JACKSON DEMONSTRATION STATE FOREST

JDSF AND CARBON:
Managing Forests for the Future

General Carbon Facts

- **Carbon (C)** – A basic building block for all life on earth. When found in our atmosphere as carbon dioxide (CO_2) it is one of the greenhouse gas (GHG) elements that regulates earth's temperature and contributes to global climate change.
- Healthy forests have the capability to sequester (capture) and store large amount of carbon. Forests can be both carbon sinks and sources.
- The forest carbon cycle is an incredibly complex, dynamic topic with ongoing research. Forest stand structure, species composition, age, and natural disturbance cycles can all influence the carbon cycle.

Existing Forest = Carbon Storage

Carbon Storage vs. Carbon Sequestration

- Carbon Storage – Forests store carbon in the trees' bole, branches, roots, and soil. This carbon is most secure in ecosystems that are resilient to disturbance. JDSF stores ~19 million metric tonnes of CO2 across the Forest.
- Carbon Sequestration – Through photosynthesis, trees combine CO_2 from the atmosphere with water from soil and convert them to oxygen and sugars using the power of the sun. The sugars provide energy for tree growth (carbon storage) and the oxygen is released back into the atmosphere. Vigorously growing trees can sequester large amounts of carbon through this process. JDSF is sequestering ~200,000 metric tonnes per year which is enough to offset the annual emissions of 19,000 average Californians[1].

Active Forest Growth = Carbon Sequestration

Carbon in a Managed Forest: Short-term vs. Long-term Carbon Storage and Sequestration

- California's Cap and Trade program recognizes that forests can mitigate climate change by increasing or conserving forest stocks through reforestation, avoiding conversion, and improving forest management. Improving forest management includes activities that increase the overall age of the forest, increase forest productivity and health, and maintaining high stocking levels[2].
- Though it may seem counterintuitive, halting all timber harvests might have a negative affect on carbon sequestration as it can lead to overcrowding, which stresses the trees and leaves them vulnerable to disease, pests, and disturbances. Forests today, and in the future, facing climate uncertainty, need to be diverse to withstand human caused and natural disturbances.

Resiliency - the stands ability to persist after a disturbance.

- Creating more resilient forests by using management activities, including varying stand density, using prescribed fire, and maintaining a network of fuelbreaks across the landscape, can address the risk of losing the forest and its carbon benefits. Periodic timber harvests are used to manage density and maintain forest health. Both California Policy and third parties[3] recognize that redwood forest products continue to store carbon and provide a net carbon benefit.
- Disturbances within the forest release carbon and convert some trees from carbon sinks to carbon sources which can no longer contribute to future sequestration.
    - Dead material can and still does contribute to the forest ecosystem as habitat, nutrient cycling, etc.
- Management activities will reduce the short-term carbon storage by removing vegetation, but can increase the stability, or resiliency, of long-term carbon storage by reducing the stress of competition from other trees; and maintain high rates of carbon sequestration through vigorously growing trees[4].

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[1] "Latest GHG Inventory shows California remains below 2020 emissions target." California Greenhouse Gas Emission Inventory Program. *California Air Resources Board*. July 28, 2021. https://ww2.arb.ca.gov/our-work/programs/ghg-inventory-program

[2] "Cap and Trade US Forest Projects Protocol." 2014 *California Environmental Protection Agency: Air Resources Board.* https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2014/capandtrade14/ctusforestprojectsprotocol.pdf

[3] Sahoo and Bergman. 2020. "Cradle-to-Gate Life-Cycle Assessment of Redwood Lumber in the United States. *USDA, US Forest Service.* https://www.fpl.fs.fed.us/documnts/fplrp/fpl_rp706.pdf

[4] Hurteau et al. 2010. "The Carbon Cost of Mitigating High-Severity Wildfire in Southwestern Ponderosa Pine." *Global Change Botany*. 17(4):1516-1521 DOI:10.1111/j.1365-2486.2010.02295.x

California's Wildfire and Forest Resilience Action Plan. 2021. Forest Management Task Force. https://www.fire.ca.gov/media/ps4p2vck/californiawildfireandforestresilienceactionplan.pdf

