

Money to Burn: The Economics Of Fire and Fuels Management

Part One: Fire Suppression

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INTRODUCTION

***"Whenever you have opportunities to spend over a billion dollars a year, there are numerous opportunities for waste, fraud, and abuse."* [1]**

Forest conservationists are beginning to take economic issues of federal forest management seriously, examining how taxpayer funds and resources are used to subsidize private resource extraction activities on public lands. The next area for concerted economic analysis and critique should be the fire/fuels management activities of federal land management agencies. These activities do not necessarily require commercialization or commodity extraction, but nonetheless involve ecosystem degradation for the purpose of actively imposing bureaucratic management and control over the Land. With federal fire and fuels management programs currently costing upwards of \$1 billion per year, there is a need for greater agency accountability, public awareness, and Congressional scrutiny over the federal "fire shop." The conservation community must articulate the kinds of socioeconomic impacts and tradeoffs resulting from exorbitant bureaucratic spending on largely unplanned emergency fire suppression actions.

This paper, the first of three parts, focuses on the economics of wildfire suppression. [2] It is intended for use as a kind of primer for forest conservationists to begin thinking about and demanding greater fiscal and environmental accountability in federal fire management policies, programs, and practices. Most of the research centers on the U.S. Forest Service, the nation's largest and world's most expensive firefighting agency. Much of the data for this paper comes from various internal agency reports, and from unpublished papers presented at an unprecedented conference on fire economics held in San Diego on April 5-9, 1999. At this conference, several speakers reported that they were unable to finish their studies because the Forest Service's accounting system was so flawed by invalid, unreliable, or missing data.

The prevailing mood at this conference was one of an emerging crisis of accountability and impending public scandal over the economics of fire/fuels management. Given the soaring costs of suppression in the 1990s, there was the unspoken fear that Congress might alter or abolish the system of carte blanche deficit spending for firefighting that has existed for the last 90 years. There was also the concern that yet another public scandal over Forest

Service mismanagement of taxpayer funds and resources would threaten funding needed for future fire/fuels management work. This work to reduce hazardous fuels and restore fire processes will be expensive. It will require substantial taxpayer and Congressional support, and a long-term commitment by agencies. Conservationists and taxpayers should be wary of "throwing good money after bad" unless and until real changes are made in fire/fuels management policies and practices.

The active involvement of forest conservationists in reforming federal fire/fuels management programs is urgently needed. It is time for a new "dollars and sense" approach, such as American Lands' Forest Appropriations Initiative, which critically examined the fire management portion of the Forest Service budget and proposed significant shifts in the agency's budget and spending priorities. For example, the Initiative called for money to be shifted from emergency wildfire suppression accounts, and instead, invested in basic fire ecology research projects, fire management planning, and prescribed burning programs. This would be combined with changes in budget allocations for other resource management programs to help agencies such as the Forest Service change its mission from commodity-oriented resource extraction to community-based ecosystem restoration. For the long-term ecological and economic health of ecosystems and communities, conservationist need to pressure Congress, the administration, and land managers to stop wasting precious tax dollars on a failed and inevitably futile strategy of aggressive fire suppression and systematic fire exclusion. We are running out of money to burn.

FEDERAL WILDLAND FIRE MANAGEMENT POLICY

"The Federal Wildland Fire Policy represents the latest stage in the evolution of fire management philosophy" [3]

Fire control was the Forest Service's first "conservationist" mission at the origins of the national forest system, and firefighting has endured as an important source of political, public, and financial support throughout this century. In the 1970s, the agency realized that it had reached a point of diminishing economic returns from further investments in fire suppression capability, and underwent a change in philosophy from fire control to fire management. However, this change in philosophy existed mainly as policy ideals on paper that were rarely put into on-the-ground practice. More recently, studies such as the Sierra Nevada Ecosystem Project report, the science assessments for the Interior Columbia Basin Ecosystem Management Project, as well as numerous fire-related timber sale NEPA documents, have disclosed the widespread, significant, adverse ecological impacts resulting from aggressive fire suppression and systematic fire exclusion. Ironically, the effectiveness of a century of firefighting coupled with decades of commercial logging, grazing, and road-building has created a much more flammable landscape. The general trend is that the frequency and intensity of large-scale wildfires are increasing (posited as the results of climate change), and the costs of suppressing large fires are rapidly rising. [4]

