Given the important effects that drought can have on forest health and wildfire, we include a brief example of how a disturbance other than fire can be assessed. Here we present current condition using spatially explicit datasets of tree mortality (primarily because of drought and bark beetles) in the North Fork Tuolumne River watershed. Forest management questions associated with drought-induced beetle mortality have some similarities with questions associated with fire mortality.

Current key questions that managers are asking include (1) how do we prioritize areas for restoration that have experienced low tree mortality to increase resilience to future disturbance events, and (2) where would we prioritize restoration of high-tree-mortality areas in order to reduce potential for severe effects of future disturbance events (e.g., fire on top of insect-driven mortality)?

We characterized current condition based on disturbance size and magnitude, using the Ecosystem Disturbance and Recovery Tracker (eDaRT) change detection data. The USDA Forest Service-University of California-Davis eDaRT system (see app. 2) is now routinely used to rapidly map mortality events at the 30-m scale by the U.S. Forest Service in California (Koltunov et al. 2019). This system provides sub-annual updates using all available Landsat imagery. The core version of eDaRT provides a proxy for disturbance magnitude, which was calibrated to match actual canopy cover loss. The eDART system has been applied in multiple vegetation types, including stands of low-moderate elevation ponderosa pine and mixed-conifer forests; higher elevation red fir, lodgepole pine, and subalpine forests; as well as areas including hardwoods, riparian species, and montane chaparral. Errors of commission (false positives) averaged 12 percent across vegetation types; those errors were lower in coniferous areas (10 percent), but they were higher in areas dominated by hardwoods (up to 34 percent), which were represented by a small number of reference events (Koltunov et al. 2019).

Our demonstration analysis involved first compiling 2015 and 2016 disturbance data to represent the time period when the greatest mortality occurred.
high resolution imagery, we translated the disturbance magnitude proxy to actual classes of disturbance type and intensity (higher magnitude events are most reliably detected by eDaRT, and can be verified most accurately with high-resolution imagery.) In addition, we used the Forest Service Activity Tracking System database to identify where forest treatments occurred in 2015 and 2016. The classes we present included the following:

1. No disturbance detected
2. Low magnitude event (<10 percent canopy cover loss)
3. Moderate magnitude event (10 to 50 percent canopy cover loss)
4. High magnitude (severe) event (>50 percent canopy cover loss)
5. Areas that were treated in 2015 or 2016 were classified as their own category because we could not separate drought/insect mortality and treatment.

The disturbance data were then segmented with vegetation and topography data to evaluate current condition. This analysis indicated that 10 percent of conifer-dominated forests in the assessment area experienced some mortality event in 2015 and 2016 (fig. A6.1). The highest mortality was associated with ponderosa pine (*Pinus ponderosa* Lawson & C. Lawson) forest on mid-slopes less than 30 percent.

The current condition data could be combined with future condition and targeted local data to prioritize and evaluate landscape restoration strategies. Restoration opportunities on a landscape affected by drought-induced mortality may be similar to opportunities in a postfire landscape. Some potential opportunities for this landscape might include (1) focused thinning treatments in ponderosa pine stands on mid-slopes <30 percent to reduce competition and increase future resilience to drought and insects, and (2) removal of hazard trees in high mortality areas to evaluate natural regeneration in high mortality areas.

Reference

Figure A6.1—Magnitude of mortality events in the North Fork Tuolumne River watershed overlaid with *Pinus ponderosa* on midslopes <30 percent.