

SECTION 7 - FUELS, FIRE BEHAVIOR, AND TACTICS BY GEOGRAPHIC AREAS OF THE UNITED STATES

The purpose of this section is to identify by geographic areas of the United States:

- important fuel, topographic, and fire weather conditions that produce critical fire behavior situations.
- appropriate safety, strategies, and tactics for fire suppression.

The following geographic areas are covered:

- Alaska, pages 205 - 218
- Northwest and Northern Rocky Mountains, pages 219 - 236
- Southern and Central California, pages 237 - 256
- Great Basin and Southern Rocky Mountains, pages 257 - 282
- Southwest, pages 283 - 296
- Northeast, pages 297 - 312
- Southeast, pages 313 - 332

SOUTHEAST

I. GENERAL

The southeastern section of the United States can be divided, for fire suppression purposes, into three geographical regions:

- Appalachian Mountains.
- Piedmont Plateau.
- Coastal Plains.

Note that there are other unique geographical regions in the southeastern United States, such as the Everglade Swamp in Florida and the Pocosins in North Carolina, that have unique problems.

There are two separate fire seasons in all the geographical regions, fall and spring. Fall fire season usually begins in October with leaf fall and ends when the winter rains and snow begin in December. The spring fire season usually begins around March 1 and extends into May when vegetation begins to grow. Spring fire season is characterized by warm, windy days and cool nights, and this is usually when the most severe fires occur.

Each geographical region has unique fire suppression problems. Four major factors that affect strategy and tactics in these regions are: topography, weather, fuels, and the degree of mechanization of fire suppression forces.

Topography is the most important factor affecting fire behavior in mountainous regions but is a minor concern in Piedmont and Coastal Plains, (where weather and fuels are the major elements affecting fire behavior).

In the flat woods of the coastal plains and rolling topography in the Piedmont the key word is mechanization. Dozers range in size from a Type III equipped with a fire plow to a Type I using a blade. They can construct more fireline in a given time than 25 to 100 line personnel. Crews to patrol burnout and backfire are needed. Some fires with a heavy tractor operation, will have more tractor personnel than firefighters.

II. WILDLAND FIRE SUPPRESSION

- A. Wildland fires in the southeast quite often involve both public and private land. Further, the public land may be under the jurisdiction of more than one federal agency as well as a state agency.

Generally, the agency that establishes the original incident command on fires involving more than one agency remains in control of that fire. Most states have cooperative agreements with federal agencies within their boundaries to this effect. There are provisions in these cooperative agreements allowing a different agency to assume command of a fire that is burning within their jurisdiction or, more often, to establish a joint command.

Incident management teams should be aware of any cooperative agreements in effect. The agreements spell out pay rates for personnel and equipment and areas of responsibility.

- B. Most of the land area in the southeast is owned by the small private landowner and forest industries. Generally speaking, state forestry organizations are responsible for all fires burning on private land. In situations involving industrial forest lands, state and industrial personnel cooperate closely, but state personnel still have ultimate responsibility. You will often see forest industry personnel and equipment working under state direction on fires not on industry land.
- C. You should be aware of a basic difference in philosophy between state fire organizations and most federal agencies. State organizations are generally more cost conscious; they just don't have the money!
- D. Most southeastern and south central compact states have adopted ICS, but their personnel are at different stages of acceptance and knowledge. When working with some state agencies they may not be aware of who a line officer is and you will probably not get an Escaped Fire Situation Analysis (ESFA). Incident management teams may have to write the delegations of authority for them. Help them out, they may not be up to standard in all areas, but work with them. They can be a valuable resource.
- E. Southeast firefighting personnel may be a mixed bag indeed. While few state organizations handle all fire responsibilities, most depend heavily on volunteer fire departments, a system of part-time forest wardens, and pick up firefighters to supplement their forces.

F. Federal Excess Property Program (FEPP) - southeast has more excess property than the rest of the United States put together.

- Aircraft.
- Large Engines.
- Small Engines.

