Program for Climate, Ecosystem and Fire Applications

Coarse Assessment of Federal Wildland Fire Occurrence Data

Report for the National Wildfire Coordinating Group

Timothy J. Brown
Beth L. Hall
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DRI
Desert Research Institute
Division of Atmospheric Sciences

CEFA Report 02-04 December 2002

Forward

This report describes the results of a coarse assessment of federal wildland fire occurrence data. The assessment was an outgrowth of current projects under Assistance Agreement 1422RAA000002 between the Bureau of Land Management National Office of Fire and Aviation and the Desert Research Institute (DRI) Program for Climate, Ecosystem and Fire Applications (CEFA). For further information regarding this report or the database discussed, please contact either:

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Executive Summary

Can federal wildland fire agencies point to a national database of fire occurrence and say with confidence that the management decisions being made are based on quality data?

This report provides a coarse assessment of U.S. historical federal wildland fire occurrence records. These records are from USDA Forest Service (USFS), and the Department of Interior (DOI) agencies Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (FWS) and National Park Service (NPS). Our initial purpose in assessing these data was to provide an inventory and quality control of occurrence records for subsequent analyses in several wildland fire research projects at the Desert Research Institute (DRI) program for Climate, Ecosystem and Fire Applications (CEFA). But it was soon recognized that describing the results of our assessment might be beneficial to other academic researchers, wildland fire personnel (e.g., fire specialists, fuels specialists, meteorologists, etc.) and database managers where the records originated. Thus, this report describes our initial efforts of working with federal wildland fire occurrence data, and is offered as reference and recommendations to the National Wildfire Coordinating Group (NWCG), NWCG working teams, researchers, agency data managers, and other interested parties.

Our analysis is different from the recent effort of Hardy and Bunnell (1999) in that we examined various potential issues with the dataset, and covered a longer time period. One primary result of our analysis is a flagged data set of federal wildland fires. Certain flag values imply a subset of fires that we deem usable for our own subsequent studies, but with the stipulation that these records only underwent the coarse assessment, and not a detailed quality analysis. Other flag values indicate serious data issues. Many of the maps and figures shown in the report will be made available for public distribution. The flagged dataset will also be made available once our planned internal analyses are complete.

An important outcome resulting from this study is an understanding of the fire occurrence records, and the requirements for quality control and assurance of these data. Of the 657,949 total fire occurrence reports examined, 10% of USFS and 30% of DOI records were found not usable due to reporting issues. Thus, we offer several key recommendations to wildland fire agencies for consideration. Given a newfound sense of these data, and data importance for fire business, we believe the following recommendations should be a priority for fire agencies:

Recommendation 1: Work on both a comprehensive quality historical database and a process for improving the quality of the original observation.

Recommendation 2: Create and adopt a uniform recording procedure for fire occurrence across all agencies, and encourage states to utilize the same method.

Recommendation 3: Create and adopt a system for improved real-time additions to a national fire occurrence database that can be readily accessible.

Recommendation 4: Undertake a process of acquiring and documenting appropriate metadata to make readily available in support of the current historical and future national fire occurrence database.

Recommendation 5: Organize a national workshop to address the various issues and aspects of a national fire occurrence database, comprised of both management and scientific representatives, to establish fire occurrence information needs.

Recommendation 6: Establish a national interagency wildland fire occurrence database that is readily available to both fire management agencies and the public.

To ensure quality fire occurrence records, there must be reasons or incentives to establish and maintain a quality database. It needs to be understood that these records are no longer just for money tracking purposes; that there are indeed a multitude of reasons for a quality database – for both management and scientific uses. The most important one for now may be the justification of the way of doing fire business and agency accountability. The analysis presented shows downward trends in the quality of DOI fire records that indicates issues of quality data are not simply a problem of the past. Though this trend is not present in USFS records, it must be assured that this will not be the case in the years to come. There are numerous quality control and assurance aspects of fire data observation and recording that need to be addressed today, and maintained into the future.

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Introduction

This report provides a coarse assessment of U.S. historical federal wildland fire occurrence records. These records are from USDA Forest Service (USFS), and the Department of Interior (DOI) agencies Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (FWS) and National Park Service (NPS). Our initial purpose in assessing these data was to provide an inventory and quality control of occurrence records for subsequent analyses in several wildland fire research projects at the Desert Research Institute (DRI) program for Climate, Ecosystem and Fire Applications (CEFA). But it was soon recognized that describing the results of our assessment might be beneficial to other academic researchers, wildland fire personnel (e.g., fire specialists, fuels specialists, meteorologists, etc.) and database managers where the records originated. Thus, this report describes our initial efforts of working with federal wildland fire occurrence data, and is offered for reference and recommendations to the National Wildfire Coordinating Group (NWCG), NWCG working teams, researchers, agency data managers, and other interested parties.

The need for assessing and improving fire occurrence data has been a topic of discussion at several recent scientific workshops (e.g., University of Arizona 2002a; 2002b). Basically, these discussions have pointed out the value of having quality datasets of historical fire occurrence for numerous scientific analyses. Federal agencies have also recognized a need to develop consistent quality datasets for fire management. A federal FY02 effort by the USDA Forest Service Washington Office of Fire and Aviation Management is currently underway to begin standardization of spatial layers of fire occurrence and fire planning units. There have been at least two substantial efforts besides our own to produce a quality controlled dataset of fire occurrence. A recent Joint Fire Sciences Program (JFSP) project has made available federal and state fire occurrence data for the period 1986-1996 (Hardy and Bunnell 1999). Some quality control work was done on these data, including removal of records with incorrectly reported spatial coordinates, records of false alarms, assist fires, prescribed burns, unsuitable fire types and those fires not located within the same state as indicated. Deliverables from the JFSP project include a fire occurrence database, metadata, map graphics, geographic information system (GIS) data layers and documentation. Dr. Anthony Westerling at the Climate Research Division, California Applications Program, Scripps Institution of Oceanography in La Jolla, California has developed a western U.S. gridded (1 degree latitude/longitude) dataset of fire occurrence for 1980-2001 for climate related analyses (Westerling et al. 2002) using federal fire occurrence data (along with some state records). Some quality control work was applied to these data in the determination of whether or not an individual report could be included in the grid.

We refer to our assessment as coarse because this was not a formally funded project with specific deliverables, but rather a necessity for other project analyses, and our quality control procedures did not include substantial manual checks (e.g., evaluation of key punch records). Thus, an extensive analysis of all database fields was not done, nor was there an examination of occurrence records beyond the electronic data (i.e., comparison of original paper records to electronic database). Other than the Hardy and Bunnell (1999) work, no quality controlled historical observed individual federal fire occurrence data set is readily available to our knowledge. Due to limited resources, most of our effort was placed on flagging each record as to its quality, and performing minimal effort in terms of corrections or record analysis. The flagging process was primarily done with in-house computer software, though some limited hand checking and GIS was utilized. Records that appeared correct were flagged as available for subsequent analyses. This does not mean that the record was absolutely error free, but only that no obvious problem was found. For those records with an apparent problem, a specific flag was used to denote the problem (e.g., missing or incorrect spatial coordinates). Other flags indicate that a conversion took place, such as from Township-Range-Section (TRS) or Universal Transverse Mercator (UTM) coordinates to latitude/longitude. This type of conversion was done so that all useable records were in the same coordinate system, with a latitude/longitude preference.

The result of our analysis is a flagged data set of federal wildland fires. Certain flags imply a subset of fires that we deem usable for our own subsequent studies, but with the stipulation that these records only underwent the coarse assessment described below, and not a detailed quality analysis. Other flag values indicate serious data issues. Many of the maps and figures shown below will be made available for public distribution. The flagged dataset will also be made available once our planned internal analyses are complete.

Databases

USDA Forest Service data were extracted from the National Interagency Fire Management Integrated Database (NIFMID) at the USDA Forest Service National Information Technology Center in Kansas City, Missouri. These occurrence data are from Report 5100-29 that are locally compiled and then electronically transferred to NIFMID. Department of Interior (DOI) occurrence data are from the DOI Form-1202 used by the Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), Fish and Wildlife Service (FWS) and the National Park Service (NPS). These reports are annually updated in the Shared Applications Computer System (SACS) located at the National Interagency Fire Center in Boise, Idaho.

The period of record used in this assessment is from 1970-2000 (updates are planned as data become available, and time and projects permit). DOI reports prior to 1980 are very minimal, thus DOI occurrence data effectively start in 1980. The 31-year time period yielded 657,949 combined agency fire occurrence reports, of which 538,809 have flags indicating a "usable" occurrence record. Usable is strictly our definition as having a fire discovery date, latitude/longitude location, total area burned and cause values that originally appeared correct or were changed per our quality control (QC) procedures. Except where specially indicated, the graphical figures and tables in this report incorporate only these usable records. Other users of fire occurrence data may have their own definitions of usable information.

Figure 1 shows a map of the contiguous U.S. with red points indicating locations of federal wildland fire occurrence. Though there are some federal fire reports in the eastern U.S., clearly the bulk of occurrence is in the western U.S. due to the extent of federally managed land. Figure 2 shows point locations of all federal agency fires combined in the western U.S. (west of 100ºW). Because of TRS conversion, it is likely that several fires could be plotted at an identical latitude/longitude location in both plots. Regions with sparse fire activity may be due to the lack of fuel availability (e.g., southwestern Nevada, western Utah), but many of the void areas have state or local responsibility that were not included in this assessment.

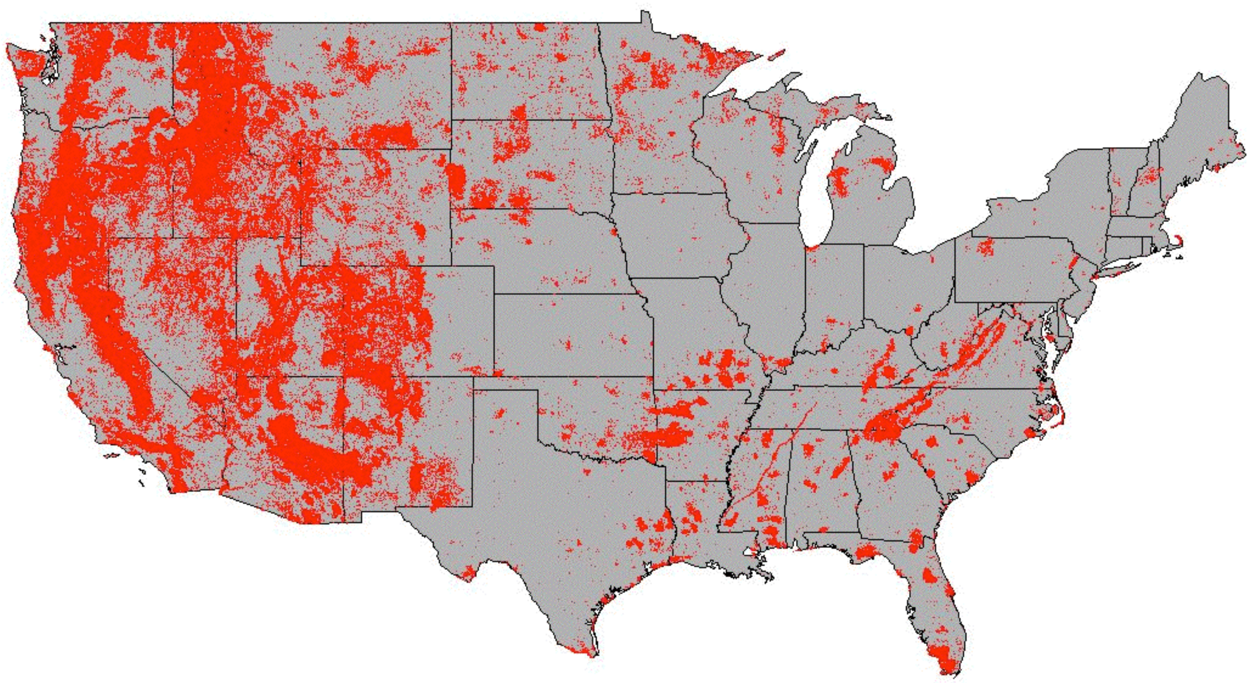

Figure 1. Point locations of coarse quality controlled U.S. wildland fires (red symbols) from the federal fire occurrence database for the period 1970-2000.

