Description of Fuel Models

The following Fuel Model Classifications are based on the National Fire Danger Rating System, USDA Forest Service General Technical Report INT-39:

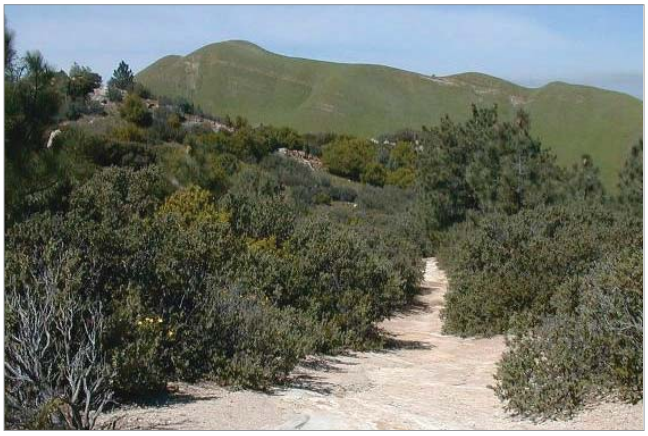
Fuel Model A (#1) .....
This fuel model represents western grasslands populated by annual grasses and forbs. Brush or trees may be present but are very sparse, occupying less than one-third of the area. Examples of types where Fuel Model A should be used are cheatgrass and medusahead. Open pinyon-juniper, sagebrush-grass, and desert shrub associations may appropriately be assigned this fuel model if the woody plants meet the density criteria. The quantity and continuity of the ground fuels vary greatly with rainfall from year to year.

Western annual grasses such as cheatgrass, medusahead, ryegrass, and fescues

Eastern annual grasses such as fescue and broom sedge

Fuel Model B (#4) .....

Mature, dense fields of brush 6 feet or more in height are represented by this fuel model. One-fourth or more of the aerial fuel in such stands is dead. Foliage burns readily. Model B fuels are potentially very dangerous, fostering intense, fast-spreading fires. This model is for California mixed chaparral, generally 30 years or older. The F model is more appropriate for pure chamise stands. The B model may also be used for the New Jersey Pine Barrens.



California mixed chaparral

Fuel Model C (#2) .....

Open pine stands typify Model C fuels. Perennial grasses and forbs are the primary ground fuel but there is enough needle litter and branch wood present to contribute significantly to the fuel loading. Some brush and shrubs may be present but they are of little consequence. Types covered by Fuel Model C are open, long-leaf, slash, ponderosa, Jeffery, and sugar pine stands. Some pinyon-juniper stands may qualify.

Open ponderosa pine stand

Pinyon - juniper stand

Fuel Model D (#7) .....

This fuel model is specifically for the palmetto-gallberry, understory-pine association of the southeast coastal plains. It can also be used for the so-called "low pocosins" where Fuel Model O might be too severe. This model should only be used in the Southeast because of the high moisture of extinction associated with it.

Palmetto-gallberry in southern coastal plains

Fuel Model E (#9) .....

Use this model after fall leaf fall for hardwood and mixed hardwood conifer types where the hardwoods dominate. The fuel is primarily hardwood leaf litter. The oak-hickory types are best represented by Fuel Model E, but E is an acceptable choice for northern hardwoods and mixed forests of the Southeast. In high winds, the fire danger may be underrated because rolling and blowing leaves are not accounted for. In the summer after the trees have leafed out, Fuel Model E should be replaced by Fuel Model R.

Appalachian Oak-hickory forest

Fuel Model F (#6) .....

Fuel Model F represents mature closed chamise stands and oak brush fields of Arizona, Utah, and Colorado. It also applies to young, closed stands and mature, open stands of California mixed chaparral. Open stands of pinyon-juniper are represented; however, fire activity will be overrated at low wind speeds and where there are sparse ground fuels.

Pinyon Pine – Gambel Oak in the Southwest

Fuel Model G (#10) .....

Fuel Model G is used for dense conifer stands where there is a heavy accumulation of litter and downed woody material. Such stands are typically over mature and may also be suffering insect, disease, wind or ice damage—natural events that create a very heavy buildup of dead material on the forest floor. The duff and litter are deep and much of the woody material is more than 3 inches in diameter. The undergrowth is variable, but shrubs are usually restricted to openings. Types meant to be represented by Fuel Model G are hemlock-Sitka spruce, coastal Douglas fir, and wind thrown or bug killed stands of lodgepole pine and spruce.

