Reflections on the USA/Portugal Wildland Fire Technical Exchange Project

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The year 2003 brought Portugal the worst fire season in recent history in terms of area burned and lives lost. Some attribute this to an unusual weather anomaly but then the 2005 fire season has already demonstrated that a continuing potential exists for large, multiple day, campaign fire combat events when conditions are right. Climatologists also suggest that increasing climate variability could lead to extreme deviations from average conditions, including some years being significantly hotter and drier and others, significantly cooler and wetter. Portugal needs be prepared for more years of unusually severe fire weather similar to what occurred in 2003 and 2005.

During the summer, 2004, I participated in a USA-Portugal wildland fire technical exchange project to observe and evaluate wildland fire protection capability. During my 3 week visit we observed fire combat operations and interviewed fire brigade commanders, emergency command center (CDOS/CPD) supervisors and staff, personnel from the National Service for Fire and Civil Protection (SNBPC), the Forest Service (DGRF), Forest Owners Associations, first intervention assets for private fiber companies (ALFOCELCA), Mayors, Governors, and technical staff from several municipalities. As a result, we developed some general impressions about the wildland fire program in Portugal.

We concluded that the initial attack capability of the individual fire brigades, the first intervention efforts of the Sapadores Florestais and private company first response assets (e.g. ALFOCELCA) were quite good. However, what was lacking was a single, unifying command structure and common communications capability that provided for an integrated, coordinated attack to ensure maximum effectiveness of all firefighting assets. Initial attack efforts were aggressive and often successful, however, once fires became large, or burned more than a single burn period, there was a limited ability to successfully plan and implement effective perimeter control strategies and provide for multiple day logistical needs. The limited number of hand crews also made it difficult to implement a perimeter control strategy, especially in rugged or remote areas. The lack of these “specialized forces” to handle hotspots in difficult, roadless terrain resulted in an unacceptably high rekindle rate.

The wildland fire program also appeared unbalanced. Great emphasis was given to increasing combat capability, specifically in terms of acquiring equipment, with less emphasis given to fire prevention, in terms of education programs, law enforcement, fuels reduction and silviculture treatments. More effort in prevention activities was needed. A fire that is prevented need not be extinguished, nor can it rekindle.

Finally, we determined that a comprehensive training program was needed, within this broader framework of improvements, to ensure that knowledge and skills are being successfully imported and transferred to those that must implement the actions.

Portugal's forests and rural agricultural zones are valuable national assets that deserve protection. Trends in increasing climate variability, demographic shifts caused by a rural exodus, the management complexities associated with fragmented, small dimension real estate, and forest and agricultural economics that limit fire protection investments suggest that more challenging times lie ahead. Several key structural and technical changes will help stop the continuing erosion of productivity resulting from wildland fire damage.

At the time, Portugal had all the pieces of the puzzle to construct a world-class fire prevention, detection, first intervention and combat program. However, it lacked a comprehensive plan to fit them together. A national strategy was needed to effectively educate policy makers and the public, to build a balanced arsenal of assets, to ensure integrated, coordinated utilization of assets, to provide logistical support for combat on multiple-day campaign fires, and to attain the knowledge and training to effectively apply perimeter control strategies and tactics on large, landscape-scale fires. This plan needed to identify a balanced mix of activities to support fire prevention education, fuel reduction and silviculture treatments, detection and first intervention, wildland fire combat and tactics, and the restoration of severely burned areas.

In 2004, the emphasis was to increase fire combat forces, an understandable reaction to the experiences of 2003. However, this represented a last resort strategy. Until the *Plano National—Defensa De Floresta Contra Incendios* was completed, Portugal had focused most efforts on building a strong combat force. A more balanced approach was needed, and this plan recognized that.

This plan clearly defines the roles and responsibilities of all participants including National, District and Municipal government agencies as well as Forest Owners Associations and private companies. It strives to focus all the components of a balanced program in a synergistic fashion to gain the greatest improvement for the least cost. No single entity has the budget or the assets to independently solve the problem. All stakeholders must work together, in a well coordinated way, to realize the full value of Portugal's wildland fire defense capability.

As a result, Portugal has implemented many positive changes since the USA/Portugal Wildland Fire Technical Exchange Project Report was released in 2004. Many of these improvements are still maturing and may take several more years to bear fruit. Others changes have provided immediate improvement in both performance and outcomes.

In 2004 we identified four strategic opportunities to reduce wildland fire losses.