Methodology

The primary data processing step was to investigate all of the individual records to determine commonalities that flag values could be assigned to. For example, these could be anything from "the original record appeared correct", to "the record contained no usable values". Several flags indicate where a value was converted or changed to generate a more complete record (e.g., TRS conversion, transposed geographic coordinates). As a result of this process, 22 flags were defined. Table 1 provides a list of flag numbers that were conceived as part of the QC analysis process. However, these flags do not necessarily represent all of the potential problems. For example, detailed checks of statistical and specific cause were not undertaken; nor was the number of acres controlled assessed in any detail. Perhaps in a future second phase of QC analysis additional flags for other fields can be generated.

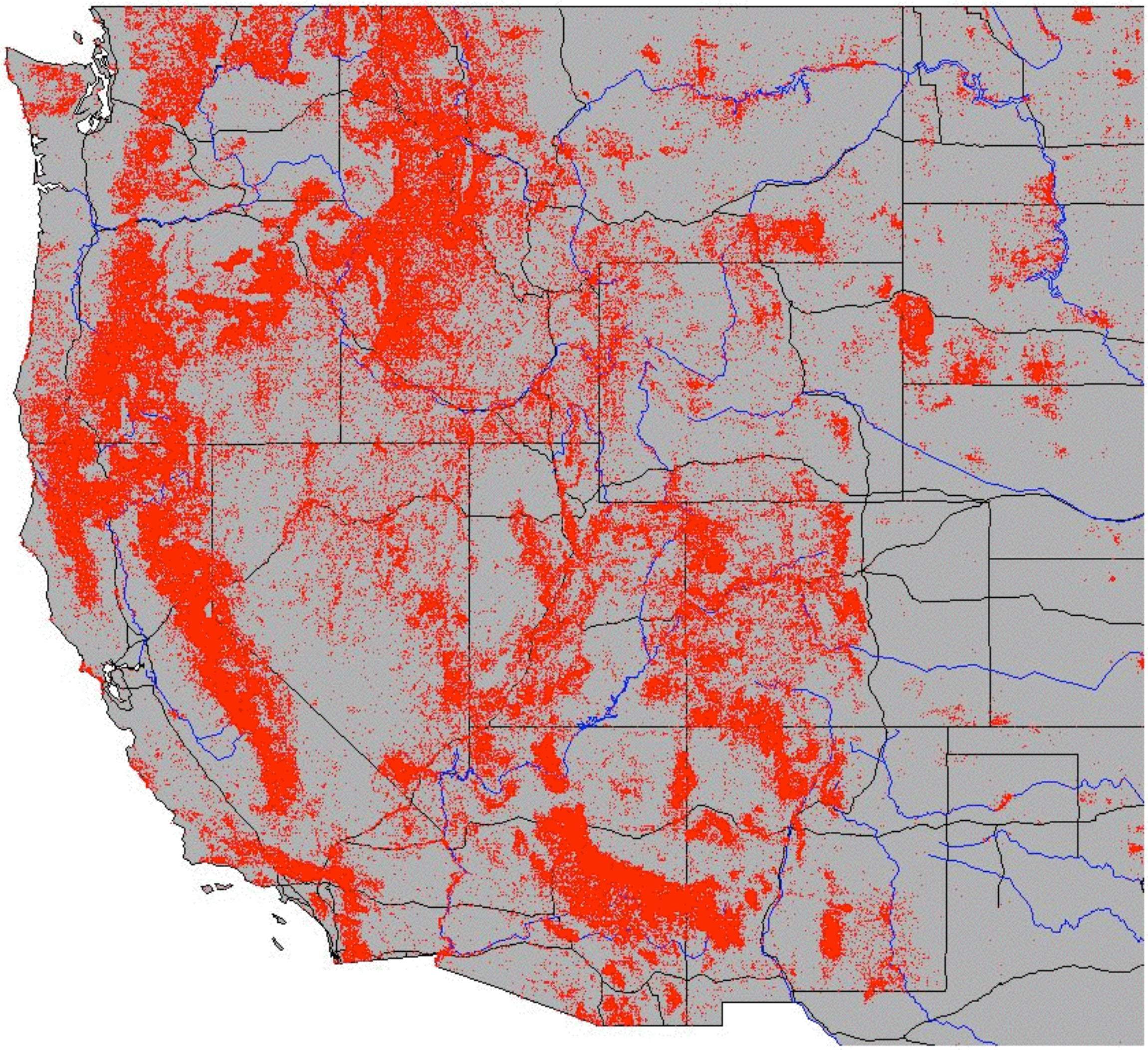

Figure 2. Point locations of coarse quality controlled western U.S. wildland fires (red symbols) from the federal fire occurrence database for the period 1970-2000. Also shown are some reference interstate highways (black) and rivers (blue).

One of the first steps in the QC analysis was to flag (flag value 21) those records that had neither location nor date information. Though this record could possibly be used in an overall count of fire occurrence, for most purposes it is not useful without temporal and spatial reference. A second step was an assessment of duplicate (identical) records. For a group of records that had exactly the same values for all fields, all but one of these records was flagged as a duplicate. This occurred only if all fields of interest were identical. There are two potential types of duplicates – intraagency (flag number 12) and interagency (flag number 14). One primary reason for an interagency duplicate is agency accounting purposes when multi-agencies are involved with the same fire.

Table 1. Flag values and definitions used in the federal fire occurrence quality control analysis.

Flag value	Flag definition
0	Acceptable report
1	TRS conversion to lat/lon
2	UTM conversion to lat/lon
3	Location over ocean, out of U.S., or no available meridian for TRS conversion
4	Location out of state, but still within U.S.
5	Flags 1 & 3 combined
6	Flags 1 & 4 combined
7	Flags 2 & 3 combined
8	Flags 2 & 4 combined
9	Latitude/longitude switched or the negative sign for longitude was missing (corrected)
10	Latitude 45, longitude –100 reported, *not* successfully converted
11	Latitude 45, longitude –100 reported, successfully converted
12	Within agency duplicate
13	State name missing (corrected)
14	Interagency duplicate report (same fire indicated in more than one agency)
15	Discovery date given, but no controlled date
16	Control date given, but no discovery date
17	No location, but date given
18	No date, but location given
19	No date, but TRS conversion achievable
20	No date, but UTM conversion achievable
21	No date and no location (TRS, UTM, or lat/lon)

Once incomplete and duplicate records were flagged, the next step was a check to determine if the desired fields were available (i.e., acres burned and cause), and whether or not a spatial coordinate conversion was required. Records with no missing values and not requiring a conversion were given a flag value of 0. For those records requiring a spatial conversion, a major effort was undertaken to convert spatial coordinates into a consistent latitude/longitude reference. Location fields originally given in units of degrees, minutes and seconds were converted to decimal degrees.

Two commonly used spatial references in the original database were TRS and UTM. Computer software was developed to convert TRS or UTM into a decimal degree latitude/longitude location. Forest Service records prior to 1985 used primarily TRS. The principal meridian is a data field in the NIFMID database, and was used for the TRS conversion (flag value 1). However, a follow-up check of the conversion using GIS would sometimes reveal that the meridian had been improperly entered. For as many cases as possible, a corrected meridian was obtained and applied in the conversion. Spatial coordinate conversion was only applied to the following western states: AZ, CA, CO, ID, MT, NM, NV, OR, WA, WY and UT. TRS conversion was limited to these states simply due to readily accessible principal meridian look-up tables. BIA and NPS agencies had a small number of locations given in UTM coordinates that were successfully converted to latitude/longitude (flag value 2).

Numerous other record issues were identified and flagged, all having to do with date or location problems. For example, these include latitude/longitude values that place the fire over a lake or ocean (flag value 3), location out of state but still within the U.S. (flag value 4), no location, but date given (flag value 17), and no date, but location given (flag value 18).

Coarse Analysis and Results

The coarse analysis provides results in terms of the overall quality of the fire records, as well as allowing for summary information to be generated for those records determined to be usable at this time. Table 2 provides the summary statistics of the total number of original and usable fire records by agency after the spatial coordinate conversion and flag checking processes. Approximately 90% of the USFS fire records appear usable forgoing a highly detailed quality control check, and approximately 70% of the original DOI fire records are usable under the same corollary. The number of records flagged as non-usable is based mostly on reports with incorrect spatial coordinates (uncorrectable), duplicates and incomplete fields. The number of usable records is based on those reports that originally had seemingly correct spatial coordinates or latitude/longitude values were attainable via conversion or correction and a valid date.

Table 2. Summary counts for national USFS and DOI fire records.

	USFS	DOI
Original number of records	357,516	300,433
Number non-usable	33,394	85,646
Number usable	324,122	214,687
Percent usable	90.65	71.00

Table 3 provides a quantitative summary of the number of records and percent of total for each flag for USFS and DOI separately, and combined. The number of records for each flag and the associated percent of total are given. A substantial fraction of the original records appeared reasonable following the flagging process (flag value 0) for both agencies (USFS and DOI with approximately 50% and 64%, respectively). Recall that flag value 0 indicates all of the original field values appeared valid, and no spatial coordinate conversions were made. Flag value 1 is the conversion of TRS to latitude/longitude coordinates and accounts for approximately 40% of the USFS records and 7% of the DOI records. It appears that USFS switched from TRS to lat/lon spatial units in 1986. For USFS, flag values 0 and 1 account for a high percentage of the records (approximately 90%), and for DOI these two flags account for 71% of the records.

The remaining flags for both USFS and DOI records are related to spatial coordinate problems, such as locations over large water bodies, the latitude/longitude do not match the state name indicated, or a problem with TRS or UTM conversion. These are generally low percentages of occurrence with a few exceptions. For instance, a little over 5% of both USFS and DOI fires were recorded with locations over the ocean, or on land outside of the U.S., or had no available meridian for TRS conversion (flag value 3). Interagency duplicates (flag value 14) accounted for approximately 0.4% of the original dataset, and intraagency duplicates (flag value 12) accounted for approximately 2% of the original dataset. DOI had a large percentage (11%) of records with a date given but no location (flag value 17); this issue was substantially reduced for USFS (0.4%). Records having no date or location information (flag value 21) were nonexistent for USFS, however, for DOI fires this amounted to 22,759 records or 7.6% of the original DOI data set. In summary, the USFS and DOI combined column yields 538,809 usable records out of 657,949 total based on flags 0, 1, 2, 9, 11, 13 and 15.

Table 3. Summary counts of USFS and DOI fire records for each quality control flag value.

