

Dirk Van Vuren: My background is in mammalian ecology, but it's also in wildlife damage management. And the issue of the kinds of impacts that mammals might have on levees is really one of wildlife damage management, in addition to being an ecological issues.

Now, there are several species of mammals around Sacramento that live on or near levees, and some of these have the potential to displace levee soil through their burrowing or digging activities. Mammals often have, or sometimes have, specific habitat requirements; consequently, the manipulation of levee vegetation may affect their distribution and abundance. What I'd like to do today is to briefly summarize or review the species of mammals that live on levees around Sacramento, on or near levees, to assess their habitat relations, to also assess their potential for soil disturbance on levees, and to try to forecast the consequences of wholesale removal of woody vegetation from levees in Sacramento.

Okay. Habitat basically provides the necessary resources for a species. Because resource requirements vary from species to species, habitat requirements may vary as well. Habitat, for mammals, provides three basic resources: cover, food, and water. Now, cover is defined as the physical structure of the habitat that provides protection from predators and from environmental extremes such as cold or heat. There's a popular misconception that cover means, says, shrubs or trees. Actually, it doesn't. Cover is the physical structure that provides that protection, and for some species, cover is an absence of features such as shrubs and trees.

Now, cover requirements vary from mammal to mammal; some are very generalized, some are relatively specialized, and it's those relatively specialized species that are especially vulnerable to habitat change. Like cover, food requirements vary from species to species from relatively generalized to more specialized. And again, the more specialized species are more vulnerable to habitat change.

The final component is water. All mammals require water, but not all mammals require free water for drinking. I basically won't be dealing with water at all in this talk for the simple reason that in our arid Mediterranean climate, the mammals that live here are pretty well adapted to dealing without free water for part or all of the summer; also, levees tend to be built near sources of permanent water, so animals that live at long levees oftentimes have water available nearby, so it's not really an issue.

Let's take a look at some of the mammals that live along California levees. First of all, a very common species, the black-tailed jackrabbit; cover requirements for jackrabbits are open habitats. Basically, the lack of a structured habitat; they require openness, and there's two reasons. One is their primary food is grasses and fords, which occur in grasslands, open habitats; but also, their main protection from predators is early detection and speed. They achieve early detection by visual detection at a distance, so jackrabbits almost never occur in shrubby habitats where that visual detection is impaired. And then, of course, their escape - as I'm sure you've all seen - is speed and agility. They basically outrun their predators. Their burrowing potential really is minimal; when they nest, the female will scrape a very shallow scrape in the soil, and that's about it. Obviously, black-tailed jackrabbits will probably benefit from removal of trees and shrubs and conversion to grassland, but impact on levees I would say would be minimal.

Their cousin, the cottontail rabbit - and we actually have two species here, I'll just call them both cottontails - they have a very different cover requirement. They do require dense shrubs, and that's in part because they have a much higher shrub component in their diet than do black-tailed jackrabbits, but also because dead shrubs are their cover, their protection from predators. That's where they run when they're threatened. Now, also unlike black-tailed jackrabbits, cottontail rabbits do use underground burrows. However, they don't dig them; what they use is an existing

burrow dug by another species. So, their burrowing potential is minimal to non-existent because they use existing burrows and don't create their own. They would probably be greatly reduced in abundance by elimination of trees and shrubs, but not much impact on levees because they have very little burrowing potential.

Now, California voles do have some burrowing potential; it's not much, but some. Their favorite habitat is grasslands, and there's two reasons they're found in greatest density -- they occur in a variety of habitats, but at very low densities; it's really grasslands that they prefer. The reason is their cover is the dense grass. They build runways through the dense grass, they're very much a surface animal and they can achieve relatively high densities. They don't do much burrowing, but they do do some. They're not great diggers and they'll dig relatively short burrows for nest chambers, but at high densities that could amount to a minor impact in displacing levee soil. So, I would consider their burrowing potential minor. Obviously they will greatly benefit by removal of trees and shrubs from levees.