Equipment rental agreements with volunteer fire departments using FEPP cannot charge the federal government for use of that property. They can charge for equipment they have placed on the property (i.e., tank, pump, etc.).

III. GEOGRAPHICAL REGIONS.

A. Appalachian Mountains

The Appalachian Mountains region comprises approximately 50 million acres of forest.

1. Fuels.

Fuel Model 9 - mixed upland hardwoods - pine; 10+ tons per acre; Fuel Model 7 - heavy laurel and rhododendron under upland hardwoods and pine; 15-20 tons per acre.

Fuels in the mountain region consist of upland hardwoods and hardwood litter interspersed with pine on the drier sites. Most of the upper slopes have mountain laurel in the hardwoods. Rhododendron grows in thickets in the more moist areas. Ozark and Ouachita mountains will not have laurel or rhododendron.

2. Topography.

The Appalachians vary in height up to 6,684 feet in elevation (Mt. Mitchell, North Carolina). Land is often steep and rocky with large outcroppings of granite, sandstone, limestone, or shale. Much of this area is inaccessible except by foot. You can be within a few miles of a fire and have to travel 15 or 20 miles to get to the base of the mountain on which the fire is burning.

3. Weather.

During winters of light snowfall the hardwood leaf litter and dead herbaceous material are more fluffy (not packed by heavy snowfall) and fire will spread at a rapid rate. Also, in high winds the fire danger may be underrated because rolling and blowing leaves are not considered. There may be a leaf fall after a bum and rebum will occur if you don't do a good job of mopup.

4. Tactics and Strategy.

Upslope runs and sustained rates of spread are more common in the mountains than the other geographical regions.

Fires may burn for several days but usually make their main run on the first or second day. Heavy ground fuels and cull trees make it difficult to mop up.

- a. Generally speaking, when fighting fires in the mountains in this region, try to get to the top for major suppression efforts.

Reasons:

- (1) When a fire makes a run you don't usually catch it until it reaches the top.
- (2) Due to accessibility, equipment is generally only useable on ridgetops.
- (3) Tactically, attack the fire indirectly and backfire the line to construct a sufficiently wide break to hold the fire.

- b. If a fire is making a fast run and is very hot you may have to make a flanking attack. If you must flank a fire remember:

Your major suppression effort, all other factors being equal, should be on the east flank first. Dry, cold weather fronts can cause a 90 degree wind direction change in a short time, creating a new front along the east flank.

5. Safety.

- a. Appalachian ridges and slopes often have shallow soil and loose rock. Tractor operation can be hazardous. Ledges and cliffs created naturally, or by strip mining, can be a problem to people at night, as well as to equipment.
- b. Backfires are often started by local people from streams, trails, etc. to protect their own property or, in some cases, by arsonists who use the confusion to start additional fires.
- c. Heavy vegetation can hamper fire suppression and movement of personnel.
- d. You may need law enforcement personnel to escort crews.

6. Resources Available.

States in the southeast have some type of aerial support in times of emergencies. Tactics used are usually concerned with helicopters with water buckets or fixed tanks making multiple drops in support of ground forces rather than attacking the fire in a direct suppression effort. Federal lands generally have both helicopters and aerial tankers available. Due to cost of large airtankers, states may not opt to use this resource. A new tool recently introduced is a "scoop" tanker used where large bodies of water are available. It is not widely available, but is very effective.

The helicopter with bucket or fixed tank is a very effective tool in the southeast due to the proximity of water sources. In much of the mountain region a turnaround time of 5 to 6 minutes isn't unusual. Use of Class A foam is on the increase.

Type III dozers with fire plows and communications are widely available. Handtools are effective and the first line of defense. At times it isn't necessary to get mineral soil to stop a running fire in the f i t attack. Removal of the loose leaf litter is often enough and that can be accomplished by leaf blowers and handtools. Another important tool is the All Terrain Vehicle (ATV) which makes accessibility easier and helps move supplies and equipment.

7. Special Considerations.

Strip mines and haul roads for timber or coal are numerous in some areas, allowing access, and acting as a fire breaks. They are not on any map but local forestry personnel will know about them.