	USFS		DOI		USFS & DOI	
Flag value	Number of records	Percent of total	Number of records	Percent of total	Number of records	Percent of total
0	181,459	50.76	192,342	64.02	373,846	56.87
1	141,007	39.44	21,177	7.05	162,197	24.67
2	0	.00	184	.06	184	0.03
3	18,159	5.08	15,769	5.25	34,460	5.24
4	1,849	.52	3,377	1.12	5,226	0.79
5	186	.05	12	.01	199	0.03
6	160	.04	126	.04	286	0.04
7	0	.00	1	.00	1	0.00
8	0	.00	8	.00	8	0.00
9	550	.15	544	.18	1,114	0.17
10	0	.00	72	.02	72	0.01
11	0	.00	199	.07	199	0.03
12	7,032	1.97	6,771	2.25	13,007	1.98
13	1	.00	440	.15	441	0.07
14					2,567	0.39
15	1,105	.31	0	.00	1,059	0.16
16	3,530	.99	0	.00	3,737	0.57
17	1,589	.44	33,540	11.16	35,153	5.35
18	698	.20	83	.03	781	0.12
19	0	.00	61	.02	61	0.01
20	0	.00	13	.01	13	0.00
21	0	.00	22,759	7.58	22,759	3.46

Table 4 shows the number of fire records and percentage by flag value similar to Table 3, except for the DOI agencies individually. Of the usable records, FWS has the highest percentage of usable data (flags 0, 1, 2, 9, 11, 13 and 15) with approximately 85%, followed by BLM with approximately 79%, followed next by BIA with 71%, and finally NPS with approximately 55%. Both BIA and NPS had high occurrences of records with spatial coordinates not within U.S. state boundaries (flag value 3) with approximately 6% and 12%, respectively. Both FWS and NPS had a fairly high percentage (approximately 2%) of locations not matching the indicated state (flag 4). Within agency duplicates (flag 12) were notable for BIA and NPS with approximately 4% and 1%, respectively. Interagency duplicates (flag 14) comprise approximately 0.4% of the total number of fires. This is not necessarily a problem, and simply indicates that multiple agencies can respond to a particular fire. Though only an issue for BIA, flags 10 and 11 indicate the use of a generic latitude/longitude apparently when the actual location was not known. Typically, a latitude value of 45 and longitude of –100 was given. Sometimes TRS information was also provided, and for this case flag 11 indicates a successful conversion to latitude/longitude coordinates. One of biggest general problems seen in these summary counts is an agency not reporting a fire location, even though a date was provided (flag 17). This occurred as much as 17% percent for BLM, 10% for BIA, followed by FWS and NPS with approximately

6%. This is ultimately a large percentage of fires that cannot be analyzed in any spatial context. The percent occurrence of records lacking date or location information is also unfortunately large with approximately 6.7% (BIA), 0.1% (BLM), 3.0% (FWS) and 23.0% (NPS). It is not immediately obvious as to why so many NPS records lack temporal and spatial reference, but clearly almost one-fourth is a substantial number.

Table 4. Summary counts of DOI agency fire records for each quality control flag value.

	BIA		BLM		FWS		NPS		DOI	
Flag value	Number of records	Percent of total	Number of records	Percent of total	Number of records	Percent of total	Number of records	Percent of total	Number of records	Percent of total
0	70,414	55.40	69,779	79.24	22,543	83.30	29,606	50.86	192,342	64.66
1	19,461	15.31	0	.00	18	.07	1,698	2.92	21,177	7.12
2	1	.00	0	.00	0	.00	183	0.31	184	0.06
3	7,875	6.20	121	.14	822	3.04	6,951	11.94	15,769	5.30
4	984	.77	542	.62	617	2.28	1,234	2.12	3,377	1.14
5	9	.01	0	.00	0	.00	3	.00	12	0.00
6	88	.07	0	.00	3	.01	35	0.06	126	0.04
7	0	.00	0	.00	0	.00	1	.00	1	0.00
8	0	.00	0	.00	0	.00	8	0.01	8	0.00
9	101	.08	0	.00	50	.18	393	0.68	544	0.18
10	72	.06	0	.00	0	.00	0	.00	72	0.02
11	199	.16	0	.00	0	.00	0	.00	199	0.07
12									6,771	2.28
13	101	.08	19	.02	293	1.08	27	0.05	440	0.15
14										
15	0	.00	0	.00	0	.00	0	.00	0	0.00
16	0	.00	0	.00	0	.00	0	.00	0	0.00
17	13,190	10.38	15,378	17.46	1,692	6.25	3,280	5.63	33,540	11.28
18	7	.00	0	.00	10	.04	66	0.11	83	0.03
19	16	.01	0	.00	3	.01	42	0.07	61	0.02
20	0	.00	8	.01	0	.00	5	0.01	13	0.00
21	8,449	6.65	122	.14	808	2.99	13,380	22.98	22,759	7.65

A spatial depiction of those fires flagged with problems is provided in Figure 3. The point size used for each fire symbol exaggerates the spatial coverage over the U.S., but nonetheless shows that the issues are more involved than just spatial reference. However, the incorrect recording of spatial coordinates is well highlighted on this map with numerous fires located over the oceans and several continents. There are 119,140 fires plotted on this map.

It is also revealing to plot flag percentages for each agency over time. One key question that this will help answer is how do QC issues change over time. Figures 4 through 8 show the time series of usable fire records for each year. It is particularly notable in these plots that there are trends in the percent of usable records, and generally not favorable ones. The USFS data (Figure 4) is the only series that shows a high percentage of usable records consistently each year (a range of .94 to .99%), and there has even been a slight improvement (approximately .02-.05% depending upon the perspective) over time.

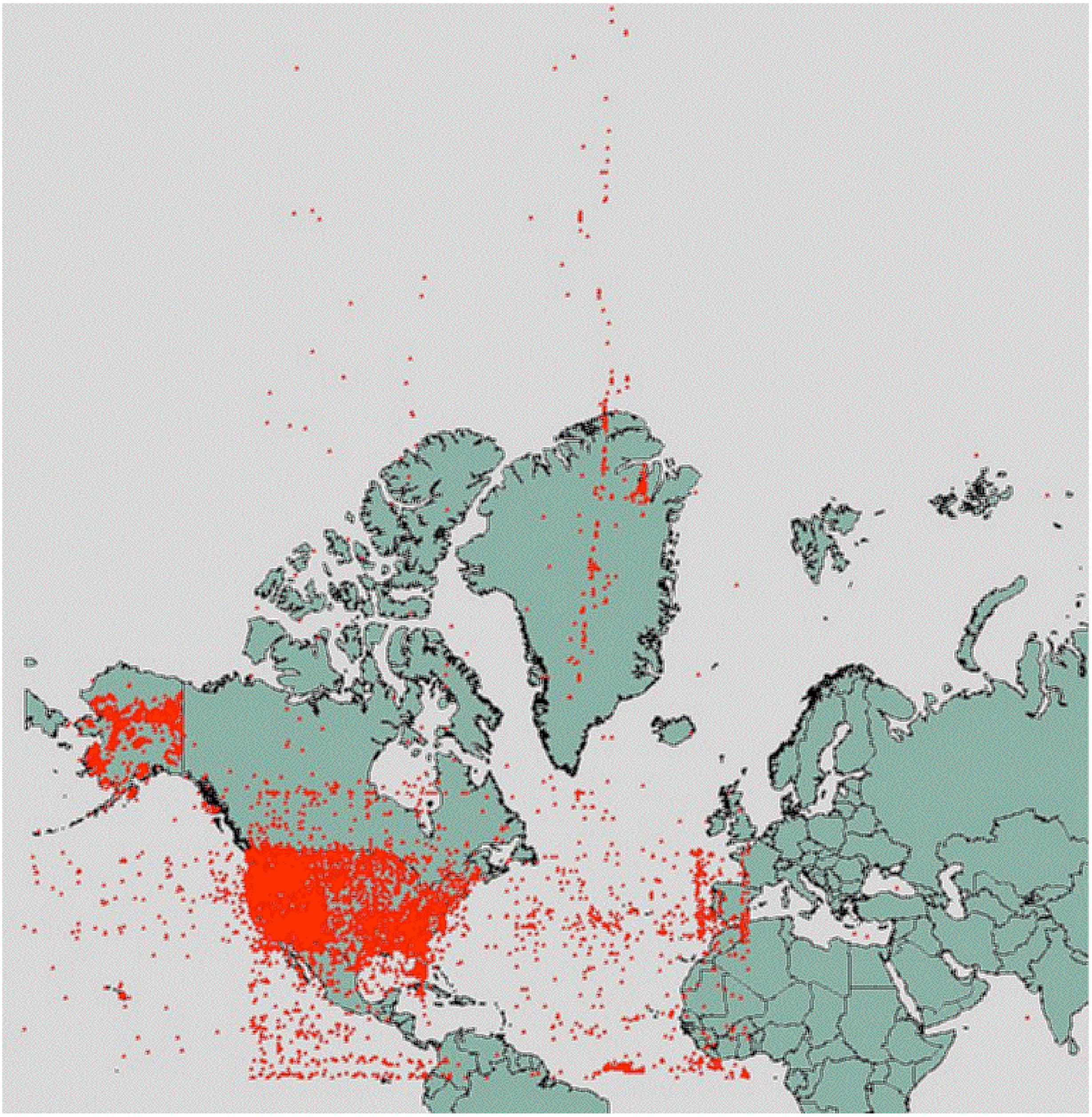

Figure 3. Locations of fires (red symbols) flagged with an identifiable problem from the original federal fire occurrence database.

However, for each DOI agency series, the trend is gloomy. Figure 5 shows the percent of usable records for BIA. Because of uncertainties with DOI records during the 1970s, each series begins in 1980. The series starts out quite low (below 50%) and gradually increases, perhaps reflecting the adaptation of a new recording system. In just five years a 95% occurrence is achieved, but then falls nearly as quickly as it rose, leveling off to around 70% starting in 1988. For the remainder of the period, values range from the low 60s% to the upper 70s%. The highest year for BLM (Figure 6) is in fact their first one, 1980. The percentage remains modestly high for the remainder of the 1980s (in the 80% range), but takes a dramatic fall in the early 1990s to less than 70%, and increases again to around 80% in the latter half of the 1990s. Of all of the agencies, FWS (Figure 7) holds the current record for achieving 100% usable records for at least one year (1982). The first ten years were generally high, averaging around 90%. For most of the 1990s, this dropped to around 85%. It is not clear what happened in the year 2000 to yield only 70%. The NPS record (Figure 8) is the most dramatic of all. The number of usable records begins at near 80%, but consistently drops over the length of the entire record, with a brief exception in the early 1990s. By the year 2000, only 30% of the records were usable.

We have no immediate explanation of any of these patterns. One could argue that these trends indicate something about agency value of fire reporting, such as, it has been a priority for USFS but not necessarily for DOI agencies. However, because to our knowledge these records have never been presented in this manner, one could also suggest a simple lack of awareness that these problems were occurring. These trends indicate a serious issue regarding DOI fire occurrence records. In supposition one could argue that 70% or 80% of reasonably accurate reporting is satisfactory. Is there really a difference, say, between 70% and 80% usable records? For the DOI period of record, this represents 210,000 and 240,000 usable fire records, respectively, a difference of 30,000 reports. Is this a significant number? This depends on one's perspective. Perhaps it is not, unless a really important fire is not accurately accounted for, or other important fires, or a pattern in the data emerges that inhibits management decisions or scientific analyses for decision-support.