Southern pine beetle killed timber

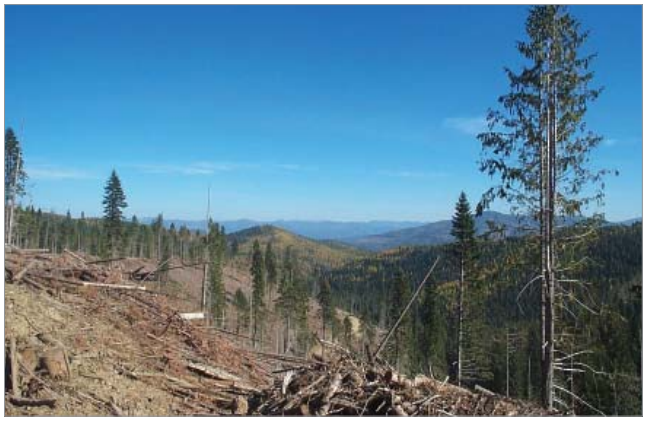
Fuel Model H (#8) .....

The short-needled conifers (white pines, spruces, larches, and firs) are represented by Fuel Model H. In contrast to Model G fuels, Fuel Model H describes a healthy stand with sparse undergrowth and a thin layer of ground fuels. Fires in the H fuels are typically slow spreading and are dangerous only in scattered areas where the downed woody material is concentrated.

Open Eastern White Pine stand

Fuel Model I (#13) .....

Fuel Model I was designed for clear-cut conifer slash where the total loading of materials less than 6 inches in diameter exceeds 25 tons/acre. After settling and the fines (needles and twigs) fall from the branches, Fuel Model I will overrate the fire potential. For lighter loadings of clear-cut conifer slash, use Fuel Model J and for light thinnings and partial cuts where the slash is scattered under a residual overstory, use Fuel Model K.



Clearcut in Pacific Northwest

Fuel Model J (#12) .....

This model complements Fuel Model I. It is for clear-cuts and heavily thinned conifer stands where the total loading of material less than 6 inches in diameter is less than 25 tons per acre. Again as the slash ages, the fire potential will be overrated.

Appalachian hardwood clearcut

Fuel Model K (#11) .....

Slash fuels from light thinnings and partial cuts in conifer stands are represented by Fuel Model K. Typically the slash is scattered about under an open overstory. This model applies to hardwood slash and to southern pine clearcuts where loading of all fuels is less than 15 tons/acres.

Thinned Eastern White pine stand

Fuel Model L (#1) .....

This fuel model is meant to represent western grasslands vegetated by perennial grasses. The principal species are coarser and the loadings heavier than those in Model A fuels. Otherwise the situations are very similar; shrubs and trees occupy less than one-third of the area. The quantity of fuels in these areas is more stable from year to year. In sagebrush areas Fuel Model T may be more appropriate.

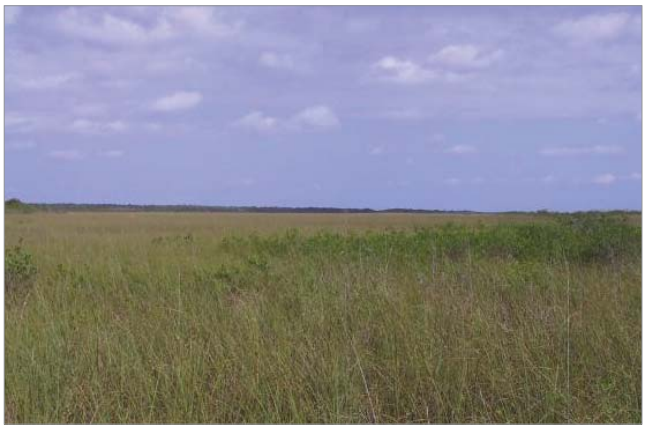
Rocky Mountain open lodgepole pine forest

Fuel Model M.....

There is no Fuel Model M.

Fuel Model N (#3) .....