Caution: It is easy to get trapped on steep slopes created by over burden pushed off the strip benches. Stay on the benches and construct indirect fireline. Post Lookouts if needed.

8. There usually is no problem with density altitude: Most of southeast is less than 5000' MSL; 80% less than 1000' MSL.

B. Piedmont Plateau

The Piedmont Plateau comprises approximately 50 million acres of forest.

1. Fuels.

Fuel Model 9 - Mixed hardwoods-pine.

Fuel Model 1 - Open southern pine plantation.

Fuel Model 9 - Closed pine stands.

Most of this region is covered with mixed hardwood pine forest. Fuel continuity is frequently broken by open spaces where land has been cleared for agricultural purposes.

There is a wide range of fuel sizes and densities. Many areas have hardwood fuel types not unlike the mountain regions. There are other extensive areas of loblolly and slash pine plantation ranging from seedlings to pole and saw log size timber.

The wide range of fuels in pine plantations makes fire suppression difficult and hazardous. The younger plantations have large amounts of light fuels (herbaceous materials, pine litter, seedlings, hardwood debris). The sapling size plantations will easily crown given proper conditions and their density hampers working with equipment.

Fuel types near streams and wet bottoms consist of mixed bottomland hardwoods but with less leaf litter than the upland sites. Also, there is often heavy cover of Japanese honeysuckle which is usually not as flammable as loose leaf litter. This cover is not usually a "Fuel Ladder" since it is shaded out in pine fuels where crown fires occur.

2. Topography.

Approximately 213 of the Piedmont is forest land. The rolling topography consists of deep, clay soils and numerous small streams. Except in local situations, such as river bluffs, slope generally has little effect fire behavior.

This area historically has been the center of agriculture in the southeast. The region has been burned repeatedly by local residents and only in recent years have fire prevention activities shown results. People still cause most of the fires in this region, either through debris burning or arson. Railroads also cause serious problems in some areas. Claims personnel need to be aware of how the fire started.

3. Weather.

As in mountains, fires in the Piedmont area usually burn the most acreage during the first day. Fires tend to die down nightly and the rolling terrain allows much suppression activity to be done at night when the humidity recovery is high. There are exceptions to this and weather forecasts are important.

4. Tactics and Strategy.

a. Fires burning in mixed pine-hardwood fuel types are fought differently than pine plantation fires:

- (1) Slow moving fires are attacked direct and at the head. This is perfect terrain to use dozers in conjunction with burnout, and this tactic is used extensively.
- (2) Fast moving fires are attacked at natural breaks or by flanking the fire with mechanized equipment with burnout. .

In most cases where natural fuel types prevail there will be breaks in the fuel continuity by roads, agricultural land, or streams. These are excellent breaks from which to make a stand against the fire and should be used where possible. Again, backfiring is mandatory if these lines are to be effective.

- b. Young pine plantations create a totally different situation than natural fuel types. When conditions are such that major fires are possible it is usually not practical to try a frontal attack on a plantation fire.

In some parts of the Piedmont and Coastal Plains extensive reforestation programs have created literally miles of different aged plantations, broken only occasionally by natural forest types.

The situation is not as bleak as it sounds. All plantations of any size have a system of fire breaks and/or roads. Also, streams, branches, and wet drainages remain in hardwoods with little ground cover, thereby creating a natural avenue for equipment and a good break in fuel continuity.

- (1) Fires in intermediate and young pine plantations are usually attacked on the flanks with mechanized equipment and burned out and, if natural breaks are available, at the head with backfiring.

Caution is the watchword and you must have an experienced person handling the frontal attack.

Important: Effective burning out is necessary in this situation. Burnout must be coordinated with line construction. The burnout must be set at that specific time when the wildfire is "drawing" the air toward the fire from the line, preventing the burnout from spotting over the line.

- (2) On extremely fast moving plantation fires it is unlikely that a frontal attack will be successful. In this situation about all you can do is to keep the width of the fire at a minimum by flanking attack and make your main stand after the fire moves out of the plantation and is burning in other fuel types.