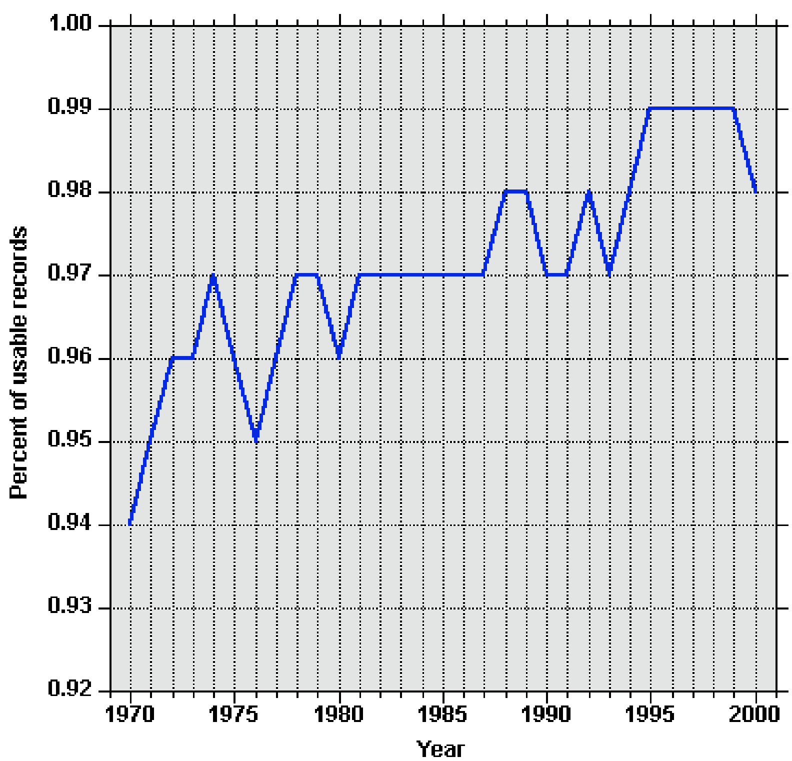

Figure 4. Annual percent number of USFS usable fire records from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000.

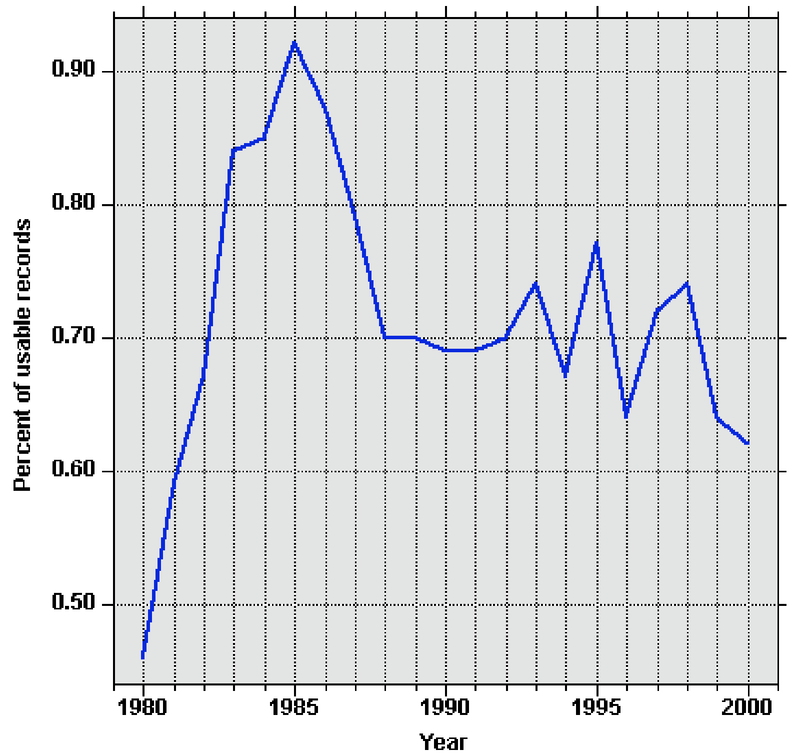

Figure 5. Annual percent number of BIA usable fire records from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000.

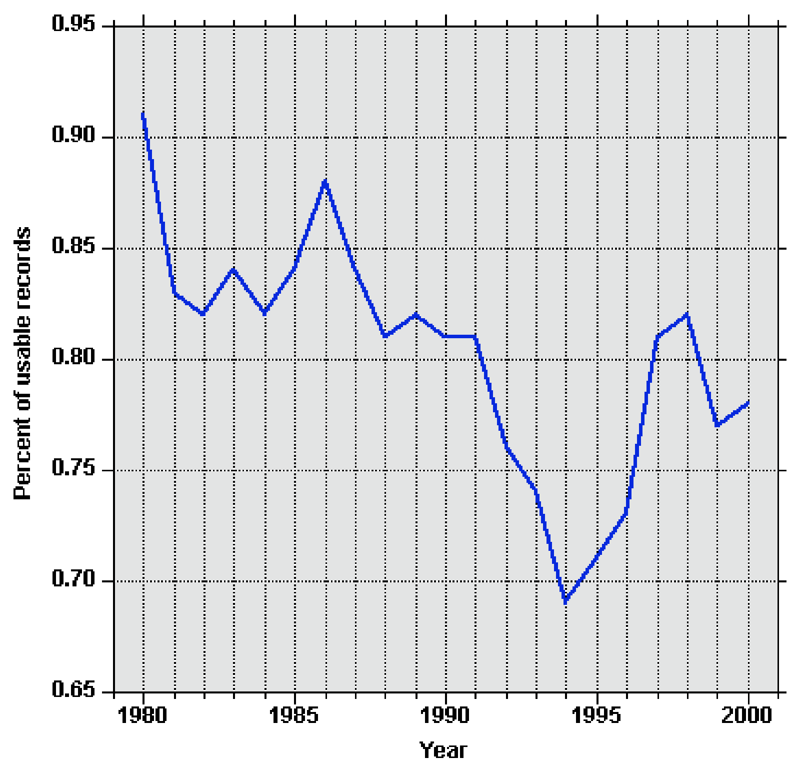

Figure 6. Annual percent number of BLM usable fire records from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000.

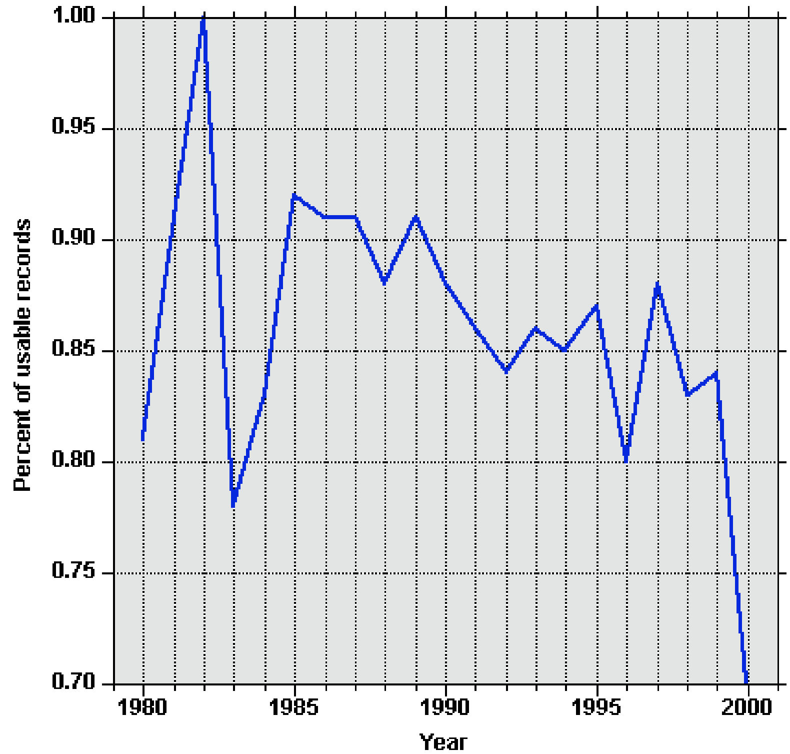

Figure 7. Annual percent number of FWS usable fire records from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000.

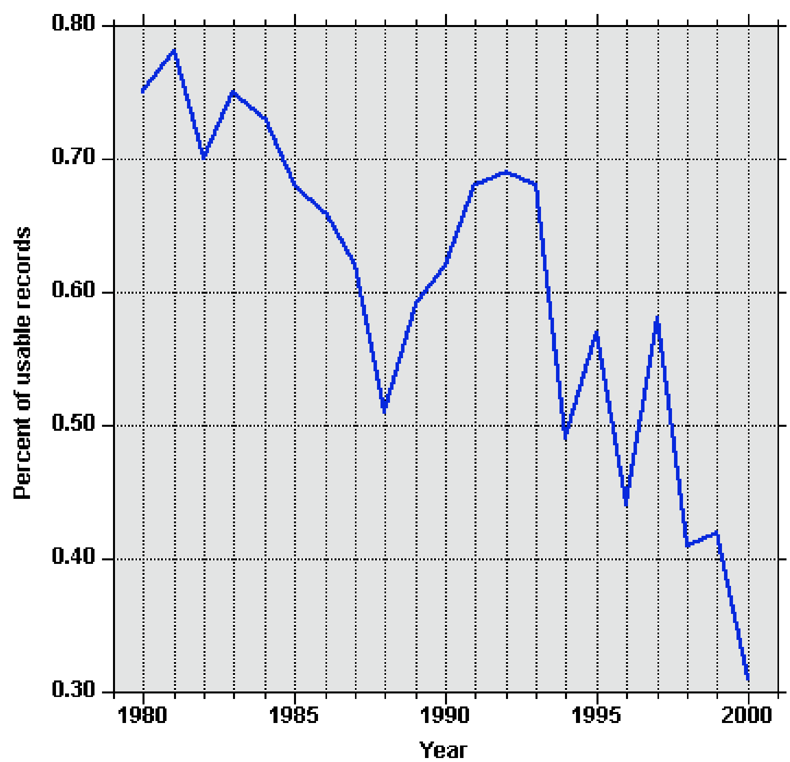

Figure 8. Annual percent number of NPS usable fire records from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000.

A fire report field of interest is the cause of the fire in terms of ignition source. In a broad sense, the ignition of a wildland fire is either caused by a natural factor (most often lightning) or by a human factor (e.g., campfire, smoking, fire use, incendiary, equipment, railroads, juveniles). In some cases, the cause is undetermined, and given a classification of unknown. In the 5100-29 reports there are three fields that can be entered: statistical cause, general cause and specific cause, and in the 1202 reports, general cause and specific cause are provided for. General cause in the 1202 reports is similar in context to statistical cause in the 5100-29 reports, though there are detailed differences. USFS and DOI cause codes are given in Appendix A.

Table 5 provides the percentage of fire by both statistical and specific cause categories for USFS and DOI separately. The upper portion of the table shows the ranked nine categories of USFS statistical and DOI general cause. A tenth code value (0) has been added to indicate those occurrences where no statistical or general cause was given in the original report. These percentages were calculated following our QC flagging process; so only usable fires are incorporated into this analysis.

In the statistical/general cause categories, lightning/natural cause dominates with approximately 54% for USFS and 27% for DOI. This can be interpreted as approximately half of all USFS fires are lightning caused, but only a little over one-fourth for DOI. The percentage of DOI lightning caused fires seems intuitively low, though perhaps our intuition is misguided. Are there physically based reasons as to why DOI should have considerably fewer lightning fires than USFS? None readily come to mind. However, while there may be physical reasons, such as regions prone to “dry” lightning occurrence, the obvious reason may come directly from the records. Nearly 30% of DOI records indicated zero for a statistical cause. In other words, no cause was given. Perhaps a large fraction of this group belongs in the natural category. Unfortunately, there are few means to determine this. One possibility is to count how many times a specific cause of lightning was reported when the general cause was zero. However, there were no occurrences of this combination. The cause information may now be lost forever, and it will “officially” appear through data that DOI has significantly less lightning caused fires than USFS. Perhaps they do, but at present it is difficult to state this with supportive information.

Because there are more categories of specific cause in Table 5 compared to statistical/general cause, the percentage values for this group tend to be smaller in comparison. Lightning has the largest percentage for both USFS and DOI, which should be expected because of the correspondence to lightning/natural occurrence as a statistical/general cause. However, both USFS and DOI percentages seem low given this correspondence. For example, the USFS percentage of lightning is nearly 35%, which is approximately 15% less than that given for statistical cause. These two percentages should be identical, assuming that cause codes were properly entered in the 5100-29 reports. Likewise, DOI percentage of lightning is only 13%, which is approximately half of the general cause natural percent value. DOI does have an additional specific cause under natural, volcanic, but it is unlikely that this accounts for 13% of all natural fires (less than .01% was actually reported for specific cause of volcanic which intuitively seems reasonable).