1. Prevent fires though public education, high risk area patrols and law enforcement programs.
2. Create fire resistant landscapes through strategic application of fuel reduction and silviculture treatments.
3. Maintain a strong fire detection and first intervention program to extinguish fires before they become destructive.

4. Effectively engage in large fire combat.

A single minded focus on any one of these strategic opportunities will fall short. A balanced approach is required to optimize effectiveness. In the wake of catastrophic fire losses, there's always a strong tendency to focus primarily on strengthening defensive measures, Strategic Opportunities 3 and 4. However, sustained, long-term success can only be achieved by aggressively attacking the root of the problem; minimizing numbers of fires and their potential to spread. By also taking the strong offensive position provided by Strategic Opportunities 1 and 2, the demand on first intervention and combat forces is reduced, allowing greater success.

Many changes have occurred in government structure in an attempt to provide more effective coordination in the campaign against wildland fire. Some of these changes, like the creation of the FEB—Forças Especiais de Bombeiros Canarinhos, have proven to be valuable. Others, like the creation of the APIF—Agência para a Prevenção de Fogos Florestais, have already been determined to be of little value, and dismantled. Benefits resulting from of these changes are often difficult to directly correlate to any one specific annual outcome. It can also be very difficult to isolate the degree to which weather has been a factor in the results.

For example, burned area statistics for 2007 look very promising, but can this be attributed to improvements made to the fire defense program, or was it just the result of a wet weather pattern that existed throughout the summer? It will take many years, possibly even a decade, before trends in fire statistics can be reasonably correlated to annual actions taken. Just in the last 5 years (2003-2007) Portugal has seen a year of record high temperatures (2003), a year of record drought (2005), and a very wet summer (2007).

We know that global climate variability is expected to increase. This means that greater annual deviation from average annual climatic conditions can be expected. The trend is for some years to be significantly hotter and drier than average (e.g. 2003 and 2005), while other years will be significantly cooler and wetter than average (e.g. 2007). Together, both of these conditions present a problem for reducing wildland fire losses. The cooler, wetter years will provide better growing conditions resulting in an increasing accumulation of flammable fuel. The hotter, drier years will provide meteorological conditions that allow this additional fuel to burn with greater intensity, spreading fires faster, resulting in more large destructive fires.

As illustrated in Figure 1, during the late 80s and 90s decades, the 4-year moving average for burned area was relatively constant at about 100,000 ha annually. However, in the most recent period from 2003-2007, the deviation from the annual burned area increased dramatically in both directions by a factor of 4. This pattern of extreme annual deviation is now being termed *Asymmetric Fire*, and is showing up in other geographic areas of the globe as well. It has been mostly attributed to two factors. 1) A similar increase in the annual deviation of climate variables that most influence burned area; hot/dry and cool/wet years and, 2) an increase in the continuity of fuels across large landscapes without meaningful interruption.

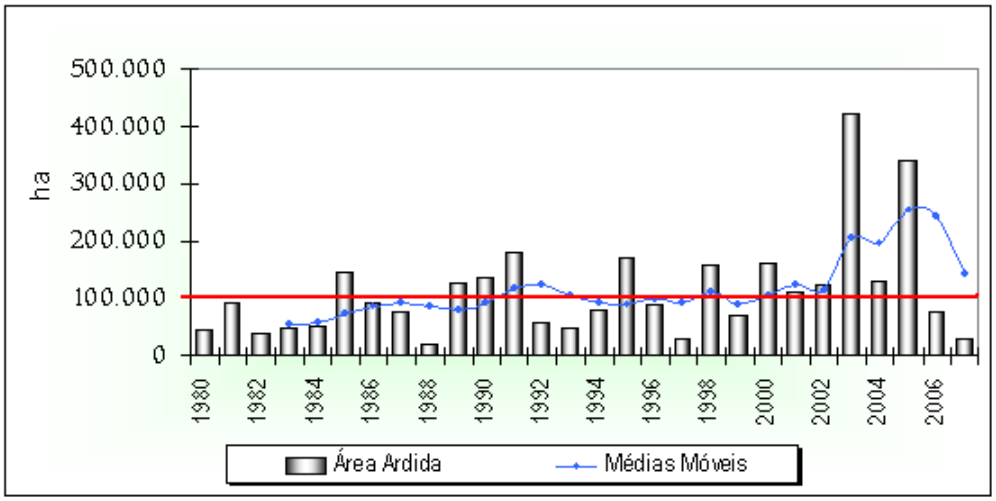

Figure 1: Annual totals of burned area, with 4-year moving averages (blue) for the period 1980-2007. The red horizontal line represents the annual burned area objective in accordance with the PNDFCI up to 2012. *Source: Dados cedidos pela DGRF (Julho, 2008).*