This fuel model was constructed specifically for the sawgrass prairies of south Florida. It may be useful in other marsh situations where the fuel is coarse and reedlike. This model assumes that one-third of the aerial portion of the plants is dead. Fast-spreading, intense fires can occur over standing water.



Sawgrass prairie in south Florida

Fuel Model O (#4) .....

The O fuel model applies to dense, brush-like fuels of the Southeast. O fuels, except for a deep litter layer, are almost entirely living in contrast to B fuels. The foliage burns readily except during the active growing season. The plants are typically over 6 feet tall and are often found under open stands of pine. The high pocosins of the Virginia, North and South Carolina coasts are the ideal of Fuel Model O. If the plants do not meet the 6-foot criteria in those areas, Fuel Model D should be used.

Southern coastal plain pocosin forest

Fuel Model P (#9) .....

Closed, thrifty stands of long-needled southern pines are characteristic of P fuels. A 2-4 inch layer of lightly compacted needle litter is the primary fuel. Some small diameter branchwood is present but the density of the canopy precludes more than a scattering of shrubs and grass. Model P has the high moisture of extinction characteristic of the Southeast. The corresponding model for other long-needled pines is H.

Southern loblolly pine stand

Fuel Model Q (#6) .....

Upland Alaska black spruce is represented by Fuel Model Q. The stands are dense but have frequent openings filled with usually inflammable shrub species. The forest floor is a deep layer of moss and lichens, but there is some needle litter and small diameter branchwood. The branches are persistent on the trees, and ground fires easily reach into the crowns. This fuel model may be useful for jack pine stands in the Lake States. Ground fires are typically slow spreading, but a dangerous crowning potential exists. Users should be alert to such events and note those levels of SC and BI when crowning occurs.

Alaska black spruce stand

Fuel Model R (#8) .....

This fuel model represents the hardwood areas after the canopies leaf out in the spring. It is provided as the off-season substitute for Fuel Model E. It should be used during the summer in all hardwood and mixed conifer-hardwood stands where more than half of the overstory is deciduous.

Appalachian hardwood forest

Fuel Model S (#1) .....

Alaskan and alpine tundra on relatively well-drained sites fit this fuel model. Grass and low shrubs are often present, but the principal fuel is a deep layer of lichens and mosses. Fires in these fuels are not fast spreading or intense, but are difficult to extinguish.

Rocky Mountain Alpine Zone

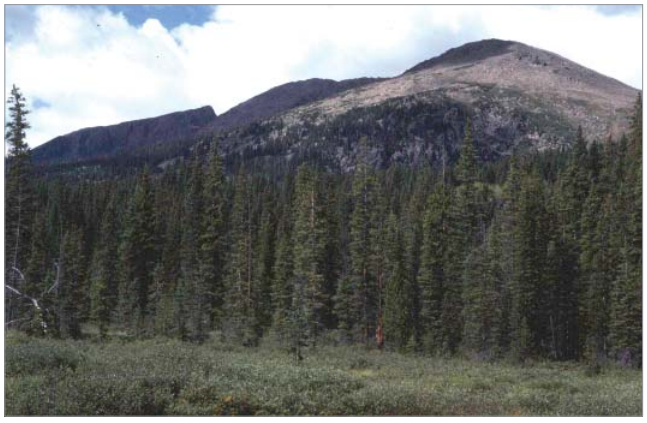
Fuel Model T (#2) .....

The bothersome sagebrush-grass types of the Great Basin and the Intermountain West are characteristic of T fuels. The shrubs burn easily and are not dense enough to shade out grass and other herbaceous plants. The shrubs must occupy at least one-third of the site or the A or L fuel models should be used. Fuel Model T might be used for immature scrub oak and desert shrub associations in the West and the scrub oak-wire grass type of the Southeast.

Sagebrush-grass types of the Great Basin

Fuel Model U (#9) .....

This fuel model represents the closed stands of western long-needled pines. The ground fuels are primarily litter and small branchwood. Grass and shrubs are precluded by the dense canopy but may occur in the occasional natural opening. Fuel Model U should be used for ponderosa, Jeffery, sugar pine stands of the West and red pine stands of the Lake States. Fuel Model P is the corresponding model for southern pine plantations.