Table 5. Percent of USFS and DOI wildland fires by statistical/general and specific cause. The statistical and general cause categories are ranked by percent occurrence.

USFS			DOI		
Code	Statistical cause	Percent	Code	General cause	Percent
1	Lightning	54.01	0	Zero	28.30
7	Arson	10.91	1	Natural	27.44
4	Campfire	12.02	4	Fire use	10.39
9	Miscellaneous	7.51	9	Miscellaneous	9.98
3	Smoking	5.19	5	Incendiary	7.75
5	Debris burning	3.94	8	Juveniles	5.22
2	Equipment use	3.31	2	Camp fire	3.66
8	Children	1.93	6	Equipment	3.53
6	Railroad	1.18	3	Smoking	2.83
0	Zero	.00	7	Railroads	.91
Code	Specific cause	Percent	Code	Specific cause	Percent
1	Lightning	36.51	1	Lightning	13.10
2	Aircraft	0.08	2	Aircraft	.08
3	Burning vehicle	1.10	3	Vehicle	1.51
4	Exhaust-power saw	0.38	4	Exhaust – power saw	.82
5	Exhaust-other	0.86	5	Exhaust – other	.14
6	Logging line	0.05	6	Logging line	.02
7	Brakeshoe	0.66	7	Brakes	.51
8	Cooking fire	4.02	8	Cooking fire	3.50
9	Warming fire	4.31	9	Warming fire	.09
10	Smoking	4.05	10	Smoking	2.87
11	Trash burning	0.82	11	Trash burning	3.96
12	Burning dump	0.33	12	Burning dump	.95
13	Field burning	0.27	13	Field burning	1.95
14	Land clearing	0.30	14	Land clearing	1.26
15	Slash burning	0.79	15	Slash burning	.72
16	Right-of-way burning	0.21	16	Right-of-way burning	.17
17	Resource management burning	0.15	17	Resource management burning	1.65
18	Grudge fire	1.94	18	Grudge fire	.92
19	Pyromania	2.76	19	Recurrent	4.54
20	Smoking out bees or game	0.27	20	Smoke out bees/game	.07
21	Insect/snake control	0.04	21	Insect/snake control	.02
22	Job fire	0.08	22	Employment	.04
23	Blasting	0.06	23	Blasting	.04
24	Burning building	0.41	24	Burning building	.38
25	Power line	0.64	25	Power line	.62
26	Fireworks	0.45	26	Fireworks	1.43
27	Playing with matches	1.17	27	Ignition devices	4.10
28	Repel predatory animals	0.02	28	Repel predators	.03
29	Stove fuel sparks	0.11	29	House/stove flue sparks	.35
30	Other	4.54	30	Other (unknown)	10.9
	Zero	32.62	31	Volcanic	.00
			32	Other (known)	.35
				Zero	43.13

The most likely reason for this discrepancy is that both USFS and DOI have large percentages of no report (zero) for specific cause (approximately 32% and 43%, respectively). These high percentages are probably due to a decision during data entry that when lightning or natural was indicated as a statistical/general cause, there was no need to also indicate a lightning specific cause. For both USFS and DOI, adding the zero code percentage to the lightning specific cause percentage yields values larger than those given for lightning/natural statistical/general cause. Specifically for USFS, specific cause 0 summed with specific cause 1 yields a value of approximately 69% that is larger than the 54% shown for statistical cause one. Likewise for DOI, specific cause 0 summed with specific cause 1 yields a value of approximately 54% that is larger than 27% shown for general cause one. This implies that other specific cause categories have been omitted for both USFS and DOI, and thus putting into question the accuracy of any of the specific cause values. Perhaps the percentages can be used for relative comparison (e.g., ignition by smoking occurs more frequently than ignition by fireworks), but it is not known if there are other consistent specific cause category omissions.

Finally, it has been suggested via various personal communication that the DOI other (unknown) specific cause category can be considered a lightning cause. The justification for this is that if a human cause was not determined, then it was probably lightning. The percentage of other unknown (10.90%) plus the lightning percentage (13.10%) does yield a sum close to the statistical cause value for natural (27.44%). However, we are not convinced that using unknown counts in this context is a prudent action to take, especially given the other quality control issues seen in the dataset. Our recommendation would be to not include other unknown cause with lightning cause.

Table 6 shows the total number of federal fires by coarse cause (natural or human) during the period 1970-2000. The number of DOI fires is less than USFS in part because DOI reporting was not continuous for most of the 1970s. A natural cause is counted when the statistical/general cause is 1 and the specific cause is 1 or 0. We make the assumption here that for the latter case, the specific cause was left blank when natural was indicated as a statistical cause. Volcanic activity is also considered natural, however, this occurred only .003% of the time. Thus, for all practical purposes, a reference to a natural fire refers to lightning. This table is provided as simply a quick summary of coarse cause.

Table 6. The number of usable federal fires based on coarse cause during the 1970-2000 period.

	Natural caused fires		Human caused fires		
	Number	Percent of total (%)	Number	Percent of total (%)	Totals
USFS	175004	54.0	149118	46.0	324,122
DOI	58,824	27.4	155,863	72.6	214,687
Totals	233,828	43.4	304,981	56.6	538,809

Figure 9 shows the point locations of western U.S. natural fire occurrence based on the usable federal records. The West is highlighted here due to the frequent occurrence of "dry" lightning over the region. The map shows that lightning caused fires can occur virtually anywhere across the West where there is available fuel. Some areas are clearly preferred locations of lightning fires, such as the Mogollon Rim in Arizona, the Sierra Nevada Range and the northern Rockies. Some of the areas showing minimal activity may be state or local jurisdiction from which data are not included in this report, or areas not prone to lightning caused fires due to the lack of fuel availability.

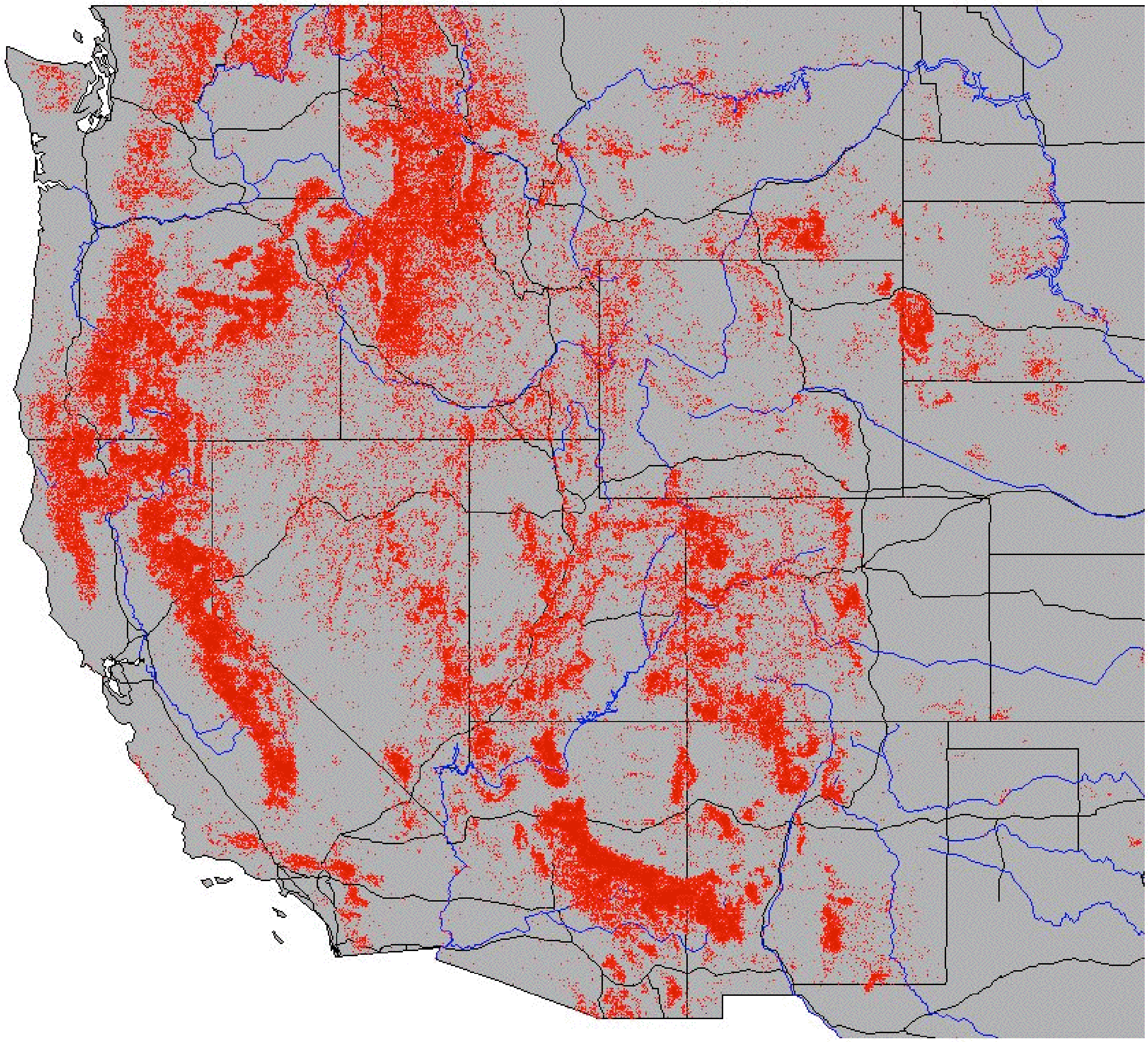

Figure 9. Point locations of coarse quality controlled western U.S. natural caused wildland fires (red symbols) from the federal fire occurrence database for the period 1970-2000. Also shown are some reference interstate highways (black) and rivers (blue).

Figure 10 shows locations of western U.S. fire starts due to human ignition sources. In general, many of the fire locations are similar to those caused by lightning. However, there are patterns on this map unique to human influence. For example and not surprisingly, there is a tendency for fires to occur along roads and rivers, paths taken by smokers and recreation enthusiasts. Many of the fire locations on the map are not far from urban centers, as highlighted in southern California and the Sierra Nevada Range.

