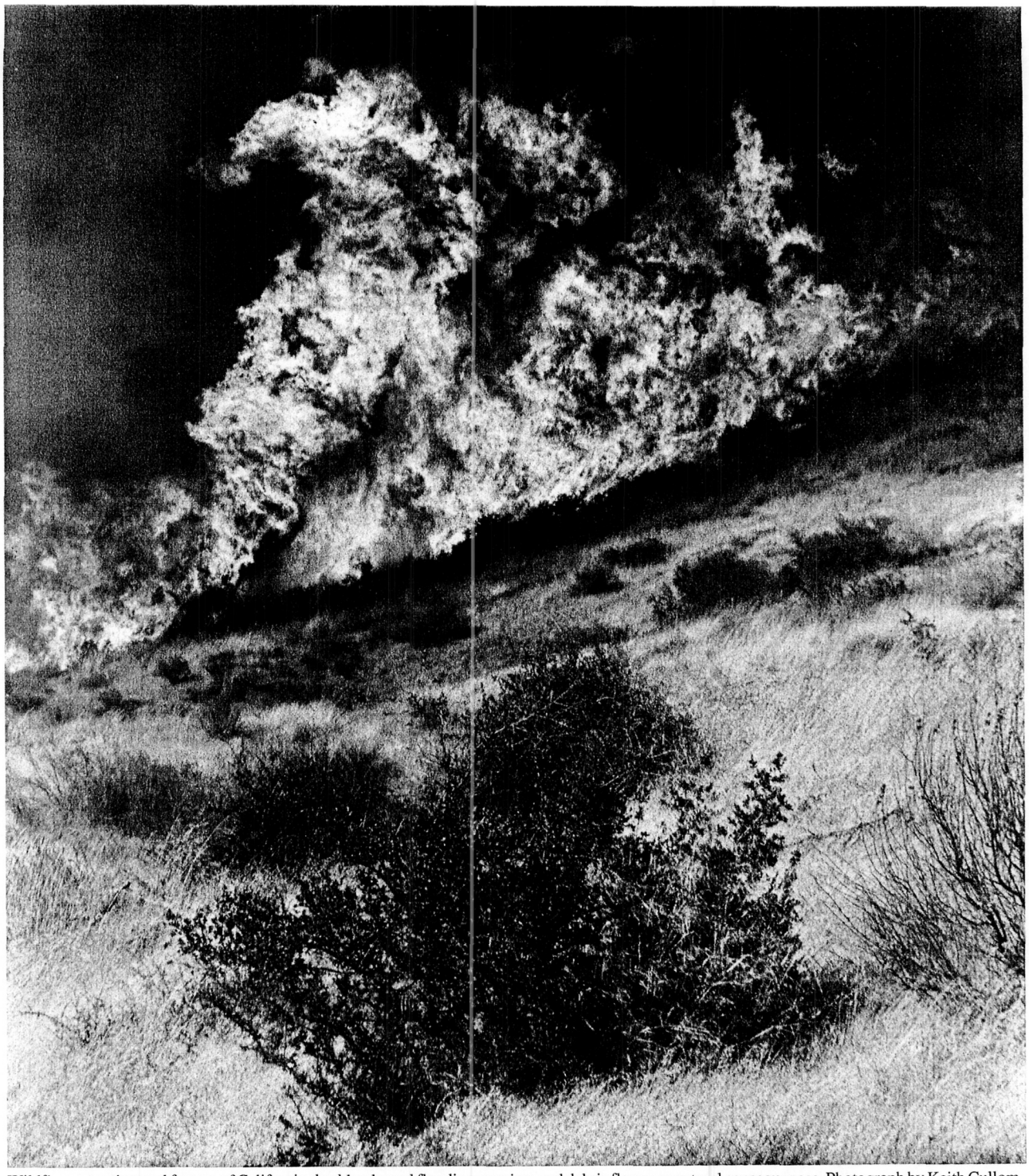

Wildfires are an integral feature of California shrublands, and flooding, erosion, and debris flows are natural consequences. Photograph by Keith Cullom.

POSTFIRE MANAGEMENT: WORKSHOP SUMMARY

by Jon E. Keeley

POSTFIRE MANAGEMENT OF CALIFORNIA BRUSHlands is of great concern to many people. One of the primary values of these ecosystems is as watershed that protects water resources and reduces the threat of winter floods. Wildfire, which eliminates above-ground vegetation, increases sedimentation and hillside erosion, increasing the threat of downstream floods and debris flows. There is widespread agreement among experts that, while further research is needed to clarify certain postfire management issues, we have sufficient information to make recommen-

dations regarding the ecological and economic effects of postfire rehabilitation procedures such as aerial seeding.