This type of wide fluctuation in annual burned area presents a difficult problem for fire defense organizations. Budgeting for fire defense based on average annual numbers and sizes of fires may have provided sufficient information for funding in decades past, but now is increasingly prone to failure. Budget planning for an average year when significant deviations could occur has two inherent risks. Either too much money will be spent for a fire defense capability that isn't needed during a cool/wet year or, if a hot/dry year develops, fire defense capability will be significantly deficient. Budgeting for a fire defense program to be successful during extreme years when it's most important is cost prohibitive. This is why it's so important to increase the odds of success in ways that aren't dependent on betting on a particular annual climate/weather scenario to play out.

Detection, first intervention and fire combat capability have been greatly strengthened since 2003. Improvements in radio communication and the coordination of first intervention and combat forces is ongoing and showing promise. Training programs have been developed to improve fire defense skills. However, two very significant problems remain in Portugal that, without significant improvement, will only continue to result in greater losses from wildland fire. Both of these have a strong human connection with either the cause, or the cure.

The first is the high number of human-caused ignitions in Portugal as compared to other Mediterranean countries. Statistics show that Portugal, as compared with Mediterranean countries having similar fuel and weather conditions, has a disproportionately high number of human caused ignitions relative to population. For example, Spain is 5 times larger than Portugal, and has 4 times the population, yet has fewer ignitions. This high number of ignitions occasionally exceeds first intervention and fire combat capability. Generally speaking, more

ignitions increase the probability they will occur on severe fire weather days, presenting an even greater challenge for first intervention success.

Even more disturbing is the high proportion of incendiary fires intentionally-set to cause damage, to voice political or social discontent, or to cause civil disruption. This phenomenon isn't just a technical fire prevention problem. The reasons are more cultural, psychological and demographic in nature. Unemployment, low wages, poor living conditions, egocentrism, grudges against society, boredom, and criminal intent are all possible root causes for this behavior. A broader range of expertise is needed to shed more light on the cultural, social and psychological drivers that create a desire to use fire for destructive purposes. These issues deserve more study in relation to preventing incendiary fires.

On the bright side, the total number of annual ignitions has been trending downward, with the notable exception of 2005 which set a new record (Figure 2). That spike could certainly be attributed to the severe drought conditions that existed, causing many potential ignition sources to start fires that might not have otherwise occurred given more average moisture conditions. This indicates that some prevention measures undertaken in the last 5 years have been working. More effort is needed, however, to reduce the still unacceptably high number of human-caused ignitions in Portugal.

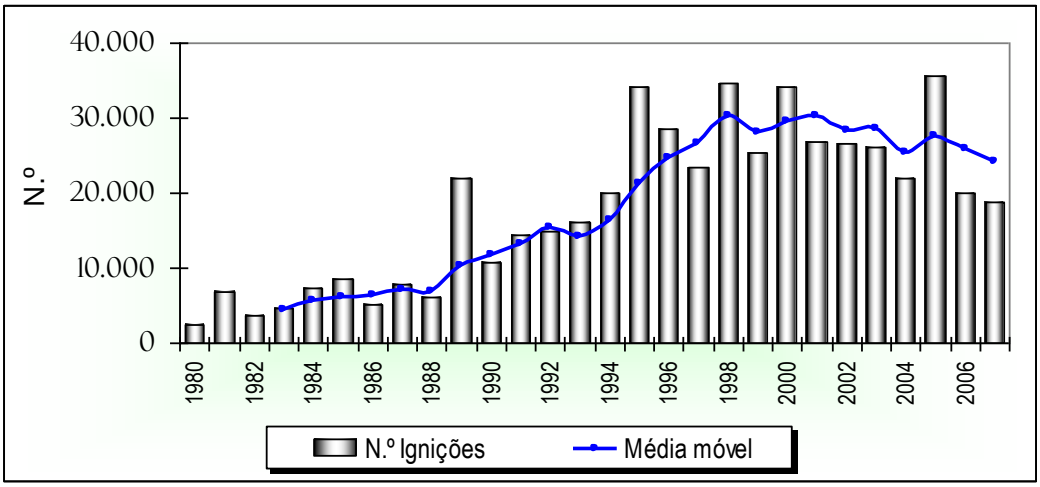

Figure 2: Annual number of ignitions with 4-year moving averages (blue). *Source: (DGRF, 2008a).*

The second significant problem is the increase in large, continuous areas of unmanaged or inadequately managed flammable vegetation. This ranges from vast landscapes of even-aged commercial eucalyptus forests, to once cultivated agriculture lands that have been abandoned and are now dense with flammable weeds and shrubs. In addition, thousands of small, individual tracts of once well-managed forest are going unattended, only to become indistinguishably aggregated into the next future fire storm.