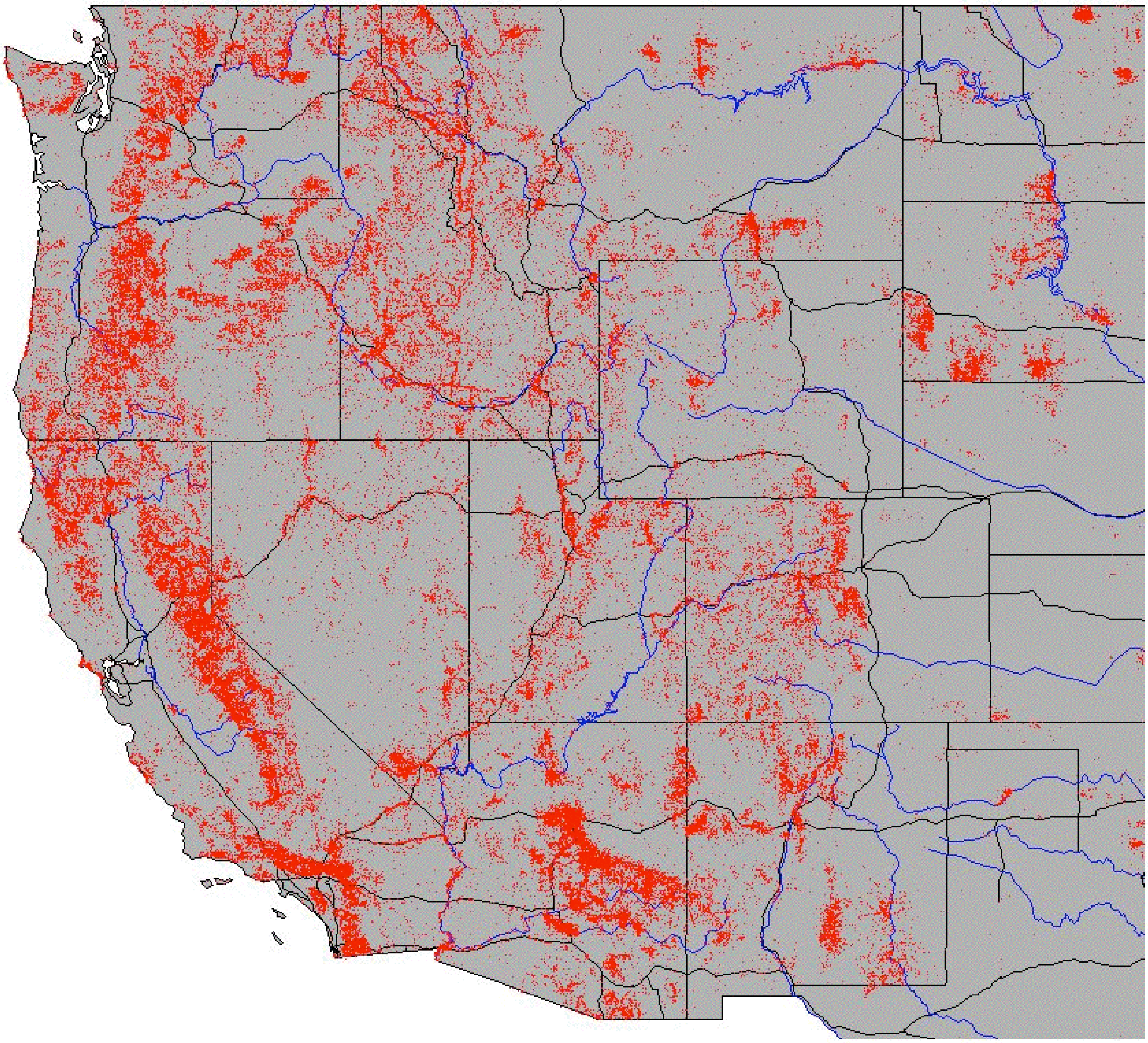

Figure 10. Point locations of coarse quality controlled western U.S. human caused wildland fires (red symbols) from the federal fire occurrence database for the period 1970-2000. Also shown are some reference interstate highways (black) and rivers (blue).

Figure 11 shows the percent occurrence of lightning caused fires across the western U.S. The percentages are based on a one-half degree spatial resolution grid overlain across the region. The number of lightning fires within each grid cell during the 31-year period is counted, and this sum divided by the total number of fires within the grid cell. The percentages are shown as shaded contour intervals. Several areas show a dominance of lightning caused fires such as southeast New Mexico, western Colorado, central Great Basin, central Oregon, central Idaho and eastern Montana, where percentages exceeding 80% are common (red color areas). These same regions can be qualitatively recognized by visually comparing Figures 9 and 10. Conversely, the highest percentages (> 80%) of human caused occurrence are primarily along the coast, and in southern California (blue color areas). There appears to be a high correlation between human caused fires and nearby population density, as might be expected. Despite the earlier noted issues with DOI lightning cause data, these percentages may be generally acceptable because they indicate relative comparative values between natural and human caused fires. For example, those areas showing a high percentage of lightning fires implies a lower occurrence of human fires, such that even if the lightning fires are underreported, there are still more lightning counts than human cause counts. However, this does not resolve the possibility that for a particular region, the lightning counts are reasonably accurate, but the human counts are under-reported. In other words, both types of cause likely have reporting issues, but in a relative sense, the differences in counts between the two may be similar and this will not overly bias the percentage comparison.

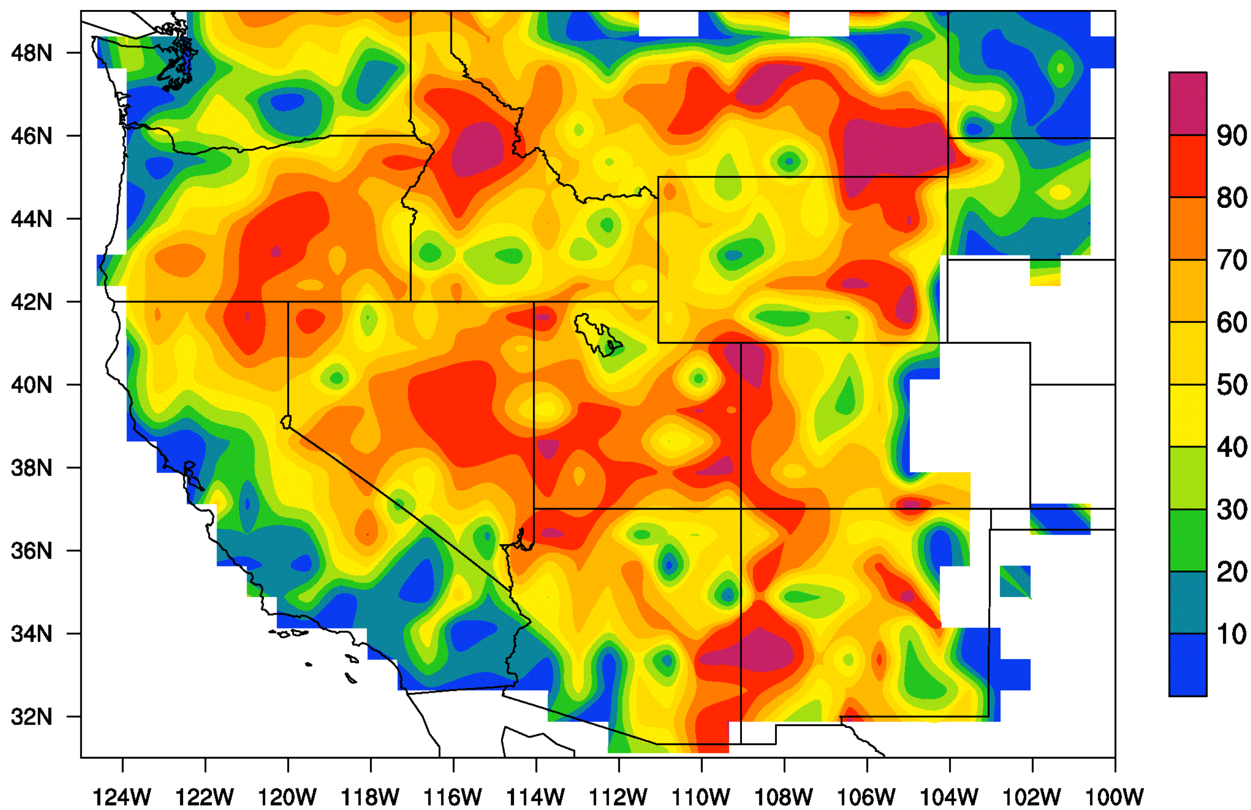

Figure 11. Percent of coarse quality controlled western U.S. federal wildland fires caused by lightning for the period 1970-2000.

As with spatial fire characteristics, there are temporal patterns of interest in the understanding of historical fire occurrence. Figure 12 shows the annual number of USFS and DOI fires in the western U.S. for the region corresponding to the maps above. Several patterns are readily apparent in both time series. First, interannual variability is large as shown by the year-to-year fluctuations in the number of fires. USFS and DOI have reported as few as 4,500 fires in a single year, and as high as 12,500 fires. Some periods seem to be more variable than others. For example, the late 1980s in the USFS series show relatively little change, while most of the 1990s have substantial variability.

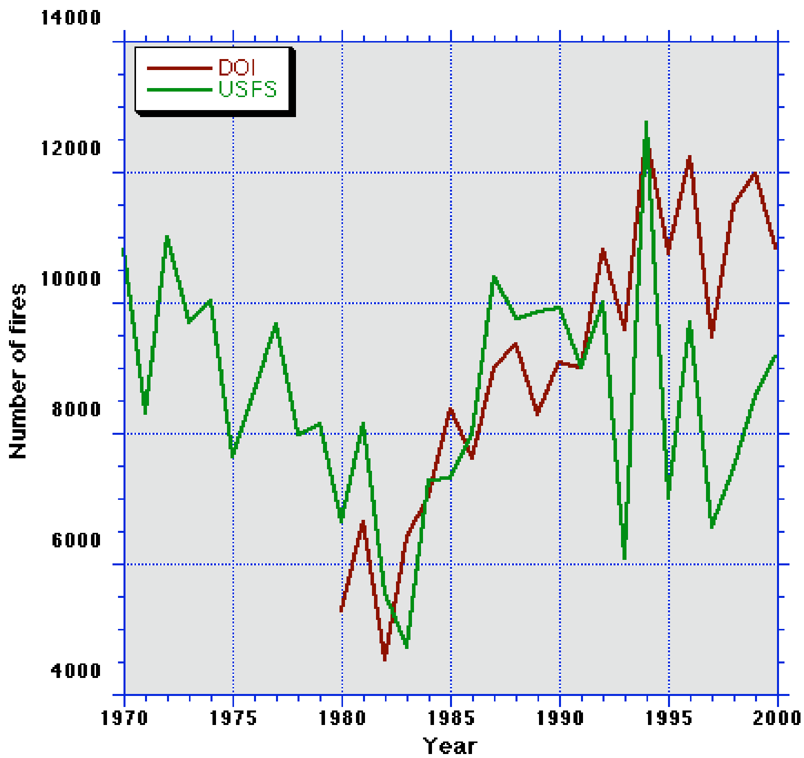

Figure 12. Time series plots of the annual number of USFS (green line) and DOI (brown line) fires in the western U.S. for the region shown in Figure 2.

Trend is another statistical attribute that can be seen in both series. A decreasing trend is seen in the USFS series until 1983, then appears to increase for the next four years, with no trend for the remainder of the period. The variability during the 1990s appears larger than during the trend periods. A DOI series trend is more obvious from the beginning of the record until around 1996. The variability in the DOI series is substantially reduced compared to the USFS series.

Some revelation about the patterns in Figure 12 can be acquired by separately examining yearly values of natural and human caused occurrence. Figure 13 shows the annual number of fires in the western U.S. caused by lightning. The pattern in the USFS series corresponds quite well to that shown in Figure 12 in terms of the both the trends and variability previously discussed. However, there appears to be no trend in the DOI series corresponding to that shown in Figure 12, with the exception of a small trend during the 1982-1987 period.

A very different pattern emerges when plotting fire occurrence for human caused fires only (Figure 14). For this case there is little trend in the USFS series, but a substantial trend in the DOI series. At first thought, this trend might be suggestive of human encroachment on DOI managed land. However, there may be other factors involved here, such as changes in vegetation characteristics increasing the probability of fire occurrence whether or not there were substantial changes in human activity. A more disappointing factor would be data quality issues as discussed earlier that generate an artificial trend.