Rocky Mountain lodgepine pine stand

Fuel Model Key

The fuel model keys that follow are only general descriptions since they represent all wildland fire fuels from Florida to Alaska and from the East Coast to California:

I. Mosses, lichens, and low shrubs predominate ground fuels.

- A. An overstory of conifers occupies more than one third of site: Model Q (#6).
- B. There is no overstory or it occupies less than one-third of the site: Model S (#1).

II. Marsh grasses and/ or reeds predominate: Model N (#3).

III. Grasses and/ or forbs predominate.

- A. There is an open overstory of conifer and/or hardwoods: Model C (#2).
- B. There is no overstory.
  1. Woody shrubs occupy more than one-third but less than two-thirds of the site: Model T (#2).
  2. Woody shrubs occupy less than two thirds of the site.
     a. The grasses and forbs are primarily annuals: Model A (#1).
     b. The grasses and forbs are primarily perennials: Model L (#1).

IV. Brush, shrubs, tree reproduction or dwarf tree species predominate.

- A. Average height of woody plants is 6 ft. or greater.
  1. Woody plants occupy two-thirds or more of the site.
     a. One-fourth or more of the woody foliage is dead.
        (1) Mixed California chaparral: Model B (#4).
        (2) Other types of brush: Model F (#6).
     b. Up to one-fourth of the woody foliage is dead: Model Q (#6).
     c. Little dead foliage: Model O (#4).
  2. Woody plants occupy less than two-thirds of the site: Model F (#6).
- B. Average height of woody plants is less than 6 ft.
  1. Woody plants occupy two-thirds or more of the site.
     a. Western United States: Model F (#6).
     b. Eastern United States: Model O (#4).
  2. Woody plants occupy less than two-thirds but greater than one-third of the site.
     a. Western United States: Model T (#2).
     b. Eastern United States: Model D (#7).
  3. Woody plants occupy less than one-third of the site.
     a. The grasses and forbs are primarily annuals: Model A (#1).
     b. The grasses and forbs are primarily perennials: Model L (#1).

V. Trees predominate.

A. Deciduous broadleaf species predominate.

1. The area has been thinned or partially cut leaving slash as the major fuel component: Model K (#11).
2. The area has not been thinned or partially cut.
    a. The overstory is dormant; leaves have fallen: Model E (#9).
    b. The overstory is in full leaf: Model R (#8).

B. Conifer species predominate.

1. Lichens, mosses, and low shrubs dominate understory fuels: Model Q (#6).
2. Grasses and forbs are the primary ground fuel: Model C (#2).
3. Woody shrubs and/or reproduction dominate understory fuels.
    a. The understory burns readily.
        (1) Western United States: Model T (#2).
        (2) Eastern United States.
            (a) The understory is more than 6 feet tall: Model O (#4).
            (b) The understory is less than 6 feet tall: Model D (#7).
    b. The understory seldom burns: Model H (#8).
4. Duff and litter, branch wood and tree boles are the primary ground fuel.
    a. The overstory is over mature and decadent; there is a heavy accumulation of dead debris: Model G (#10).
    b. The overstory is not decadent; there is only a nominal accumulation of debris.
        (1) Needles are 2 inches or more in length (most pines).
            (a) Eastern United States: Model P (#9).
            (b) Western United States: Model U (#9).
        (2) Needles are less than 2 inches long: Model H (#8).

VI. Slash is the predominate fuel type.

A. The foliage is still attached; there has been little settling.

1. The loading is 25 tons/acre (tpa) or greater: Model I (#13).
2. The loading is less than 25 tpa but greater than 15 tpa: Model J (#12).
3. The loading is less than 15 tpa: Model K (#11).

B. Settling is evident; the foliage is falling off; grasses, forbs and shrubs are invading.

1. The loading is 25 tpa or greater: Model J (#12).
2. The loading is less than 25 tpa: Model K (#11).

VI. Vegetation (Fuel Models)

A. Characteristics of predominate vegetation within 91.4 (300 ft)

1. Light (eg, grasses, forbs, sawgrasses and tundra)
2. Medium (eg, light brush and small trees)
3. Heavy (eg, dense brush, timber and hardwoods)
4. Slash (eg, timber harvesting residue)