In the wake of the disastrous 1994 fire season in which 34 firefighters were killed and over

\$1 billion were spent on firefighting, an intensive interagency review and revision of fire management policies was commissioned. The outcome was the 1995 Federal Wildland Fire Management Policy and Program Review, signed by Department of Agriculture secretary Dan Glickman and Department of Interior secretary Bruce Babbitt. The new Fire Policy directs federal land management agencies to balance traditional fire prevention and suppression programs with greater use of natural and management-ignited prescribed fires. The intent of the Fire Policy is to provide for greater firefighter and public safety, as well as to reduce the environmental impacts and financial costs of suppression actions. Arguably, the motivations underlying the creation of the new Fire Policy was as much or more about reducing economic costs as they were about increasing human safety.

The highest priority action item needed to implement the new Fire Policy is for land managers to develop new fire plans that would allow a full spectrum of "Appropriate Management Responses" to wildland fires. These responses could range from simple aerial monitoring to aggressive fireline construction all on the same fire incident. Without these new fire plans, though, managers have only one option when confronted by fires: total suppression. Whereas Department of Interior agencies such as the National Park Service and Bureau of Land Management have invested time, money, and resources in developing new fire management plans, the Forest Service is essentially stonewalling public demands for new fire management plans. Claiming that it must first revise Forest Plans and change the Forest Service Manual, the effect is that land managers are refusing to implement the new Fire Policy.

Thus, the agency continues to aggressively attack nearly every wildland fire. On a number of lightning-caused fires in northern California in 1999 that had favorable fire behavior and weather conditions for managing as prescribed natural fires, the agency responded with full-scale suppression. Hundreds of firefighters were dispatched to incidents such as the Big Bar Complex on the Shasta-Trinity National Forest where lightning started fires in highly sensitive wildlands that included designated wilderness and inventoried roadless areas, late-successional reserves, tier one key watersheds, and spotted owl protected activity centers. For most of the duration of that fire (still burning as this paper goes to press) the fire behavior was a model understory surface fire with a rate of spread approximately 100 yards per day! The main source of burned acreage, in fact, came at the hands of firefighters doing "controlled" burnout operations. Until the Forest Service is compelled to fully comply with the new Fire Policy, its fire management program will continue to be dominated by aggressive suppression reactions, with all the inevitable economic costs, environmental impacts, and safety risks involved.

SOARING FIRE SUPPRESSION EXPENDITURES

"There are increased expenditures for suppressing large fires, and risks to financial resources. Expenditures may bear little relation to values at risk." [5]

By all accounts, emergency wildfire suppression expenditures are increasing, and the

Forest Service is spending more per fire and more per acre burned than in the past. [6] Different studies have reported different total expenditures for fire management, but it reaches cumulatively into the billions of dollars. For example, according to one Forest Service study, from 1970-1995 the agency spent about \$7.9 billion, which when adjusted for inflation translates into about \$11.8 in 1995 dollars. [7] More than half of all USFS fire management expenditures is spent on suppression—an average of \$381 million per year. [8] According to the Government Accounting Office, from fiscal year 1993 through 1997 federal land management agencies cumulatively spent \$4.4 billion on wildfire activities, with over half this amount spent on wildfire suppression. [9] The USFS spent the lion's share of this: about \$1.7 billion directly on suppression.

A problem for economic planning for fire suppression is the extreme natural variability of fire seasons, as well as flawed accounting systems that yield unreliable or invalid data. This makes the standard practice of planning according to the "average" fire season quite problematic. For example, while the infamous 1988 season saw more than 2.7 million acres burn and cost \$606 million for suppression, the 1994 season had half as many acres burned but spent \$951 million, exceeding the cost of the 1988 season by 57%. [10] Another Forest Service study came up with the figure that the total cost of the 1994 fire season was 174% higher than the 1988 season! [11] In 1996, \$689 million was spent fighting fires on approximately 4 million acres; in 1997, \$281 million was spent to suppress 2 million acres on fire. [12] Then in 1998, over \$1 billion was spent on wildfire suppression (data for total burned acreage yet to be disclosed). [13] In general, over half the total expenditures for fire management activities are spent on emergency wildfire suppression, with suppression costs rising at an "average" rate of 15.5% annually. [14]

These rapidly rising suppression expenditures are causing concern among members of Congress. Accordingly, Forest Service fire and aviation managers must now send monthly suppression expenditure predictions to the Office of Management and Budget (OMB). [15] Predictions utilize available actual year-to-date estimates and are continuously updated. This makes for better post-fire accountability, but makes pre-fire predictability somewhat of a spurious notion. Thus, economic planning for the Forest Service fire management program is still largely a moving target subject to deficit spending with weak Congressional oversight.