Now, carnivores. We have several carnivores, and I'll just go through them quickly. As a group, most carnivores are very generalized in their habitat requirements - the ones we have here - and they're also very generalized in their food requirements. So, for most of them, I wouldn't expect overall much of an impact of conversion of levee vegetation from woody vegetation to more grassy communities. But let's just quickly run through them

The coyote is the ultimate generalist, it will live anywhere and eat anything. Even though the canids - it's the largest member here of the canid family - as a group are pretty good diggers, you've all seen your dog in the backyard going after a bone or whatever, they actually don't dig very much. In fact, most of their excavation consists of using a nest burrow, a den, once a year. So, they may excavate that, but they usually

use an abandoned burrow or the burrow that they dug last year. So, considering the rather large home ranges and relatively low densities of coyotes around here, if you figure in one burrow maybe six feet deep once every two or three years, the overall impact on a levee, I would say, would be very minimal.

Same with the red fox, the smaller cousin. For a long time it was believed the red foxes here in the Sacramento Valley were exotic; there's some recent information in the case that they may be native. Variable habitat requirements; can occur in a variety of locations. Do like some shrub cover but are also seen in grasslands, so I wouldn't expect much of an impact on abundance. Again, they are pretty good diggers, but they usually don't dig their own burrow; for a nest chamber they capitalize on an existing structure so the net impact on displacing levee soil I would think would be very, very minimal.

And then finally, the grey fox, a little more oriented toward shrubby tree vegetation than the two larger canids, but again, highly variable in its habitat requirements. Like the other two canids, very variable in dietary requirements, so I wouldn't expect much of an affect in removing trees and shrubs from levees. And again, they usually use an existing burrow and only occasionally dig their own. So, minimal impact in terms of burrowing potential.

Now, raccoons are a little different from the canids in that they do make regular use of a burrow; they'll den once a day. But interestingly enough, they rarely dig their own. They almost always use an existing structure like an abandoned burrow dug by something else, a cavity in a tree, or that space under that shed in your backyard. And they are a little more oriented toward aquatic systems; their densities are often a little higher in riparian zones, but they're still very generalized in their habitat requirements, and eat a variety of things as well. So, no major impact on removing levee vegetation, and only a minimum burrowing potential.

Now, the skunk actually are excellent diggers, and they do have some burrowing potential. Again, very highly varied in their habitat requirements, both cover and food, so I wouldn't expect much of an impact on skunks. A little bit, maybe; probably a little more common in riparian systems than elsewhere with a shrubby vegetation. They are good diggers and they are more likely to dig their own dens than some other species, but again, they usually don't. They usually use an existing structure. So, the overall impact in terms of soil displacement is really pretty small.

Now, the final carnivore we're talking is rather different than the rest of them. This is the badger. This is the famous digger; it can excavate large amounts of soil very quickly. However, even though badgers occur in this area, they are very uncommon and their presence is really sporadic, hit or miss. Now, if you do get a badger in your area, it's probably going to be most abundant in grassland communities because badgers especially like to dig out gophers and ground squirrels, which, as we'll find out in a minute, are most abundant in grassland communities. So, they may benefit from conversion of tree and shrub communities to grassland communities, especially if that leads to an increase in gophers and ground squirrels. Their burrowing potential is substantial if you have one, but their occurrence is very localized and very sporadic.

A more aquatic animal that we have here in Sacramento, an exotic species, the muskrat. For a muskrat, cover is water. That's escape from predation and escape from environmental extremes. Their food is primarily aquatic plants, consequently they are closely associated with water. Their burrowing potential is substantial; they do dig burrows into the bank, some can be fairly long. And oftentimes the entrances are underwater. Impacts of conversion of levee vegetation would probably be pretty minor for muskrats, simply because they rarely leave water and they rely almost entirely upon aquatic vegetation.

