Context Document: USFS Short-Term Post-Wildfire Emergency Response ESCM

http://bit.ly/NI-ESCM

Ecosystem Service Conceptual Models (ESCMs) summarize the effects of an intervention on ecological and social systems. Each model links changes in biophysical systems caused by an intervention to measurable socioeconomic, human well-being, and ecological outcomes. This is a general ESCM that assumes the intervention is successful and includes all potentially significant outcomes for the intervention. For individual forests not all outcomes will be relevant and will depend on location and environmental conditions.

The direction of an outcome (whether the intervention will have a positive or negative influence) often depends on the specific situation. There may be multiple links (arrows) leading into an outcome that have opposite effects. Thus, language like "increased" or "decreased" is not included in this model. These models are often used to consider management with or without an intervention or to compare different interventions.

This document provides information about the intervention—**Short-Term Post-Wildfire Emergency Response on U.S. Forest Service (USFS) Land**—and details about some of the relationships in the ESCM. It also includes a list of the references used to develop the ESCM and names of experts with whom we spoke to refine the model.

USFS Fire and Timber Management Interventions

Seven interventions are included in the ESCM; all are frequently implemented in response to a wildfire within a year of fire occurrence. In many cases, multiple interventions are used together.

- **Emergency hydrology measures** including installing or improving ditches and dams to prevent excess runoff, debris flows, and further damage to infrastructure
- **Mulching and biochar** to reduce runoff and erosion. Mulching can be done with straw, wood-shred, hydromulch, or other materials; vegetative mulch is screened to prevent introducing invasive species. Biochar is less frequently used by the USFS than other types of mulch.
- **Salvage logging** is commercial harvest of burned areas to recover some economic value before the wood starts to degrade, and in some cases to reduce hazardous conditions.
- **Seeding** of plants to provide vegetative ground cover and reduce runoff and erosion. Use of native species is preferred by USFS, but nonnative species can be used if needed.
- **Repairing safety-related facilities** including fences and signs
- **Administrative closure** to limit public access to areas with dangerous post-fire conditions (e.g., potential for fallen trees or mudslides) or to avoid disturbing sensitive areas during post-fire recovery
- **Invasive species control** includes the use of chemical, biological, mechanical, and physical treatments to prevent or minimize the establishment of non-native invasive species following the fire

External Factors

Many external environmental and social factors influence the type of intervention that can be done in a certain location and how successful the intervention is. Because USFS Burned Area Emergency Response (BAER) is the primary source for post-wildfire emergency action within USFS, the BAER mission and regulations often determine what interventions, if any, are implemented after a fire (see more below). Certain treatments are not possible on steep slopes due to limited access, and co-management of land with other entities (e.g., Native American tribes) can also influence management options. Burn extent and severity affect the success of interventions at mitigating certain adverse outcomes, like debris flows, and the speed at which the landscape recovers post-fire.

Model Notes and Clarifications

Burned Area Emergency Response program: The USFS Burned Area Emergency Response (BAER) program is the primary source for wildfire response actions within three years of a fire. BAER identifies and manages potential risks to human life and safety, property, and critical natural and cultural resources following a fire. Due to this tightly defined mission, not all fires receive BAER-funded management. Specific interventions funded by BAER depend on the context and resources at risk but can include all of the interventions included in this ESCM except for salvage logging. Salvage logging generally occurs before BAER activities at the decision of forest management but is often subject to legal challenges which can delay its implementation (Chen et al. 2013; Russell 2016). For more information on BAER interventions, see USFS BAER Information Briefs (2019).

Effects of seeding and mulching on runoff: Seeding and mulching are frequently used to provide ground cover in order to reduce runoff and erosion, however, there is some evidence that these interventions may not effectively meet those goals and can have unintended consequences like invasive species introduction. A 2011 review of studies assessing the effects of post-fire seeding found that seeded sites did not have sufficiently higher vegetative cover than nonseeded sites to prevent erosion, and that seeding often promoted nonnative plants at the expense of native plants (Peppin et al. 2011). Mulch can more effectively cover the ground and reduce erosion post-fire, but it does not remain indefinitely; wood-strand mulch was found to be longer-lasting and more effective than wheat straw or hydromulch at hillslope plots established after four wildfires in the western U.S. (Robichaud et al. 2013).

Salvage logging and fuel loads: Salvage logging has complex effects on fuel loading that change over time; logging creates slash that contributes to fine fuel but limits fallen trees that create larger fuel (McIver and Ottmar 2002). An empirical model of fuel loads following fires in Oregon forests found that salvage logging immediately reduces coarse woody fuels but increases fine woody fuels (Dunn and Bailey 2015). A field study in South Dakota found that salvage logging limited the accumulation of both fine and coarse woody debris compared to unsalvaged sites five years after a fire (Keyser et al. 2009).

Salvage logging, forest recovery, and species effects: Salvage logging can also impact forest recovery and habitat for wildlife species. The South Dakota field study mentioned above saw

75% lower regeneration in moderate-severity burn sites that had been salvaged compared to unsalvaged sites due to a lack of seed sources (Keyser et al. 2009). A meta-analysis of salvage logging's impact on species found that certain species groups, such as saproxylic organisms that are dependent on dead wood, decreased in response to salvage logging, while species groups that need open habitats increased (Thorn et al. 2017). Cavity-nesting birds are also negatively affected by salvage logging, since it removes snags, but salvage logging can limit opportunities for insect pests to spread from fire-damaged trees to intact forest (McIver and Ottmar 2002).

Carbon flux: The carbon flux node represents changes in carbon emissions or sequestration. This can occur through short-term events, such as carbon emissions from wildfires, or over a longer time period, like changes in carbon sequestration rates after a management action reduces the total number of trees in the forest or shifts tree species composition. Both types of changes are included in the ESCM, represented by the links leading to the carbon flux node.

Experts Consulted

Cara Farr, National Burned Area Emergency Response and Watershed Improvement Program Leader, USFS

Nicole Balloffet, National Reforestation, Stand Improvement, and Nursery System Program Manager, USFS

Tania Ellersick, Senior Policy Analyst, USFS

Sarah Anderson, Ecologist, USFS

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