Mosquito Landscapes
Invited Paper
AAAS 1999
Joshua N. Collins, Ph.D.

1. Mosquito Landscapes title slide
Good morning. This presentation is about the potential relationship between mosquito control and wetlands restoration in the Bay Area. I intend to draw upon my past experience in mosquito research and my more recent experience in regional wetlands planning to identify the special expertise that the mosquito abatements districts (MADs) can contribute to the future of wetlands restoration in the Bay Area.

2. Presentation Outline
I'm going to address the relationship in three parts. In the first part, I will describe the regional outlook for wetlands restoration. In Part 2, I will try to provide a new perspective on mosquito control expertise, in the restoration context. In Part 3, I will describe the emerging regional wetlands organization that may provide a new venue for the special expertise of mosquito control.

3. Bay Area Satellite View
Ecological restoration is gaining momentum in the Bay Area. The focus of Environmental planning is expanding to include large-scale ecological restoration in addition to the protection of existing resources. Government at all levels is engaged in projects that are extending and connecting together patches of natural habitat large and small. Most of this restoration effort is concentrated on the wetlands along the margins of the Bay.

4. Coastal Conservancy Web Site
For example, here we see a web page from the California Coastal Conservancy showing the regional distribution of its wetlands and riparian restoration projects. There are nearly as many projects with other sponsors, including the Army Corps of Engineers, special districts, counties, and municipalities.

5. Goals Project Report cover
Representatives of all of these sponsors have been working with the regional wetlands community of scientist to coordinate the wetlands restoration efforts. Coordination requires a shared set of regional goals, within which local plans are enacted. The mosquito abatement interests have been represented on technical and management teams. There are sections of the report addressing mosquito abatement concerns.

6. Past Landscape
We might ask the question: what is the reason for all this restoration? It is the will of the people. Public surveys show that people want green and blue vistas, fish and frogs, as well as flood control and mosquito abatement. And so there is a sense of need to restore ecological function

by re-organizing land use and weaving ecological processing into the fabric of urban life, without risking property and human health.
Part of the impetus may relate to the growing sense of what has been lost during the past 200 years. Here we see the distribution of tidal wetlands, lowland creeks, and seasonal wetlands at the time of European contact, about 200 years ago.

7. Present Landscape
And here we see what exists of these habitat types today. There has been a huge loss in tidal wetlands, a large increase in seasonal wetlands, due to incomplete drainage of the reclaimed tidal marshes, and a significant loss in riparian forest.

8. Future View
Here is an example of what may be the future distribution of wetlands and related habitats in the region. This is the map created during the Wetlands Ecosystem Goals Project to illustrate the recommended amounts of habitats and their spatial relationships. The recommendations call for the restoration of about 60,000 acres of tidal wetlands, hundreds of miles of creeks with riparian forests, and the enhancement of about 70,000 acres of seasonal wetlands.

I hope the mosquito abatement people view this as a landscape of opportunity. But I can understand why a proposal for this much restoration of potential mosquito habitat can be alarming. It is not going to be possible to use hand-held dippers to monitor patches of wetlands that are 3,000 to 10,000 acres large. The regulated disuse of insecticides, especially their aerial application, greatly restricts our ability to effectively control mosquitoes in very large areas of effective habitat. It seems obvious that mosquito control will have to be built into restoration design, and this will take the on-going, direct involvement of mosquito control experts.

You might also be asking: is this plan for real? Can this be achieved? I think the evidence suggests that the plan will be implemented. The Napa-Sonoma Marsh project is about 8,000 acres at this time; the Sonoma Land Trust and other sponsors have proposed projects of more than 1,000 acres along the Petaluma River. There is the Montezuma Wetlands Project of about 3,000 acres that has passed through environmental review. There are the restoration projects associated with military base closures at Mare Island, Skaggs Island, Hamilton, Crissy Field, Alameda, and perhaps Moffett Field and the Concord Weapons Facility. There is even serious consideration of habitat restoration for most of the Salt Ponds of South Bay, with a variety of potential funding mechanisms, although nothing has been decided yet. As reported in the public press last week, there is certainly going to be restoration of Bair Island. Perhaps these are the easy projects that will not lead to any others. But there is evidence to the contrary. For example, there seems to be a growing acceptance among the regulatory agencies for the concepts of out-of-kind and off-site mitigation. In the context of the shared regional goals, the policies and programs of regulatory agencies can serve as tools for large-scale restoration.

These recommendations and related projects have large implications for the form and function of the bay ecosystem. There will likely be beneficial changes in tidal circulation as well as

changes in community structure. What I would like to focus on is the expected needs for mosquito abatement.

9. Part 2: MAD Plug-ins

The mosquito abatement districts may be the best source of special expertise that pertains directly to some of the newest concepts in wetlands restoration design and practices. Given my background in mosquito control research and regional ecological planning, I think the MADs offer the following areas of expertise critical to restoration success.

10. Natural Habitat Controls (understanding drainage)

New wetlands projects will try to emphasize the restoration of natural processes of habitat evolution and self-maintenance. This is believed necessary to minimize initial and long-term unit costs and thus afford large-scale restoration. In practice, this means that project designers must understand how the quality and quantity of surface water vary in space and over time.

In this regard, the MADs have a great wealth of pertinent field observations and practical experience. For example, through the history of mosquito source reduction, the MADs have enough first-hand experience to anticipate how hydroperiod and water salinity might vary within and among locations from season-to-season and year-to-year. Among the senior field people there is also a general understanding of how this variability is affected by natural processes and people. The long record of empirical observation that exists within the MADs is without par among the wetland agencies and science institutions. In a real sense, the MAD's constitute a wetlands agency, with teams of field observers and scientists who can reconstruct through personal experience the modern natural history of many wetlands around the Bay.