The old policy prior to 1995 was that life, property, and natural resources were valued specifically in that order of preference. Thus, fire managers were often compelled to spend vast amounts of money and sacrifice high-value public resources suppressing wildfires in order to save low-value private property. Extreme examples of this disparity include committing suppression resources to provide structural protection for old mining shacks and hunter's cabins. The new Fire Policy now values human life--especially the lives of firefighters--as the top management priority of every fire incident, then property and resources are valued equally. Managers are no longer supposed to spend inordinate funds or sacrifice high-value public resources for relatively low-value private property. Unfortunately, though, there is still much bureaucratic inertia for the old policy, and land managers continue to engage in economically unjustified aggressive suppression actions.

INEFFICIENT LARGE FIRE SUPPRESSION SPECTACLES

"Often we use resources because of the public and political pressure to do something, even though it has no effect on the fire and is an economic waste." [16]

Most wildfires on federal lands are quite small: 58% of all fires are 1/4 acre or less in size, 88% are under 10 acres, and 96% of all fires are under 100 acres. [17] According to the old economic theory of fire management developed in the mid-1930s, it is more economically efficient to engage in aggressive initial attack suppression when fires are still small, and try to minimize the size and duration of wildfires. However, the total programmatic costs of suppression are grossly skewed toward the few, rare, very large fires which also burn the vast majority of federal acres and consume the most tax dollars. On average, approximately 94% of the total burned acreage every year comes from just 2% of all fires, and in turn, these 2% of all fires account for over 97% of the total nationwide suppression expenditures. [18] Indeed, during the 1994 season just 20 out of the 24,072 total fires on federal lands cost more than \$200 million to suppress. [19] There is evidence that since 1970 the total number of fires has gone down, but conversely, the amount of burned acres has gone up. [20] The truth is that both as a natural process that has continued from time immemorial, and as a human-caused by-product of Euro-American settlement, development, and management regimes, very large fires will still occur in spite of our fire prevention, suppression, and prescription efforts.

The large-scale, long-duration wildfire suppression actions are what gains the most attention by newsmedia and politicians, and thus color public perception of forest fires and firefighting. Portrayed as a heroic crusade that is the moral equivalent of war, firefighting enjoys widespread public approval and political support, and there is almost the sense that land managers should spare no expense to defend human lives, private property, and natural resources from the ravages of "catastrophic" wildfire. Certainly, the time for citizens to raise criticisms and economic concerns about the costs of firefighting are not during actual wildfire emergencies when most of the costs are actually incurred. As a new kind of overseer in fire camp, comptrollers now staff nearly every suppression incident, trying to assess if each expense is legitimate (or not). [21] However, it is a rare accountant who will second-guess the operational decisions of fire incident command teams, and there is the strong impetus to give the "troops in the field" whatever they need to get their jobs done safely and effectively. Thus, managing from one fire emergency to another, the normal crisis-decisionmaking process of wildfire suppression makes significant economic decisions over the use of the public's precious tax dollars appropriated for forest "conservation."

But "siege-like" fire suppression actions risk lives, property, and resources, and can be very costly. [22] Large-scale suppression costs average from one to five million tax dollars per fire. [23] Often, firefighters do battle in utter futility when extreme weather situations and hazardous fuel conditions confront them. These large "project fires" are sometimes dubbed "political shows" by experienced firefighters who know when their labors will have no effect

on fire behavior. Nevertheless, firefighters are ordered to labor away in order to impress the media, politicians, and the public with the agencies' heroic albeit vain attempts to contain and control large-scale high-intensity wildfires. A new rationale for political fires is that it is far easier for land managers to avoid violating smoke management regulations from prescribed fires by simply declaring all unplanned ignitions as wildfires and then engaging in some kind of suppression effort. Although most scientific studies report that prescribed fires emit far less particulate matter than wildfires, the apparent legal and public double-standard between tolerance for smoke generated by wildfires versus prescribed fires makes for a default fuels management system based on suppression not prescription fires. Yet, firefighters should not be compelled to assume the health and safety risks or physical rigors of aggressive suppression just for a "political show."