5. Safety.

Due to the rolling terrain and ease of equipment operation it is easy to take fires for granted in the Piedmont.

Special caution should be taken when dry, cold fronts move through the area and when working in the dense fuels of pine plantations. Backfiring and burnout, while commonly used,

must be assigned to experienced personnel and coordinated directly by the operations section chief or incident commander. Escape routes for personnel and equipment are extremely important! It is easy to become careless when on a dozer.

6. Resources Available.

- a. Plantation fires burn swiftly and cover much land in a relatively short time. However, they usually burn most of their acreage in the first burning period.
- b. Fire behavior in the Piedmont is often influenced by weather systems that produce extreme behavior.
- c. People from nearby urban areas are building summer and full time residences in heavily wooded areas of the Piedmont. Property values can be high and are usually given high priority for protection if threatened by wildfire.

C. Coastal Plains

The Coastal Plains comprise approximately 100 million acres of forest.

Fuel types in the coastal plains region are determined somewhat by the land drainage patterns. They can be divided into:

- Sandhills.
- High Pocosin.
- Low Pocosin.

1. Sandhills

a. Fuels

Fuel Model 1,5 - 10 tons/acre and Fuel Model 9 - 10+ tons/acre.

Fuels in this area are often loblolly, longleaf, or slash pine with natural grass understory. Pine stands predominate but mixed hardwood stands similar to the Piedmont regions are common.

Another common fuel type is palmetto-gallberry under pine overstory.

Soils are well drained sandy soil and ground litter consists of pine needles, grasses, herbaceous materials, and hardwood understory.

Wide expanses of young pine plantations are found in the sandhills creating the same high hazard areas as those plantation in the Piedmont.

b. Topography.

Nearly flat topography with meandering streams and high water table, but generally very accessible by limited mechanized equipment. The Everglades National Park is so flat the highest point in the park is 10.5 feet in elevation.

The Coastal Plains has had some of the most severe fire problems in the past. While access is readily available to most areas, there are large, unbroken areas of forest land.

Single fires of 150,000 acres have burned in Coastal Plains regions, and fires over 10,000 acres are not uncommon during average fire years. Part of Texas and Oklahoma are in this region.

c. Weather.

Due to the fast moving dry cold fronts, fire in the coastal plains usually burns the most acreage the first day. Due to the increase in RH the fires tend to die down nightly. The rolling terrain and increase in RH, allow much suppression activity to be done at night. There are exceptions to this, such as dry cold fronts.

d. Tactics and Strategy.

Fire behavior and tactics here are practically the same as those in the Piedmont regions. Similar fuels exist and weather patterns are much the same. Often palmetto-gallberry fuel type is encountered in association with pine overstory.

e. Safety

One significant difference firefighters should be aware of is the sandhill regions tend to have an abundance of light fuels that dry out quickly. The area may receive substantial rain one day and burn fiercely the following day. The sandy soils do not hold moisture like the Piedmont clay soils.

f. Resources Available.

- 1) Dozers with blades and fire plows **as** well as volunteer fire department engines and specialized foam engines.
- 2) Many of the agencies are using swamp buggy engines with wide, low pressure tires for maximum flotation and minimum impact. Bombadiers, a tracked vehicle without a blade and with water handling capability, are also used.
- 3) Again, helicopters with buckets or fixed tanks are effective tools because of water sources. North Carolina State agricultural airtankers can carry 800 hundred gallons of retardant.
- 4) Some use of agricultural airtankers in other states.
- 5) Very few (if any) Type I helicopters in southeast.

2. Pocosins - High and Low.

a. Fuels.

The fuels found in the pocosins are similar to those found in swamps.

- 1) High Pocosin 1. Fuel Model 2, 30 - 40 tons/acre.

Mixed hardwood timber and evergreen brush from 6 - 20 feet tall. The leaves of the brush are high in oil content and highly flammable during fire seasons. Some areas have pine overstory. There is usually heavy ground litter on shallow organic to deep peat soils. Fuels are often as much as 40 tons/acre. Heavy understory of shrubs, vines, and seedlings, and young trees make up most of the fuel.

