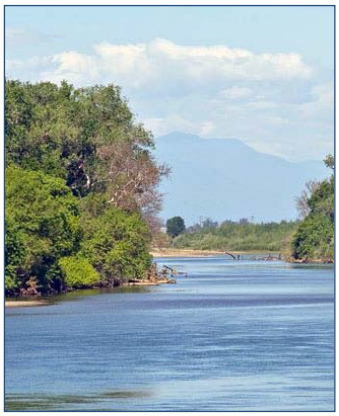
California Levee Vegetation Research Program (CLVRP)

California Future Research Needs/Priorities

December 13, 2011



The following comments are submitted to the U.S. Army Corps of Engineers - Sponsored Workshop on the Direction of Future Research to Study Woody Vegetation on Levees, December 13-14, 2011, Sacramento, CA

The California sponsoring agencies support moving toward a comprehensive risk assessment framework for all levee risk factors, including vegetation. They find it to be of utmost importance to examine not only the impacts of existing vegetation on levee performance, but also the impacts to levee performance and environmental values of removing existing vegetation. They prioritize the following four items (in no certain order):

1) Estimate the relative risk of failure due to retention of existing vegetation as compared to other known risk factors.

2) Seriously examine the question of whether removing vegetation may amplify the probability of levee failure due to other risk factors. Removing vegetation may reduce uncertainty, but it should not be assumed that removing vegetation on a broad scale increases factor of safety/reliability.

3) Additional research to help levee managers identify situational vegetation hazards, and to develop (to the extent feasible) standardized hazard tree mitigation guidelines including appropriate standards of tree removal and subsequent levee repair.

4) Evaluate the environmental impacts of vegetation removal in order to ensure compliance with State and Federal environmental law.

Finally, the sponsors feel it is important to undertake a comprehensive review of the existing literature to identify areas of uncontested common ground (areas of scientific consensus and/or overwhelming evidence related to the impacts of trees and tree removal that could reasonably be extrapolated to levee performance) as well as areas where evidence is weak or interpretations of studies are debated. This will help hone the discussion of what questions remain unanswered, and therefore which research activities would be beneficial to undertake.

Broad Topic No. 1 - Effect of vegetation removal on habitat and protected species

- If lower waterside vegetation is retained for riparian habitat but vegetation is removed from the upper waterside slope through Life Cycle Management (LCM), what are the Impacts to the remnants of the riparian ecosystem, its functionality and future natural recruitment of vegetation on the waterside? This research may include a monitoring program to determine if LCM affects species composition, recruitment, and the survival of lower waterside vegetation.

- Beneficial aspects of vegetation on levees (stability, erosion control, rodent control, etc);

- Potentially identifying desirable species to plant (that would provided benefits to stability, erosion control, etc);

- Environmental impacts of trimming up trees within what the State of California defines as the "vegetation management zone" (landside easement, landside slope, crown, and upper waterside slope) 5 feet off the ground, e.g. habitat quality impacts to ground-dwelling animal species.

- If riverine habitat is preserved but isolated by a vegetation-free zone on the rest of the levee, what are the impacts to land-based species that require access to riverine habitat?

Broad Topic No. 2 - Effect of vegetation on levee performance / how to identify hazards

- Risk analysis is particularly useful and insightful when working with differing levels of certainty or evolving research, such as the positive and negative impacts of vegetation on levees. In accord with the Corps' risk-informed approach to decision making, how can the Corps utilize risk analysis to make decisions regarding key levee vegetation policies?

- Quantify the relative risk of vegetation compared to other factors, e.g. through statistical regression based on annual probability of failure.

- Additional research to help levee managers determine under what circumstances a tree (alive or dead) on or near a levee poses an unacceptable threat to levee integrity, which is a key consideration under the California Urban Levee Design Criteria (ULDC) and Central Valley Flood Protection Plan (CVFPP) Vegetation Management Strategy. Consider developing a well defined, science based 'hazard tree criteria' removal strategy. Although more research is needed to help answer the many considerations that feed into this, perhaps an initial answer (e.g., a set of factors or computations) may be developed by using the best information to date from existing and ongoing research. Ideally, the answer developed needs to be practical so that it can be applied broadly for levee reaches, rather than an individual tree-by-tree basis (which would likely be unduly burdensome and impractical for the Central Valley). An initial take on hazard tree mitigation criteria was developed for the SAFCA Life Cycle Management paper, which could serve as a starting point.