Financial incentives to plant monoculture forests in previously cultivated and marginal lands with no forest maintenance requirements has resulted in increasingly uniform expanses of highly flammable vegetation. Fires that could once be stopped at cultivated land boundaries are now spreading through them, faster and hotter than ever before. This landscape conversion from a fine scale mosaic of cultivated plots and tended forests to large scale, unmanaged wildlands has set the stage for the future: one of bigger, more destructive fires. Just add the next drought or heat wave to the equation and any ignition potentially becomes an instant inferno. So what can be done?

During the technical review in 2004, standing on a fire detection tower in Serra D'Ossa, it was apparent that any fire escaping first intervention efforts had the potential of burning a very large area of the forest. This conclusion was based on viewing large continuous blocks of dense Eucalyptus forest with no break in fuels sufficient to offer much assistance in stopping a running crown fire. Harvesting was conducted in large continuous tracts, starting at one end and working across the landscape, like a Pac Man sequentially eating dots in a line. While this approach reduced fire risk where harvesting occurred, it offered little protection to the remaining large blocks of unharvested area. The result is that much of the forest is left highly vulnerable to crown fire propagation and spread.

Figure 3: Large, continuous tracts of harvested and untreated area in Serra D'Ossa Forest (Beighley 2004)

The solution seemed obvious; to break the forest up into a mosaic of different age classes, much like a patchwork quilt or a chessboard with smaller blocks of older, flammable forest surrounded by blocks of younger, more fire resilient forest. This crown fire spread-resistant pattern could be accomplished by designing a patchwork using computer fire behavior simulation programs and then implementing a harvest schedule to create the mosaic. The downside is that this strategy would likely increase the cost of harvesting, but the resource damage and financial losses reduced over the long term could certainly offset those costs.

Sadly in 2006, an intense fire swept through the Serra D'Ossa Mountains during August, 2006, destroying 5,344 hectares. Helicopter video clips, compliments of Bombeiros Voluntarios de Estremoz, show an intense fire burning in a continuous, mostly untreated forest.

http://www.youtube.com/watch?v=ytUkxnY9fb4&feature=related (from 2 to 3 minute marker)

The abandonment of cultivated lands that once provided effective fire breaks, the creation of large expanses of even-aged, monoculture forests and the establishment of Natural Areas with unmanaged vegetation all potentially increase fire risk. These situations invariably result in an unacceptable fuel accumulation and continuity that make fire suppression difficult, and consequently increase the risk of destruction of those ecosystems and resources intended for preservation.

In addition, this situation is complicated by an increase in unauthorized building in the middle of forests and other wildland areas. First intervention and fire combat forces needed to protect natural resources are often diverted to defend structures rather than stopping the fire from spreading into new, unburned areas. As a result, buildings are protected but fires continue to get bigger and threaten additional buildings. Fire combat forces are then required to leap-frog from building to building rather than stopping fire perimeter growth. Since the protecting structures will always take priority over protecting wildlands, this results in a continuing degradation of natural resources.

Large tracts of highly flammable forest and abandoned agricultural land need to be managed to reduce the potential for fire growth and improve resilience to damage by fire. Public policies that affect land use changes such as planting forests in agricultural land set-asides and conservation rules for natural areas need to be reviewed and revised to insure compatibility with the wildland fire prevention scheme for a given area and with a full understanding of the potential effects of a changing global climate.

In 2004, we asked many questions about fire program effectiveness and most went unanswered. Multiple levels of government and private funding sources contribute to the overall wildland fire protection program but there was no attempt to summarize all these expenditures in an annual report. What effect do various elements of the program (prevention, detection, first intervention, and combat) have on the overall objective of defending communities and natural resources? Which activities are the most effective and which are the least? Nationally, how much money is spent on extinguishing rekindled fires? It's now encouraging to see that much of this information is being accumulated, analyzed, published and discussed at workshops and conferences.

Portugal's forests and rural agricultural zones are valuable national assets that deserve protection. Several key structural and technical changes would help stop the continuing erosion of productivity resulting from wildland fire damage. Specifically, reducing the number of human-caused ignitions and creating fire-resilient landscapes are the most daunting problems left to solve. Progress in these areas would better position Portugal to minimize future fire related losses.

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