In some measure is a similar species, the beaver, is also highly aquatic; cover is water. But food is very different than muskrats, a much higher woody component, and also beavers will range much farther from water than muskrats will. Substantial burrowing potential; beavers can excavate large diameter burrows some distance into a bank, and they'll either build a stick house or they'll burrow into the bank -- either one, same species of beaver. And by the way, beavers are native in this area, sometimes I get asked that. Their food is primarily shrubs and trees. They do some grazing of grasses and forbs on the bank, but it's primarily shrubs and trees. And again, their burrowing potential is substantial.

The pocket gopher, major burrowing potential; that's how they live. They're a subterranean species, they build underground tunnels and those tunnels are their cover; their protection from predation and environmental extremes. They feed mostly, in this area, this particular species, largely on forbs and somewhat on grasses; a little bit on shrubs. Consequently, they are most abundant in grasslands. And again, their burrowing potential is substantial; they maintain extensive systems of underground tunnels.

And then finally, the California ground squirrel lives basically in open habitats. You can see them in a variety habitats; they'll live in oak savannah, grassland with scattered oak, a little bit in shrubland, but not much; really it's grasslands where they reach high densities. There are two reasons; one is their food is primarily grasses and forbs, green when it's wet, seeds of these species when it's dry. But also, they rely almost entirely on visual detection of predators and then escape into a burrow; consequently, they rely on open habitats. Their burrowing potential is substantial; they live in burrows, they're good diggers, they excavate burrows and maintain these tunnel systems.

Let's take a look, then, at those species with some burrowing potential and some potential for displacing levee soil. To get an idea of which ones may increase or decrease, voles with some burrowing potential will probably increase because they are most abundant in grasslands. Muskrats, probably no effect because they rarely go very far from aquatic habitats and they're almost entirely aquatic. Beaver, it depends on how the trees and shrubs are removed. If the trees and shrubs are completely removed and replaced entirely with grassland vegetation, if you don't have some sort of a tree or a shrub food source, you usually don't have very many beavers, so that will probably have a negative impact on beaver numbers. However, if the trees and shrubs are simply cut down and sprouts allowed to regrow, that actually is an excellent food source for beavers; they especially like those new sprouts from, say, willows and cottonwoods. So, that could actually increase the food source for beavers depending upon how the vegetation change occurs.

Gophers, there will probably be an increase in the conversion from tree and shrub vegetation to grassland vegetation. Ground squirrels, almost certainly an increase. And badgers, it's hard to tell. They are so uncommon and so localized and unpredictable, maybe there would be an increase. Again, they are so sporadic in their activity, it's hard to say.

I'd like to conclude by saying that tree and shrub removal from levees will almost certainly have a substantial impact on at least some of the resident mammals. This will be a really drastic change in habitat structure, and for some species, in terms of food supply. And this will affect many of the resident mammals and some of these have substantial burrowing potential. But what I'd like to emphasize is that to say an animal has substantial burrowing potential is not the same thing as saying that it will have a negative impact on levees, at least to an extent that we might care about. We have to be very careful, as mentioned earlier today, about making the mistake of guilt by association. I think it would be safe to say that every levee that has ever failed in this country had at least one

mammal burrow in it. That doesn't mean that that burrow caused that failure, because you could also say that every levee that has not failed had a mammal burrow in it.

In the field of wildlife damage management, this guilt by association has been commonly used for a long time. I run into it mostly in agricultural situations; you'll see a flock of birds or a herd of deer in a field and, geez, there's deer in my field, they must be doing damage, something needs to be done. This was a common perspective for a long time. In wildlife damage management, that perspective has changed dramatically in the last several decades, and the reason primarily is scientific research showing that there is not necessarily a link between the presence of an animal in a commodity and the actual damage being done.

And so let's not make the same mistake here; just because there is a burrowing mammal on a levee does not necessarily mean that that animal is doing damage. What we really need is science-based research on the magnitude of the damage in order to conduct basically a risk analysis in order to guide management efforts. Thank you very much.