Following the 1994 season that at that time racked up the highest suppression expenditures in history, the Forest Service authorized a special internal review of fire suppression costs on large fires. The 1995 Truesdale report mildly rebuked managers for selecting and attempting to implement "minimally successful and very costly" suppression strategies, and then persisting with such strategies in the face of repeated failures. [24] The report cited "public and political pressure" as the key factor for implementing an aggressive strategy, but also revealed that local Forest managers (i.e. "line officers") are not held accountable for their use of the emergency Firefighting Fund (FFF). "As a result, there is no penalty for making excessively risk-free use of these funds, because the line officer is not required to make up deficits from the unit's budget," the report states. [25] Indeed, several managers admitted that they "would have fought fires differently, and at lower cost, if the money had come from the Forest's allocated budget," instead of an emergency account from Washington, D.C. [26] Thus there are powerful political and economic disincentives for fire and forest managers to take risks in order to reduce total spending for fire suppression.

The Forest Service employs fire behavior analysts on wildfires, but regardless of their predictions, fire bosses almost never consider alternatives to conventional aggressive contain-and-control strategies for suppression. Consequently, when weather conditions may be ideal for managing fires as prescribed fires, these relatively small, cool, beneficial understory fires are routinely subjected to aggressive initial or extended attack. Again, the Truesdale report noted that,

"Many people, both inside and outside the Forest Service, fail to recognize that wildfire is a normal, positive force in the ecosystem. Often it is neither preventable nor susceptible to suppression actions. Paradoxically, every time a fire is suppressed, fuel in adjacent unburned areas continues to accumulate. Thus, successful fire suppression may increase the potential damage and cost of future fires. This cost should be considered in the process of deciding how to suppress the fire." [27]

The Truesdale study thus recommended that the concept of "least cost plus loss" be recalculated to include the long-term future costs of suppression incidents and fuels reduction treatments in the same area that could have been managed as a prescribed fire but instead was suppressed as a wildfire. Thus, according to this new proposed model of

economic efficiency, it might be cheaper to allow one 20,000 acre fire burning under beneficial prescribed weather conditions than to respond to 20 separate 1,000 acre fires burning under adverse weather conditions over the same given time period.

The National Park Service also staffs all large fire incidents with fire behavior analysts, but they have been given the authority to recommend keeping firefighters in camp instead of "hitting the fireline" when their weather and fire behavior calculations predict that aggressive suppression actions would be useless. Indeed, when feasible, the Park Service manages wildland fires as "prescribed fire use" opportunities to maximize resource benefits and minimize safety risks, environmental impacts, and economic costs. When suppression is necessary, the Park Service manages fire with time and space according to confinement objectives, using fewer firefighting resources in indirect and extended attack strategies that maximizes the use of available natural fire breaks. Choosing longer containment times and larger fire sizes when conditions are favorable allows the use of a wider range of less expensive suppression resources. [28] The Truesdale report estimated that appropriate use of this confinement strategy would save millions of tax dollars each year, especially when considered in conjunction with increased firefighter safety and reduced suppression impacts on the land. [29]

COSTLY COMMERCIALIZATION OF FIRE SUPPRESSION

***"There is lots of pressure by Congress to hire private contractors for fire suppression even though it has higher costs."* [30]**

Costs are increasing for fire suppression in part due to the increasing size and intensity of wildfires, but also due to a change in personnel policy that began with the Reagan-Bush administration's efforts to "privatize government." Beginning in the 1980s, the Forest Service's standing army of seasonal fire and fuels management crews was downsized (a process which still continues today), and this work was turned over to private contractors. Federal managers were mandated to mobilize the closest suppression resources available, whether they were public or private. This reversed a policy that originated during the Great Depression of the 1930s that specifically prohibited hiring local crews because of the epidemic of arson fires that were ignited by individuals seeking employment as emergency firefighters.