2) Low Pocosin - Fuel Model 7, 10+ tons/acre.

Consists of mixed hardwood brush, generally less than six feet tall. Evergreen brush is high in oil content and very flammable.

Low Pocosin generally has less ground litter and stands of shrub pond pine and Atlantic white cedar are occasionally found, although generally there is no overstory.

Soils are shallow organic soils or deep peat, and fuels range up to 10 tons per acre of vines, herbaceous material and conifer or hardwood brush.

b. Topography.

Pocosin is literally a "swamp" on a hill. This will be a swampy area but with an elevation of 250 - 300 feet above sea level. They have been drained extensively by canals and ditches to create farm land or to plant southern pine. The soil from these canals and ditches usually become roadways with no access to the timber. The soils and peat dry out creating severe burning ground fires.

c. Weather.

In heavy fuels, such as in high Pocosin, flank attacks are the only practical strategy in most cases. Consider weather forecasts. Cold frontal systems cause the same problems of shifting winds in the coastal plains as they do in other geographical areas of the southeast. You also need to consider sea breezes. As land heats during the day, normal wind patterns may become erratic due to sea breezes if the fire is in the eastern part of the coastal plains.

d. Tactics and Strategy.

Is there a need for a bridging crew?

Due to almost flat terrain, fuels and weather are the dominating factors in fire behavior in the Pocosin areas of the southeastern United States.

Head Attack.

Head attacks can be made where fuel is light and maneuverability is possible. In these situations, crown fires are not a great hazard. Most commonly used in low Pocosin.

A head attack is also a practical strategy when natural or man-made breaks occur in the fuels, such as canals and roadways. Line construction for a head attack should consist of multiple lines looped around the fire head and backfiring the line nearest the fire. If possible, tying the line to a barrier is superior to looping it around the head of the fire.

Caution - spotting is always a problem in these fuels and even more so when the backfire and fire's head meet.

Another method of head attack is to construct two parallel lines at the head of the fire and burn out between the two lines. Distance between the two lines would be dependent on the distance the fire is spotting.

Head attacks can also be made without backfiring if necessary. Again, multiple lines are effective as well as using serial application of retardant in conjunction with tracked equipment and fire plows.

Indirect attacks are almost always necessary to allow time for sufficient numbers of lines to be constructed.

Do not attack the head of a crowning fire. Let it run and work the flank or rear.

If all things are equal, attack a fire counter-clockwise to counteract the clockwise shift of winds if frontal systems move through the area. If there is no prospect of weather changes, attack hottest flank first or flank with most loss potential.

Attack downwind from the base of a fire and plow close enough to allow the back fire to be pulled by the indraft from the main fire. Burn out line as it is constructed.

Attacking upwind from natural-breaks should be done cautiously! You must construct firelines farther from the flank for safety reasons. Working close to the flank might allow equipment to be trapped by split heads or finger of fire.

Again, caution is paramount during upwind attacks on large fires.

Ideally, if sufficient personnel and equipment are available, both flanks should be attacked downwind at the same time. If natural breaks are available a head attack can be made in conjunction with the flank attacks.

e. Safety.

Safety is always the first consideration in fire suppression and it is doubly important in the Pocosins. These areas have hazardous fuel types and are difficult to traverse. Drainage ditches and canals where soil has been removed fill with water and are difficult for equipment to cross. Bridging crews may be necessary to construct temporary bridges.

Dense vegetation and unsure footing at times make it practically impossible for people on foot to move rapidly. All kinds of critters will be pushed out by the fire.

Attacking the head of fires is commonly done, but is dangerous. Extreme caution must be used even in an apparently routine fire.

Never allow direct attack on flanks on an upwind attack. Make an indirect attack and use an aerial scout.

Humidity is usually high. It may take time for people to get used to breathing such moist air.

f. Resources Available.

- 1) Dozers with high flotation tracks.
- 2) Helicopters with buckets or fixed tanks.
- 3) "Specialized" tracked vehicles for swamp operations.
- 4) Pumps and hoses.
- 5) Airtankers

g. Special Considerations.