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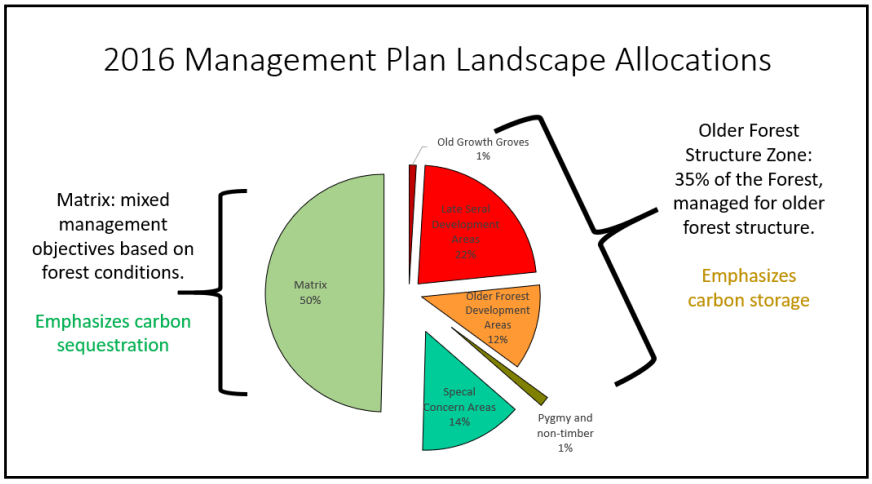
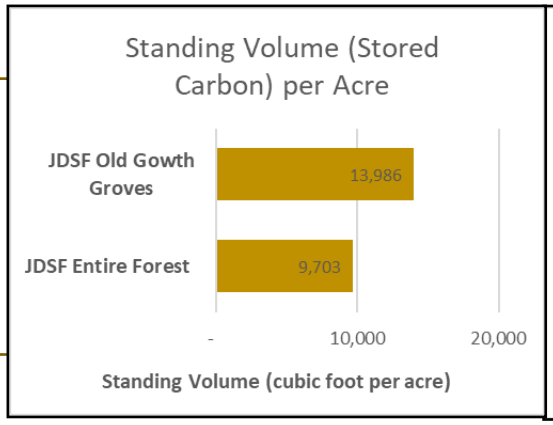
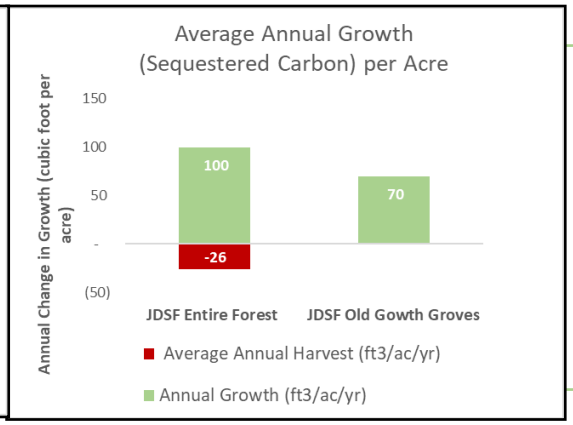
JDSF and Forest Carbon

- JDSF is a working forest that is managed for a multitude of goals and objectives, including timber production, research, carbon storage and carbon sequestration, and restoration etc.
    - To achieve these goals, the Forest has been divided into allocations, addressing different forest resources across the landscape.
- JDSF manages to foster both higher carbon storage (old growth & Older Forest Structure Zone) and carbon sequestration with vigorously growing stands created through periodic harvests.
- Dynamics of stand growth is a more important factor than individual tree size, so JDSF manages across all size and age classes, including large trees, to control density, provide for long-term sustainability, and maintain high rates of sequestration through faster growing young trees. Old growth reserves, scattered individual old growth trees, and younger trees with exceptional wildlife attributes are protected across the landscape.



Volume is used as a proxy for carbon. JDSF Old Growth Groves store more carbon per acre, but they comprise less than one percent of JDSF.





Volume is used as a proxy for carbon. Even with annual harvests of 26 ft3/ac on average across the Forest, it is growing more (sequestering) than the Old Growth Groves on a unit area basis.

To demonstrate a climate resilient forest, both older forest structure (storage) and vigorously growing (sequestration) trees are needed to mitigate climate change and enhance other resources.

JDSF and California's Climate Change Goals

- JDSF and other Demonstration State Forests (DSF) are included in the draft Natural and Working Lands Climate Smart Strategy Document by stressing the importance of their research and exploration of how to balance management activities in complex ecosystems[5].
    - DSF are well poised to be the example for the rest of the State on balancing the need to manage natural resources while conserving ecosystems.
- JDSF demonstrates longer rotation ages than are common in the redwood region. This allows JDSF to grow larger/older trees which provide both aesthetic and economic values. Longer rotation ages are a "Nature-base solution" as defined by the Strategy Document.

