratory furniture is sturdy with surrounding spaces accessible for cleaning.
☑	☐	5. If the laboratory has windows that are open, they are fitted with fly screens.
☑	☐	6. Sharps are discarded in a puncture-resistant sharps disposal container.
☑	☐	7. A fire extinguisher and first aid supplies are easily accessible within the laboratory
☑	☐	8. An eyewash facility is easily accessible within the laboratory.