Arson fires can create temporary but lucrative job opportunities for firefighters and salvage loggers, but are often some of the most costly and damaging human-caused wildfires. For example, the arson-caused 1994 Cottonwood Fire in northern California roared across 46,000 acres and cost \$12.5 million to suppress. [31] A predictable outcome of the Reagan-Bush administration's new policy was, in fact, a rapid increase of arson-caused wildfires, particularly in Regions Five and Six that experienced some economic dislocation from sawmill closures and logging restrictions in the 1990s. Nationwide, from 1991-1996, reported arson fires averaged 25% of all wildfire ignitions, accounting for 19% of the total burned acreage. [32] The category of "miscellaneous" also suspiciously increased during

the same time, accounting for 19% of all fire starts and 15% of the total burned acreage. **[33]** Conservationists should be suspicious of the category of "miscellaneous" ignitions since the 1991 Warner Creek Fire, a known arson attack against a spotted owl Habitat Conservation Area, continues to be labeled a "miscellaneous" ignition in Forest Service fire statistics.

This hiring policy that gives preference to local private contractors still prevails, and has even expanded under the Clinton-Gore administration. So-called "contractual services," profit-oriented private companies providing labor, equipment, or services to the government, now account for over half the total suppression costs on large fires. Approximately 56% of the total costs go to contract services, compared to 32% for agency personnel wages and 12% for all other costs. **[34]** From fiscal years 1993-1997, of the \$1.7 billion that the Forest Service spent on wildfire suppression activities, \$1.2 billion of this amount went to private contractors for services and supplies. **[35]** The annual costs for availability contracts for "suppression stand-by status," which pays private companies simply to be available for firefighting, would shock many taxpayers. For example, each air tanker and crew costs \$350,000; each hotshot crew: \$450,000; each helicopter and crew: \$210,000; each engine and crew: \$85,000; each smokejumper: \$30,000! **[36]** These costs are paid whether or not these resources are ever used on a fire. The armada of standard firefighting equipment such as engines, dozers and low-boys, water tenders, helicopters and air tankers is largely privately-owned, and the USFS pays a premium price for use of these. For example, some aircraft cost over \$600 per minute, and fire managers can spend over \$250,000 per day for aircraft services on large fires! **[37]** During the 1994 season, \$57 million was spent just on Type I helicopters—more money was spent on helicopters in all other years combined. **[38]**

The preference for private contractors has its own alleged economic rationale: it is assumed to be more "efficient" to pay for firefighters only when they are needed to fight fire. But the prevalence of "stand-by" contracts undermines this rationale, and the costs of firefighting continue to rise along with the efforts to privatize it. Indeed, there are many valid reasons for challenging the assumption that private contractual firefighting services provide greater economic efficiency for government agencies.

Another measure of economic efficiency besides examining total costs would be assessing the quantity and quality of work produced by firefighting personnel. To date, there has yet to be a study comparing public agency versus private industry fire crews. In truth, most ground-level firefighters hired by either public or private entities are paid relatively low hourly wages for the hard work and hazardous conditions they endure; however, adding overtime and hazard pay adds up to relatively large paychecks at the end of fire season. Consequently, both kinds of firefighters are highly motivated to work, especially on long-duration large-fire incidents. But in my personal opinion, there are differences in the labor experience coming from people who have public "service" versus private "profit" motivations. This is particularly revealed during the fire rehabilitation work that immediately follows suppression, when workers' motivations to repair the damages caused by firefighting is based more on environmental than economic rewards. The objective quality of the work "product," and the subjective quality of the work process, can and should also become measures of the economic efficiency of firefighting policies and practices.

In sum, as the federal fire/fuels management workforce continues to shrink, private contract firefighting companies are increasing in number and price, and this is raising the costs of fire suppression. In fact, contract firefighting is an international business, and business is booming especially for suppliers of heavy equipment and aircraft. The multinational trade agreements being promoted by the Clinton-Gore administration will speed up the international trade in firefighting equipment and services. [39] Predictions are that there will be greater interagency and international cooperation in the future, prompted by global climate change, and aided by a globalized firefighting economy. The growing firefighting industry will likely become a serious economic and political force for conservationists to contend with in terms of getting federal agencies like the Forest Service to shift focus in fire/fuels management policies and practices. As well, the political and economic forces and cultural factors that tend to make aggressive suppression the standard, routine response to nearly all wildland fires will keep driving up economic costs as more large fire episodes loom in the future.