- Research on actual levee seepage as compared to modeled assumptions of levee seepage.

- Remake geotechnical models using inputs from newer, more extensive field data on root systems and root-architecture models emerging from new quantitative analyses. Existing geotechnical models of slope stability and seepage are based on very limited field data – currently at most one or portions of a few trees and their root systems. Tree root architecture models currently being developed should be incorporated into future piping and seepage models, which may entail creating new combined models. Updated root architecture models can be used, for example, to do the following. 1) Evaluate trees on different levee types nationally (clay vs. sand, permanent vs. seasonal) with accurate depictions of how trees grow in these levee types. 2) Compare land-side and water-side tree root systems to evaluate architecture. Do compacted levees or dry levees reduce tree root systems in the levee side compared to non-levee? 3) Compare impacts of healthy trees vs. diseased, declining, over-mature trees, and dead trees.

- Further root decomposition studies needed. Build on work by Zanetti et al with species specific studies in the CA Central Valley and other regional jurisdictions.

- Research on the operational impacts of vegetation on visibility, access, and flood fighting, e.g. a historical study of levee records.

- Limited resources force local and State interests to work with the less-than-ideal conditions of existing levees. There is an apparent lack of research into the effects of levee vegetation on already-compromised or substandard levees (e.g. levees composed of cohesionless soils, steep slopes) and a comparison of their performance with new levees built to modern standards. This makes up a significant portion--in some states a majority--of the levee inventory, thus this would inform economic analyses of levee rehabilitation projects or even the type of levee rehabilitation required.

Broad Topic No. 3 - Effect of vegetation removal on levee performance / how to safely repair a levee after removal

- Historical study of regional jurisdictions where levee vegetation has been removed. How do they perform compared to control sections?

- Effect of vegetation removal on surficial erosion and levee stability under conditions of overtopping, wave wash (e.g. boat wake), and /or flood flow currents parallel to a levee system.

- Effect of vegetation removal on burrowing mammal abundance. The vegetation ETL references an outdated notion that burrowing mammals generally prefer wooded habitats. This is not true of California ground squirrels or Botta pocket gophers, two particularly important burrowing species widely found on and near California levees. Recent research by Van Vuren (UC Davis) suggests that converting levees to open habitat will increase the abundance of critical burrowing mammal species on levees, and the resulting damage could be extensive (grouting study, UC Berkeley). Increasing damage by burrowing mammals could far outweigh perceived benefits gained by vegetation removal. Recommend convening an expert panel of mammologists to inform current state of understanding of burrowing mammal habitat preferences/associations with woody vegetation;

- Effect of mass vegetation removal on the risk of piping and seepage. If trees are found to increase piping / seepage, does removing trees *en masse* create more risk than removing them (or letting them die naturally) in a chronologically staggered fashion?

- Hypothesize/quantify any change in risk to the stability of the levee embankment associated with levee repairs post-vegetation-removal. For example, the repaired sections inevitably will have different materials and compaction vs. original sections, which may increase the risk of slumping and sliding failures due to the introduction of hydraulic discontinuities in the levee.

- Root removal and the extent to which it should be required when a tree is removed. Current USACE policy says to remove all roots larger than ½ inch. The draft ULDC says to remove all roots larger than 1.5 inch within 3 feet of the trunk perimeter, but more removal may be needed depending on type, location, soils, etc. The draft ULDC also says trees smaller than 4 inches diameter at breast height (DBH) usually don't need their roots removed when removing the tree. What is an acceptable procedure to chase roots to Corps standards? How extensive is the damage to the levee? What is the standard of repair required to ensure an improved factor of safety? What is the cost of root chasing and subsequent levee repair?

About the CLVRP

The California Levee Vegetation Research Program (CLVRP) is a partnership of federal, state, and local agencies formed to conduct original scientific research to address vegetation policy issues affecting the state and federal levee system in the California Central Valley.

The CLVRP began in 2009 and is funded by the California Department of Water Resources and the Sacramento Area Flood Control Agency.

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