- 1) Fires burning in peat and deep organic soils will burn down to the water table. In periods of drought it may be necessary to irrigate firelines with high volume pumps to completely extinguish fires.

A common observation during wildfires in dry periods is the soil burning away from tree roots causing them to topple over as the fire advances.

- 2) Always use two dozers together in wet or swampy terrain. One can help the other get unstuck; or in some cases, one dozer will plow while the other pulls.
- 3) In wet or swampy terrain, have equipment set a course as close as possible on a straight a line. Plan lines to minimize turns since this is where the dozer is most likely to get bogged down.

Never plow the same line twice and cross previously plowed lines at right angles. It is not uncommon to have 3 - 4 dozers on initial attack and 15 - 20 on extended attack.

D. Swamps.

1. Fuels.

Fuel Model 7 - Sand Pine - sand pine has a very small range and the largest concentration is a block of 280,000 acres on the Ocala National Forest in North Central Florida. It is a fire species. Usually there is one fire per generation and usually this is a high intensity crown fire. Under normal conditions the sand pine scrub is virtually fire proof. This is primarily due to mature sand pine having a dense understory of evergreen oaks with little or no herbaceous ground cover.

Fuel Model 3 - Tall Grass.

Fuel Model 1 - Short Grass.

Upland Pine (Longleaf/Slash Primarily).

Historically, you are looking at a pine/grass understory. With the absence of fire, it becomes pine/brush understory or pine/palmetto-gallberry. It is basically a Fuel Model 2, for pine/grass and Fuel Model 7 for pine/palmetto-gallberry bush. With heavy loadings and needle drape upland pine can be Fuel Model 2 and 5 - 15 tons per acre in Fuel Model 7, dependent on the age of the rough.

2. Topography.

There are numerous swamps and lowlands in the southeast, located in the coastal plains. They are characterized by a low elevation and generally fragile ecosystem that requires special technique to combat the fires. If at all possible order up a micro-RAWS for weather. The topography for this area is flat flat flat!!!

3. Weather.

The weather for this area will be the same as the coastal plains.

4. Tactics and Strategy.

a. Tall Sawgrass.

The most effective tactic to use in tall sawgrass is to work when RH is high. Primarily between daylight and 0900. You can add another two hours or so when supported by water drops.

Fight the fire by flanking (direct attack) with flaps. The tactic is to start swatting at the rear of the fire, flanking the fire and gradually pinching off the head. In the areas of tall sawgrass there usually are some pockets of spike rush that are intermingled in with the sawgrass. Weedeaters with cutting blades can be used to cut a fireline. Connect the fireline to spike rush flats or to tie it into burned areas. From these cut lines you can bum out. Spotting is generally short range due to rapid consumption of fuels. Helicopters are used to support ground crews with water.

The most effective tactic to use in sand pine is plowing lines and burning out. If this does not work the strategy usually calls for going to a fuel break, such as a road and backfiring.

In dense stands, fires crown fairly easily and spread rapidly. Estimated spread rates of 5 mph and higher have been reported. Flame lengths have been estimated in excess of 100 feet.

Large fires typically occur between February and June. This is primarily due to fuel and weather conditions. While drought conditions may occur at other times of the year the foliage moisture and mineral content is not as critical.

The low moisture content of new and old needles occurs in March. Moisture content of old needles increases through the summer and reaches its highest value in August and September. Moisture content of new needles rises sharply to very high values in June and July and decreases through the rest of the year. The high values result from initiation of new growth.

The ether extractive in both old and new needles peaks primarily in March. Ether extractives and energy values for sand pine are generally higher than those for most other pines and they compare with the high values of California brush species.

Studies have shown that when large fires occurred the RH tended to be low (23 - 35%) and windspeeds high (9 - 20 mph). Visibility was very good (12 - 15 miles), indicating frontal passage or an unstable air mass.

b. Short Grasses.