CONCLUSION

"Analogous to the medical profession, we have the ability to spend enormous funds doing amazing emergency interventions in catastrophic situations, but not spend smaller, sustainable amounts of money in preventative measures for forest health."
[40]

Ironically, the first formulation of the "Economic Theory" of fire suppression in 1916 was used to justify a policy of "let burning" in remote wildlands in order to avoid the expenses of suppression altogether. [41] This early formulation was abandoned because, although suppression costs were in fact minimized, land managers' perception of "damages" to potential merchantable timber was deemed to exceed the cost savings. The economic theory of suppression was thus redefined in the 1930s to mean minimizing the size and duration of forest and range fires, a feat accomplished by aggressive initial attack and dogged extended attack against all fires big or small, hot or "cool." The new Fire Policy's concept of "appropriate management response to wildland fires" (versus the old policy's notion of "appropriate suppression response to wildfires") implies the possibility of redefining suppression to mean reducing the intensity and severity of fire instead of its absolute size or duration. [42]

In a number of ways on both economic and ecological grounds, conservationists can argue that the "conventional warfare" approach to fire suppression is inefficient, ineffective, and irrational. This is especially true when the costs of reactive fire suppression are compared to the costs of proactive prescribed burning. For example, in 1998 on National Park Service lands--some of the most politically sensitive and publicly cherished wildlands in the U.S.A.--it cost approximately \$2,100 per hectare for wildfire suppression compared to only \$200 per hectare for prescribed burning. [43] The cost of prescribed fire is slowly increasing as the Park Service begins burning more total acres and manages more complex burns in very

sensitive areas; however, these costs pale in comparison to the rapidly and vastly increasing costs of suppression.

Federal land managers sense that sooner or later there will be an end to unlimited federal dollars for fire suppression. Assuming that some kinds of fire suppression will still be needed in the foreseeable future, it will probably no longer be based on a "stand alone" initial attack apparatus anymore, but instead, will be part of an integrated fire/fuels management program. [44] Meanwhile, some program analysts are considering a variety of ways to immediately cut costs and gain efficiency on suppression actions with existing institutional structures. One of the most sensible of their ideas is to avoid doing aggressive suppression during extreme weather and fire behavior situations. In particular, stop ordering "media-show" airlights when the fire behavior is such that retardant drops are ineffective. Other good ideas are to use more natural firebreaks and fire confinement strategies; construct appropriate firelines with the right kinds and amounts of personnel and equipment; avoid "overkill" in dispatching or mobilizing firefighting resources; reduce the mop-up phase (which often inflicts the most amount of environmental damage) because it is far cheaper to let the fire naturally burn out than to physically put it out; and finally, reduce the size of fire camps (which can sometimes dwarf the size of nearby rural communities) and reduce travel time by "spiking" crews out more often. [45]

Efforts to reform fire/fuels management policies and practices will not be easy since a huge federal fire bureaucracy and swelling private firefighting industry have vested political and financial stakes in perpetuating the annual "war" on wildfire. The collection of essays in "Wildfire! An Endangered Ecosystem Process," argues that the social and ecological effects of firefighting results in essentially a militarization of forest management, and that federal firefighting has evolved into an appendage of the military-industrial complex. [46] This perspective is not widely shared by a public long-conditioned to view forest fires as destructive, even demonic forces of Nature, and wildland firefighters as "heroes" waging a good and just war. But regardless of one's cultural or philosophical views of wildland fire, the economic facts speak for themselves: federal firefighting is breaking the budget and cannot be sustained without significant social and ecological tradeoffs. The public deserves these tradeoffs to be debated in democratic forums, not made under emergency decree by "nameless/faceless" bureaucrats working as fire bosses.

If there is any federal money to burn, it should be used literally for prescribe burning the forest and grassland ecosystems that have been denied fire for too long. The Forest Service acknowledges that 57 million acres of National Forest land are in forest types that require periodic fire. [47] Accordingly, the agency wants to prescribe burn up to three million acres per year by 2005, which will cost an estimated 160 to 200 million dollars per year. [48] The National Park Service is already actively increasing its fire research and restoration program, and views prescribed fire costs as "capital investments" for the purpose of reducing hazardous fuels, limiting suppression impacts, and restoring ecosystems. These are tangible ecological "returns," but the socioeconomic benefits of ecosystem restoration have yet to be fully explored. It is up to the conservation community to articulate to the American people and Congress the many sound economic and ecological arguments for

reforming fire/fuels management policies, programs, and practices, with a goal of converting firefighters into fire-lighters.