Wildfires are a natural feature of California shrublands. Plants in these ecosystems exhibit the capacity, under most conditions, to rapidly reestablish. This built-in restoration program of plants, however, does not eliminate the threat to downstream resources by flooding and the debris flows that can result following a fire. It is important that people living in the wildland/urban interface recognize that postfire sediment movement is a natural feature of these ecosystems.

It is increasingly evident that seeding of ryegrass or other species does not reliably reduce erosion from burned hillsides and cannot be relied upon to reduce significantly the threat of downstream loss of resources. The primary reason is that in order for seeding to be effective, seeds must germinate early and plants develop rapidly, prior to major winter storms. Numerous studies have shown that in most years, particularly in Southern California and the Sierra Nevada foothills, autumn rains are insufficient to generate significant plant cover prior to winter storms. In some years favorable weather conditions may result in successful establishment with some potential for slowing erosion. However, since seeding must be done prior to the rainy season, it is never possible to anticipate which years will provide conditions suitable for effective establishment.

Under some circumstances seeding is not a viable option, regardless of rainfall patterns. In particular, watersheds with steep slopes (over thirty-five degrees) generally do not provide stable substrate suitable for grass establishment. These are also the watersheds most susceptible to sediment losses and known to produce flooding with rainfall intensities as low as a quarter of an inch in fifteen minutes. If sufficient overland flow exists to initiate flooding or debris flows, then there is increased likelihood that seeds will be washed downslope even in the smallest storms.

On shallower slopes, under ideal conditions, seeding may reduce sedimentation resulting from sheeting erosion and rilling. However, no studies have demonstrated that seeding results in any measurable increase in protection from flooding and debris flows. This is because the principal forms of soil loss are dry ravel and the concomitant build-up of colluvium and streambed sediment loading, and this occasionally leads to disastrous outwash mudflows. These sources of soil loss occur immediately following a fire and thus are not affected by seeding.

Any significant increase in slope stability, over that provided by natural regeneration, is likely to occur only under conditions where natural regeneration is impaired. This could come about following fires of particularly high intensity, which may reduce the natural soil seed bank and affect other soil properties. Further research is needed to determine the conditions of fire severity that result in diminished natural recovery.

Under conditions where establishment of seeded species is good, threats to natural recovery need to be considered. Available scientific evidence indicates that ryegrass may competitively displace the natural regeneration. As seeding success increases, natural recovery and diversity are threatened, both through direct competition and indirectly by increasing the potential for reburns in subsequent years. A reduction in shrub seedling establishment could have long-term impacts on dry ravel production and increased potential for future debris flows. Further research is needed to fully ascertain the extent of this threat.

In response to these environmental concerns about seeding with non-native ryegrass, some resource managers have used seed mixtures with native species. Before seeding of native species can be generally recommended, however, several problems should be addressed. First, the native status of recommended species needs to be confirmed. For example, there is a mistaken belief that zorro fescue is native. Attention also needs to be given to determining whether species are native to the site. It would be inadvisable to use native species if they do not normally establish in burned habitats. For example, recruitment of native grasses is rare on recently burned sites.

The ecological consequences of broadcasting natives into situations where their natural occurrence may be low or zero also needs to be determined. For example, some species are found almost exclusively on south-facing slopes. Their introduction onto north-facing slopes by seeding may either result in low establishment or in undesirable competitive interactions with north-slope plant species.

The genetic effects of seeding also must be considered, as introduction of non-local seeds may swamp local genotypes, or "outbreeding depression" may reduce seed set or the vigor of subsequent generations. And finally, the feasibility and costs of maintaining proper seed stocks for native species are potential obstacles that may be difficult to overcome.

In conclusion, it is important to recognize that seeding with native or non-native species is likely to provide an unreliable and often unmeasurable reduction in sediment yields. Where significant downstream resources are at risk, seeding under most conditions cannot be counted on to significantly reduce hillside erosion after wildfires. Further research is needed to determine when this technique is appropriate as well as cost-effective, and to determine its potential for long-term ecological impacts on chaparral and coastal sage ecosystems. Mechanical solutions to postfire flooding and mudflows, such as straw bale check dams, k-bars to channelize mudflows, debris basin construction, or hydromulching without seed, ultimately may prove more reliable than aerial seeding. Such techniques also may be far less disruptive to natural ecosystem processes. Their cost-effectiveness needs to be evaluated.

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