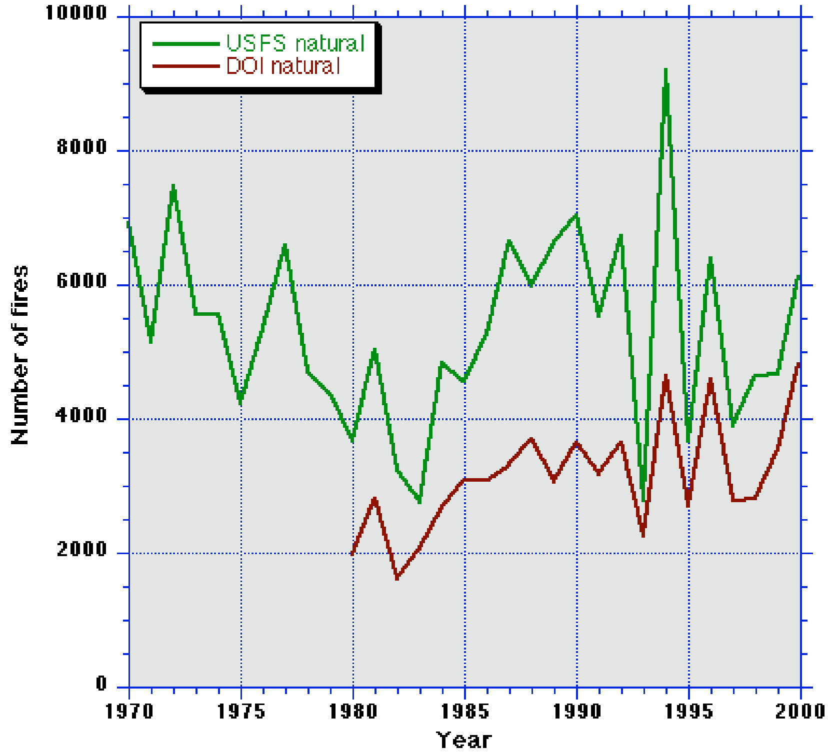

Figure 13. Time series plots of the annual number of USFS (green line) and DOI (brown line) fires caused by lightning activity in the western U.S. for the region shown in Figure 2.

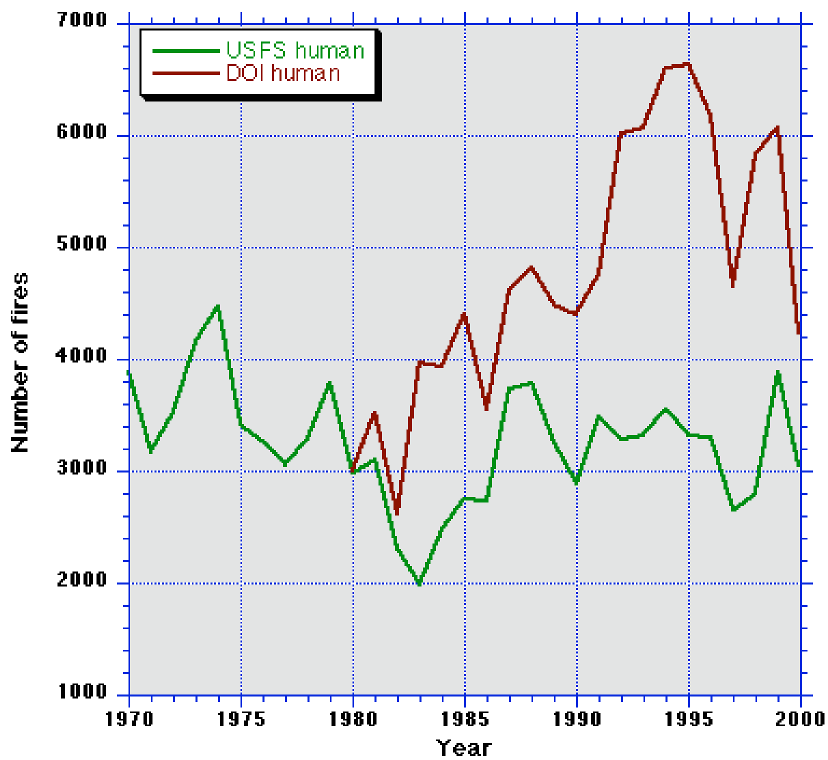

Figure 14. Time series plots of the annual number of USFS (green line) and DOI (brown line) fires caused by human activity in the western U.S. for the region shown in Figure 2.

Other simple statistical information of interest regarding fire occurrence can be gleaned from this dataset. For example, local fire managers know well in their area of responsibility the times of the year when the fire season begins, when the bulk of activity occurs, and when the season ends. Figure 15 shows contours of the median date of first occurrence for natural and human caused fires combined (based on the calendar year beginning January 1). These contours utilize the same grid scheme used for Figure 11. In general, and not surprisingly, fire occurrence begins earlier in the warmer southwest region (e.g., February, March and April dates) compared to further north. For much of the West, early June or July dates are common. However, even in the north, fire occurrence is typical in early May for several areas of Montana and Washington, perhaps in part related to agricultural or rangeland burning. Despite the use of a grid and some contour smoothing, there is considerable spatial variability in the date of first occurrence. This is due to the combination of climate, human and topography factors.

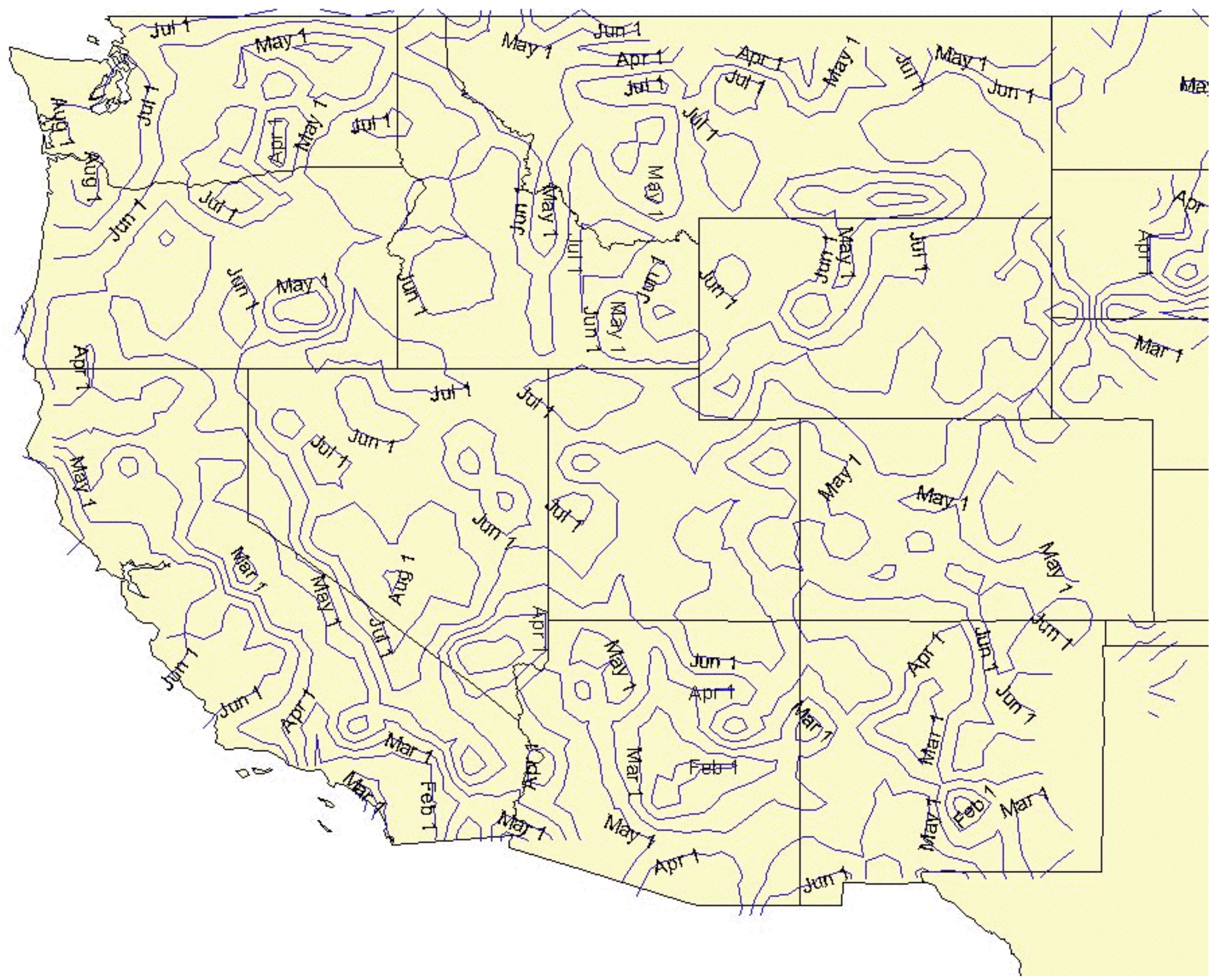

Figure 15. Median date of first fire occurrence for natural and human caused fires combined from the coarse quality controlled western U.S. federal wildland fire database for the period 1970-2000.

Natural caused fire occurrence dates will obviously correspond closely to the seasonal cycle of lightning. Figure 16 shows that over most of the West, the first median date is late June or early July. The southwestern area typically has a start date of May or early June. There is less spatial variability for natural occurrence primarily because the lightning season onset is more uniform across most of the West compared to the variety of potential human causes.

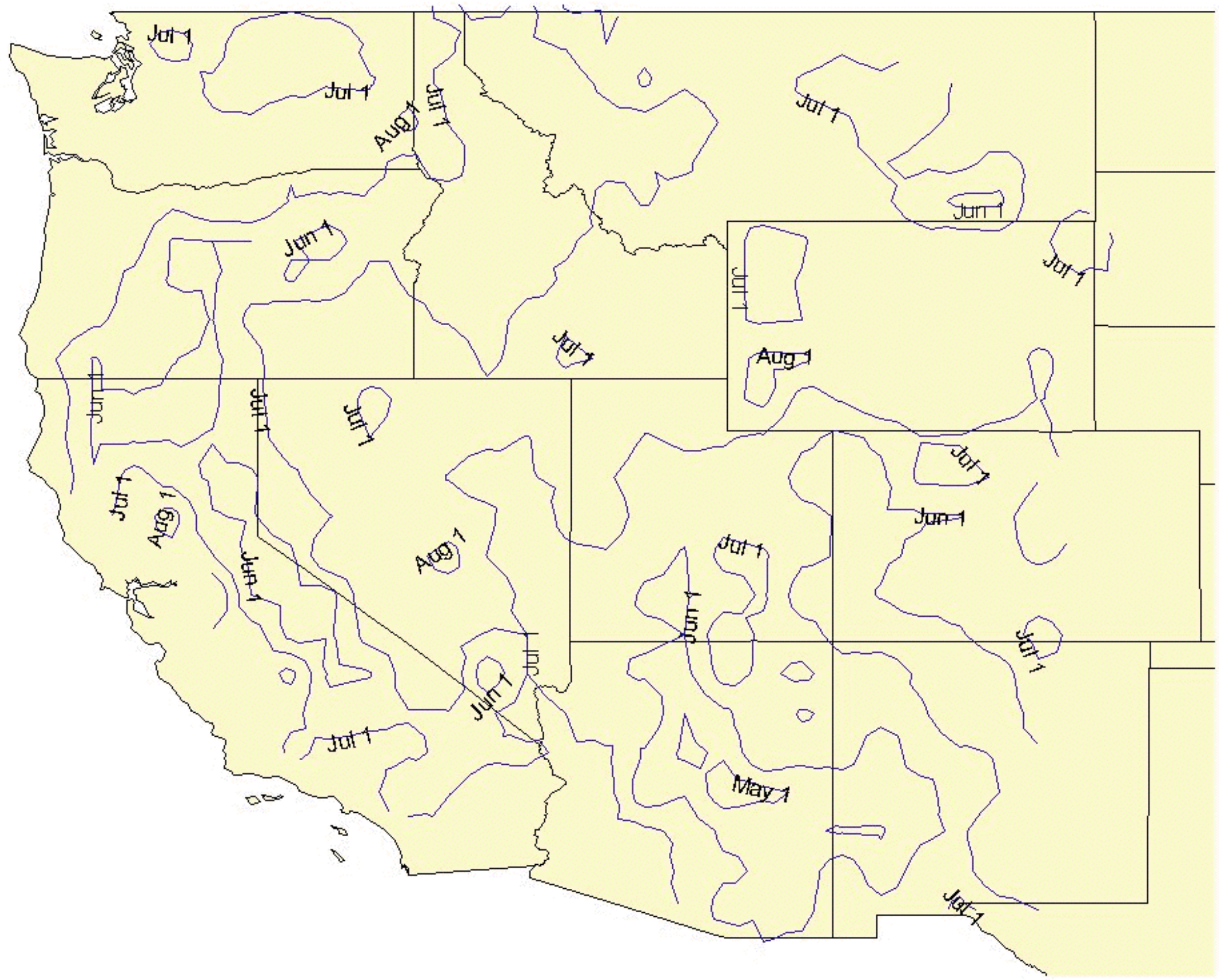

Figure 16. Median date of first fire occurrence for natural caused fires from the coarse quality controlled western U.S. federal wildland fire database for the period 1970-2000.