Rotation Age – the age that an individual tree can be harvested.
Harvest Entry – the number of years between harvests for a stand.

[5] "Natural and Working Lands Climate Smart Strategy - Draft." 2021. *Nature-based Climate Solutions*. https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/FINAL_DesignDraft_NWL_100821_508-opt.pdf

Forest Carbon Glossary

- **Bole**: the tree's stem.
- **Cap and Trade Program**: visit https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2014/capandtrade14/ctusforestprojectsprotocol.pdf
- **Carbon**: A basic building block for all life on earth. When found in our atmosphere as carbon dioxide (CO_2) it is one of the greenhouse gas (GHG) elements that regulates earth's temperature and contributes to global climate change.
- **Carbon Sequestration:** Any process by which CO_2 is removed from the atmosphere and stored in solid or liquid form. Through photosynthesis, trees combine CO_2 from the atmosphere with water from soil and convert them to oxygen and sugars using the power of the sun. The sugars provide energy for tree growth (carbon storage) and the oxygen is released back into the atmosphere. Vigorously growing trees can sequester large amounts of carbon through this process. Active Forest Growth = Carbon Sequestration.
- **Carbon Sink:** a negative source of CO_2 in the atmosphere via absorption and storing of carbon in vegetation, the atmosphere, and the ocean.
- **Carbon Source:** a positive source of CO_2 to the atmosphere.
- **Carbon Storage:** Forests store carbon in the trees' bole, branches, roots, and soil. This carbon is most secure in ecosystems that are resilient to disturbance. Existing Forest = Carbon Storage.
- **Climate Uncertainty:** while the climate is changes and humans have caused some extent of that, there is disagreement about what the future will hold for the climate. Exactly how hot, dry, cold, wet, or what extreme weather is unknown. All current knowledge is based on models and previously recorded records that we can make inferences on to lead to best management practices, but no one knows what the future holds.
- **Conservation:** seeks the sustainable use of nature by humans (includes permitted hunting, limited harvesting/gathering of forest materials, monitored water use, and regulated recreation – camping, hiking, biking, horse-riding).
- **Conversion:** change in land use, i.e. forests to crop farm land (vineyards or marijuana) or urban development.
- **Composition:** the makeup of the forest in terms of the living organisms or groups of organisms and non-living components present in the forest; all the tree species that are found in the forest.
- **Disturbance:** events that change the structure and composition of a forest ecosystem, beyond the growth and death of individual organisms. Disturbances, both human-induced and natural, shape forest systems by influencing their composition, structure, and functional processes.
- **Forest Management Activities:** prescribed burning, timber harvesting, fuels treatments etc.
- **Forest Structure:** the vertical and horizontal spatial arrangement of the component parts of the forest ecosystem.
- **Fuels Treatments:** Activities that change the continuity (or density) of the vegetation. Treatments include: lop and scatter, pile and burn, mastication, prescribed burning, and chipping.
- **Green House Gases (GHG):** Atmospheric gases, both natural and anthropogenic, that allow solar radiation to reach the Earth's surface and re-absorb infrared radiation emitted by the Earth.
- **Harvest Entry:** the number of years between harvests for a stand.
- **Long-term Carbon Storage:** Looking at a longer time frame (20-hundreds of years) for carbon storage.
- **Nature-Based Solutions:** visit https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives /Expanding-Nature-Based-Solutions/FINAL_DesignDraft_NWL_100821_508-opt.pdf
- **Old Growth:** any live conifer, regardless of size or species that was present in the original stand before the first historic logging on what became JDSF (1860).
- **Photosynthesis:** the process by which plants use sunlight, water and carbon dioxide to create oxygen and energy in the form of sugar.
- **Preservation:** protecting nature from human over-use (leave no trace model).
- **Resilient or Resiliency:** The stands ability to persist after a disturbance.
- **Rotation Age:** the age that an individual tree can be harvested.
- **Short-term carbon storage:** Looking at only a short time frame (1-15 years) for carbon storage.
- **Stand Density:** the number of stems per acre on a landscape.
- **Vigorously Growing:** determined by the growth rate of the stand.
- **Volume used as Proxy for Carbon:** Volume is correlated with carbon calculations. Volume is easier to understand and visualized.