11. Regional View of Local Conditions (understanding small habitats)

San Francisco Bay is one of the most urbanized estuaries in the world. One of the legacies of the history of intensive land use is a complex array of disturbed wetlands. The history of disturbance has increased habitat complexity at a variety of scales.

12. Photo of diked and tidal marsh lands

Large patches of tidal marsh have become mosaics of levees and ditches and various land uses.

13. Close up of disturbances

For any given land use there are numerous unnatural places of poor drainage that can breed mosquitoes. Mosquito control demands close examination of the landscape in great detail. More mosquitoes are generated by smaller habitat patches than any other group of species so important to people. For example, a single set of wet hoof prints can yield a significant number of mosquitoes, but all the hoof prints in the region do not support significant numbers of fish, amphibians, or waterfowl.

14. Aerial photo of seasonal wetlands

While avian ecologists are looking at hundreds of acres of tidal marsh or season wetlands as habitat for waterfowl....

15. Photo of moist grasslands
.... Mosquito control experts are looking more closely at mosquito habitats within the bird habitats ...

The only other wetlands scientists, besides mosquito control experts, who examine the landscape so closely are other entomologists and rare plant specialists. I have noticed that these experts have similar approaches to their basic field surveys, covering the same amount of area at similar paces, while scanning small spaces. These are the experts that are needed to review the fine details of wetlands restoration projects

16. Satellite view of wetlands
I would like to try to make this point again. Here we see a distant view of wetlands in the Bay Area. This is the chosen perspective of experts in the earth sciences, including the study of landscape evolution.

17. Aerial photo of wetlands showing 100-acre patch
Now we have zoomed in to see about 100 acres of wetlands. I am told by waterfowl managers that this is a reasonable size patch of waterfowl habitat. Or it might be subdivide into 4 or 5 management units.

18. Aerial photo of wetlands showing 10-acre patch
Now we have zoomed in closer. Here we see about 10 acres of wetlands. This is perhaps too close to see the landscape as waterfowl habitat, but close enough to see a reasonable size patch of habitat for small mammals and resident birds, and perhaps some plant communities.

19. Photo of wetlands showing a 10-square meter patch.
Now we have zoomed in too close to see a complete patch of small mammal habitat, and barely close enough to see the habitats of mosquitoes. My point is that together the perspectives of avian ecologists, small mammal ecologists, and mosquito control experts comprise an ecological zoom lens that allows wetlands to be viewed at a variety of scales. This is essential to design successful wetlands. The mosquito control experts provide the close-up view of the finest ecological grain. This view of local detail is not only important for mosquito control, but it can help explain the form and function of habitats at larger scales

20. Focus on Edges (understanding ecotones)
There is a growing interest among the natural resource agencies in this region to focus wetlands restoration on transition zones or ecotones.

17. Coyote Hills close up
There are plans to restore the local mosaics of tidal flat, marsh, willows, riparian forests, and seasonal wetlands on moist grasslands, in part because of the unique ecology of each of these

landscape elements, but also because of the ecological richness of their boundaries. Of particular interest is the broad ecotone between wetlands and uplands ....

18. Aerial photo of uplands transition
.... as shown here in this infra-red photo of diked lands along the Petaluma River.

There is a need to restore these broad ecotones as buffers around the wetlands, and to recover a number of rare, threatened, or endangered species of plants and animals that depend upon the ecotone for their survival.

But such ecotones are also the focus of mosquito control efforts. Surface drainage tends to be altered or interrupted at the habitat boundaries, due to changes in soil type, elevation, evapotranspiration, and the activities of people or cattle or wildlife, such that the boundary areas are poorly drained and support mosquitoes. Mosquito control experts need to work closely with other experts to assure that the mosquito production potential of these ecotones is adequately addressed. This will require rather careful design and construction of gradients to affect adequate drainage, or it might be the regular application of more invasive control methods.

19. Part 3: Looking Ahead
This new era of large-scale wetlands restoration calls for more collaboration among scientists, among the land management agencies, and between the scientists and managers.

In the Bay Area, one successful model for collaboration has been the Seasonal Wetlands Enhancement Committee, which originated within a MAD, involved a broad base of scientific and management interests, and produced the Ora Loma Wetlands, which one of the larger restoration projects to be completed in the region.

20. Photo of meeting
The model has since been applied by state and federal agencies at the regional scale, through the creation of the multi-agency Bay Area Wetlands Planning Group, its Resource Managers Group, and the supporting technical Focus Teams of the Regional Wetlands Monitoring Program. These are components of the emerging Regional Wetlands Organization. They can provide a new venue for the collaborative contributions of the mosquito abatement interests.

Perhaps the only guaranteed outcome of this emerging wetlands organization is more meetings. But I expect the meetings will produce better designs for more wetlands projects of large scale than has been previously possible.

I hope that the mosquito control districts and their superlative regional and state associations and research programs will contribute to the emerging large opportunities for wetlands restoration in the Bay Area. These may be challenging opportunities for mosquito control. But without your technical input, the restoration projects will not only produce more mosquitoes,

they may also fail to meet other ecological objectives, because their designs will not reflect your detailed empirical understanding of wetlands form and function.

Let me leave you with these ideas: that the mosquito control districts should regard themselves as centers of wetlands science, and that they should build their expertise in support of wetlands design, because it will be the primary means of mosquito source reduction for wetlands in the future.

Thank You.