Short grasses can be effectively worked during the day, except with high winds. Again it is crews with flaps along with water drops in support. The most visual cost effective tactic is to locate an area that is almost devoid of any heavy vegetation and ignite with an aerial ignition device. This requires an RH of 65 - 70 percent recovery just before sundown. You ignite an area, allow the spots to join and form a backing line, when RH reaches approximately 80 percent the moisture extinction takes over and the fire goes out.

c. Pine Types.

Scattered throughout the pine types are bays and ponds or wet boggy areas. When wet, these can be used as natural fuel breaks. If you have the opportunity to fight fire in these areas, one of the first questions to ask is, "will the bays stop the fire?" If they will, then you're in good shape. More than likely, they won't or you wouldn't have been called. If the "swampy" area is in a hardwood timber type, typically the fire will be a low intensity ground fire, but it will require handtool work cutting through peat or a deep litter layer. The ground will not usually support equipment. If it is a brush type, such as titi you may experience a running head fire in these bays.

d. Pine Plantations.

Pine plantations are going to play a larger role in fire suppression efforts in the next few years. With the Conservation Reserve Program, millions of pines have been planted. These plantations have large amounts of light flashy fuels. The sapling size easily crowns, the density hampers equipment and once inside of these it is like being a mouse in a shoebox, the only way you can see is up.

Fire behavior in these fuel types is primarily from live fuels and corresponds to the time since it was last burned. Any dead fuel will play a major role in fire activity, i.e., needle drape will encourage crowning.

Typically, you can expect 2' - 4' flame lengths and rates of spread (ROS) of 4 - 8 chains per hour on low to medium class days in lighter fuels. On moderate to high class days in light to moderate fuels expect flames of 4' - 10' with ROS of 8 - 12 chains/hr. On high class days in heavier fuels you can expect 15' - 20' flame lengths with ROS of 60 - 80 chains per hour. As a general rule, in southern pine one mile per hour is a good estimate to use on extreme fire behavior. However, in blow-up conditions, you may see these ROS go to 150 - 200 chains per hour with flame lengths in excess of 100 feet as crown fires develop.

Tactics to take on slow moving fires is to anchor into a road, stream, or any fuel break and attack the fire directly and cut off the head, burning out behind the dozer.

On fast moving and crowning fires, you back up to a fuel break, backfire and hope you can hold your backfire; if not, you get out of the way and let the head run. You work the base and try to flank the fire, burning out as you go. You can also plow a lot of lines ahead of the fire front to create a large fuel break.

5. Grass and Sawgrass Fire Behavior

FIRE BEHAVIOR YOU CAN EXPECT (3 – 6 mph eye-level winds).

	Backing		Forward	
	FL	ROS	FL	ROS
Short Grass	2' - 4'	4' - 6'	12'-15'	80'-100'
Short Sawgrass	2' - 8'	4' - 6'	10' - 20'	40' - 80'
Tall Sawgrass	8' - 12'	2' - 4'	20' - 30'	20' - 60'

6. Safety.

- a) Roads - in this part of the country are a "ball-bearing" sand which requires high flotation tires or four wheel drive to travel. Always keep one foot in the black. Tall sawgrass (up to 12') is almost impenetrable and once in these areas, visibility is almost nonexistent. A compass is a must to keep oriented.
- b) In fighting grass fires, always carry fusees. Should you get trapped, you can quickly bum out a safety island. Don't try to outrun on foot.
- c) In the south the dozer operator position is the most dangerous job, because fires in the coastal plain are wind driven. Fatalities and burnovers have resulted from wind shifts while dozer operators and firefighters were directly attacking the flanks and head of a fire and not burning out.
- d) Stumps - dozers are notorious for getting hung up on a stump. The operator will many times hang around too long trying to save a piece of equipment. If possible work dozers in tandem.

- e) Due to the flatness of the land, communications will be a challenge.
- f) Snakes, getting lost or disoriented, inaccessible areas, alligators, poison wood, poison ivy, holes, boggy areas (poor footing) are all safety concerns to be aware of.
- g) Because of the many safety concerns there is not usually a night shift in the swamp areas.