FOOTNOTES

[1] Garder, Ferry; Fire and Aviation Budget/Program Analyst, BLM-National Interagency Fire Center; presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA; April 6, 1999.

[2] Part Two of this paper will feature topics on the budget process, economic modeling and accounting systems, fire management planning, and the costs of managing fire in the urban/rural/wildland interface and special habitat reserves; Part Three will feature topics on various fuels management methods, their economic costs and environmental effects.

[3] Zimmerman, Tom; Fire Science and Ecological Applications Program Leader, NPS—National Interagency Fire Center; "Wildland Fire Appropriate Management Responses: Examples of the Range of Options and Costs;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[4] Bunton, Delvin; Computer Systems Analyst, USFS Office of Ecosystem Management-Region Six; "Cost Factors and Trends for Large Wildland Fires;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[5] Salwasser, Hal; Director, USFS--Pacific Southwest Research Station; keynote address at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[6] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. A-3.

[7] Schuster, Ervin; Cleaves, David; and Enoch Bell; 1997; "Analysis of USDA Forest Service Fire-Related Expenditures, 1970-1995"; Pacific Southwest Research Station Research Paper PSW-RP-230; p.7-8.

[8] Gebert, Krista; Economist, USFS--Rocky Mountain Research Station; "Predicting National Fire Suppression Costs;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[9] Hill, Barry; Associate Director, Energy, Resources, and Science Issues, Resources, Community, and Economic Development Division, Government Accounting Office; "Wildfire Preparedness and Suppression Expenditures for Fiscal Years 1993 Through 1997;" GAO/T-RCED-98-247; p.1

[10] Schuster, Ervin; Cleaves, David; and Enoch Bell; 1997; "Analysis of USDA Forest Service Fire-Related Expenditures, 1970-1995"; Pacific Southwest Research Station Research Paper PSW-RP-230; p.6.

[11] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. 1.

[12] Hill, Barry; Associate Director, Energy, Resources, and Science Issues, Resources, Community, and Economic Development Division, Government Accounting Office; "Wildfire Preparedness and Suppression Expenditures for Fiscal Years 1993 Through 1997" GAO/T-RCED-98-247; p.1

[13] Mangan, Richard; Fire Program Leader, USFS-Washington Office; "Issues in Large Wildfire Suppression Cost Reductions;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[14] Schuster, Ervin; Cleaves, David; and Enoch Bell; 1997; "Analysis of USDA Forest Service Fire-Related Expenditures, 1970-1995;" Pacific Southwest Research Station Research Paper PSW-RP-230; pg.7.

[15] Gebert, Krista; Economist, USFS--Rocky Mountain Research Station; "Predicting National Fire Suppression Costs;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[16] Mangan, Richard; Fire Program Leader, USFS-Washington Office; "Issues in Large Wildfire Suppression Cost Reductions;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[17] Bunton, Delvin; Computer Systems Analyst, USFS Office of Ecosystem Management-Region Six; "Super G Fires in the U.S.;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[18] Petrich, Edith; Assistant Director of Fire Planning, USFS-Washington Office; "U.S. Forest Service Fire Management Policies;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999

[19] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. 1.

[20] Schuster, Ervin; Project Leader, USFS Rocky Mountain Research Station; "USDA Forest Service Fire-Related Expenditures: An Update;" presentation at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[21] Mangan, Richard; Fire Program Leader, USFS-Washington Office; "Issues In Large Wildfire Suppression Cost Reduction: An Operational Perspective;" presentation at the

Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[22] Salwasser, Hal; Director, USFS--Pacific Southwest Research Station; keynote address at the Symposium on Fire Economics: Planning and Policy Bottom Lines; San Diego, CA, April 6, 1999.

[23] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. H-3 to H-14.

[24] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. 8.

[25] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. C-1.

[26] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. 10.

[27] Truesdale, Denny; 1995; "Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season;" USFS Fire and Aviation Management—Washington Office; pg. 6.

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