The U.S. seasonal cycle of fire occurrence helps identify, from a national perspective, when the bulk of activity will typically occur. Figure 17 shows a histogram of the number of U.S. fires for each day of the year for the period 1970-2000. The plot indicates that fires have occurred on every day of the year. As expected, low counts are observed during the winter months and the high counts are during summer. The peak counts are in July and August. The increase in counts during spring (April and May) is primarily due to a combination of southeastern and southwestern U.S. regional occurrence. The general upward trend of fires from winter to spring and the downward trend from fall to winter is quite modest in contrast to the sharp increase in the number of fires around the beginning of summer followed by the sharp decrease around the beginning of fall. This pattern defines the climatological annual cycle of fire occurrence for the U.S. as a whole, but masks out regional trends and patterns that can be substantially different. For example, typical fire seasons vary by location such as late winter and spring in the Southeast, a bimodal spring and fall season for much of the East, and spring and early summer in the Southwest.

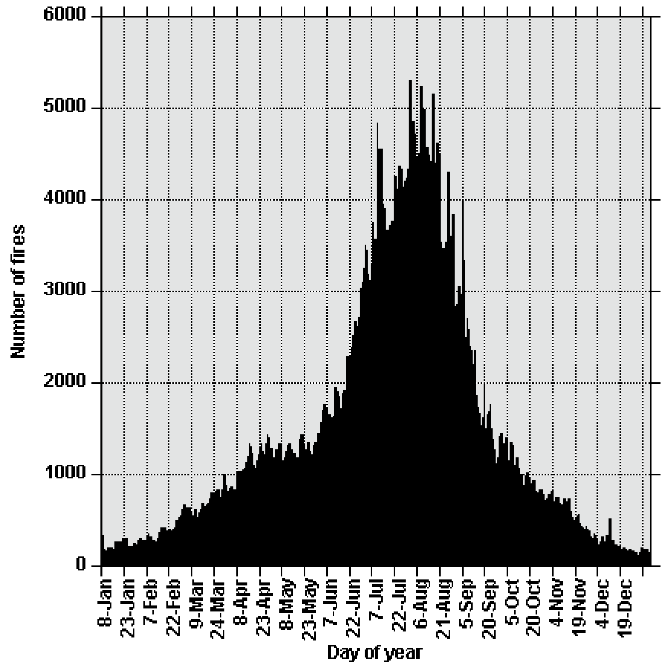

Figure 17. A histogram plot of the total number of federal fire starts by day of year fires from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000.

The number of acres burned is a tricky element for many analyses because it is highly dependent on numerous physical and management factors. For example, in order to get large acres burned, there must be sufficient dry fuels resulting from weather and climate conditions. On the other hand, the initial attack response, suppression strategies and available resources can dictate the final size of a fire. Figures 18 and 19 shows cumulative distribution function plots of acres burned for USFS and DOI, respectively, based on the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000. The acre values were not checked as part of the QC process. Without a cross-reference to the original paper records, there is little one can do in terms of a check, with perhaps the exception of verifying fires that seem excessively large. There are a large number of records with a value of zero reported for size. The intent in the recording may have been to indicate a small fire (e.g., less than one acre) simply with a zero, however, the value puts into question as to whether or not any information was entered for size. In a large percentage of cases, 0.1 acres was given, which at least indicates a small fire of non-zero size.

The plots indicate that there are differences in fire size distribution between USFS and DOI. There perhaps might be differences between the individual DOI agencies, though this was not examined. Nearly 60% of all DOI fires have been one acre or less, with a contrasting 80% for USFS fires. The commonly used large fire definitions of 100 acres for USFS and 300 acres for BLM occur around the 97th and 95th percentiles, respectively (though keep in mind that this plot is all DOI agencies combined). These values indicate that statistically, large fires by definition are not common, even though they might be newsworthy. The largest fire sizes given in the dataset are 606,940 and 427,680 acres for DOI and USFS, respectively. From recent national experience, a USFS fire size of 400,000 acres is certainly possible. We have not followed up on the reliability of the 600,000 acres in the DOI report.

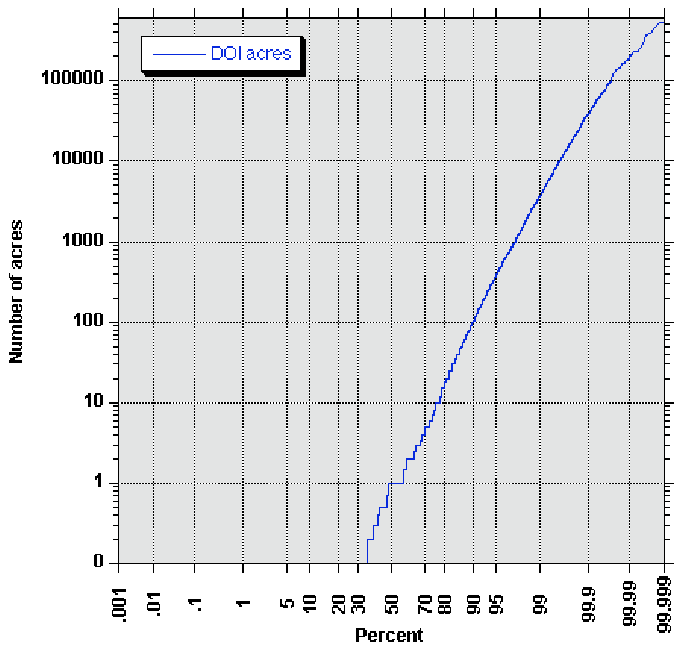

Figure 18. Cumulative distribution function for DOI natural and human caused fires from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000. The number of acres is from the "usable" flagged records. The y-axis is plotted as the log number of acres.

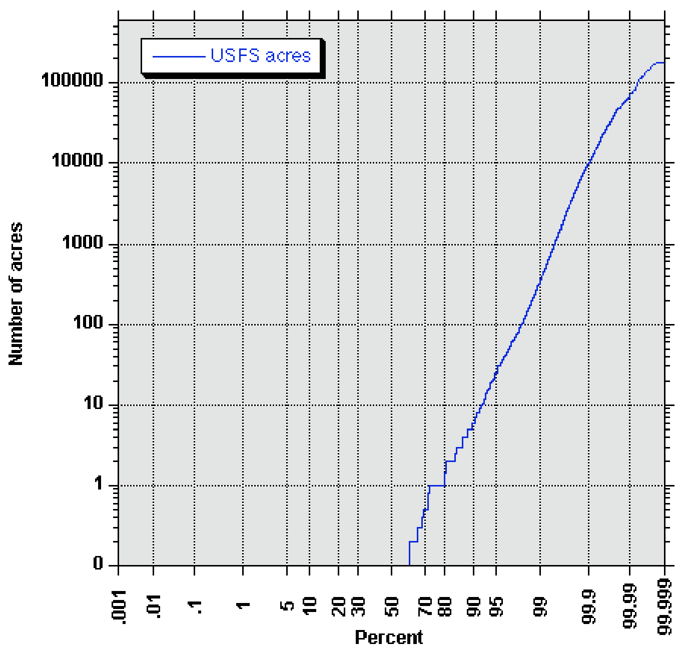

Figure 19. Cumulative distribution function for USFS natural and human caused fires from the coarse quality controlled U.S. federal wildland fire database for the period 1970-2000. The number of acres is from the "usable" flagged records. The y-axis is plotted as the log number of acres.

Discussion and Recommendations

Results from the coarse analysis indicate that a large percentage of federal fire occurrence records *seemingly* can be used for a variety of management and scientific studies. This statement emphasizes the word "seemingly" because a more detailed analysis could reveal hidden issues not readily apparent. For example, the quality of the data entry process from paper records to electronic format is not known. The need for quality data will depend largely on the needs of the analyst. A rigorous scientific study requires the highest level of quality possible in order to reduce uncertainties associated with the result. On the other hand, a simple accounting analysis may require information on whether or not there was a fire, without regard to the date of occurrence, location or cause.

Previous shown Figures 12 through 14 provide a time series of the annual number of fire starts that can be used as an example possibility of how poor quality data can affect a result. The series exhibit variability as would be expected and in some cases trend for both USFS and DOI. Are these trends real, or do they reflect something in the quality of the records? Trends can come about because of a data issue, rather than a physical phenomenon. The plots do not readily reveal inhomogeneities, such as sudden changes in occurrence recording or data entry, but indeed there may have been changes that are not obvious by simple visual examination of the series. Changes in the method of recording fires, or the process of converting paper records to digital form can create patterns that could unknowingly and falsely be interpreted as physical phenomena. For example, did the policy of recording fires change in a manner at some point in time that would yield the upward trend in occurrence apparent in the DOI human cause series? Perhaps the digital data entry process itself has caused variability or trend patterns. We have heard, but not confirmed, that some fire occurrence records were digitized in the 1980s utilizing a prisoner workforce. But we cannot speculate one way or the other as to the quality of the digitizing. It would be quite helpful to find documentation of this process to assess its reliability in a scientific manner.

The largest overall problem found as a result of the analysis was numerous incomplete records. This consisted primarily of missing location or date and missing or incomplete cause codes. Ultimately, 10% of USFS and nearly 30% of DOI reports had to be flagged as non-usable due to problematic spatial or date reference. This represents over 100,000 fires. Very high percentages of specific cause codes were missing. Though it is speculated that a large fraction of these are lightning, it raises the question of reliability of counts for any cause code statistic. Incomplete records yield overall questionable results. For example, the DOI percent of lightning caused fires seems intuitively low, and may be a result of problematic occurrence recording.

The fact that Figures 5 through 8 show downward trends in the quality of DOI fire records indicates that issues of quality data are not simply a problem of the past. Though this trend is not present in USFS records, it must be assured that this will not be the case. There are numerous quality control and assurance aspects of fire data observation and recording that need to be addressed today, and maintained into the future.

There is a very high degree of importance of quality fire occurrence information for both management assessments and scientific analyses. However, without quality data, the results may be misleading, low in confidence, or not achievable. As land management agencies are required to become more accountable for their decisions, this is going to have to be supported by quality information. Quality should be the highest priority for the most important data that a fire management agency can utilize – fire occurrence.

From our perspective, we offer the following discussion and recommendations for consideration in improving and maintaining a national fire occurrence database.

1. Quality control – This refers to a process of data quality control, both historically recorded and the process of recording. An historical database can be assessed regarding its quality using a range of simple to very detailed processes. Though time consuming and tedious, a simple process might be a coarse analysis such as this report describes. But in comparison, a detailed study could manually examine every record, perhaps cross-checking with the original paper copies if they still exist. This task could be minimized from the analysis of a random sample of original paper copies, and subsequent correlation with their electronic counterparts. The statistical probability results would reveal information about the data entry quality.

But some information is simply lost. For example, how can one determine the accuracy of the fire location written on the original paper record, or similarly, how can one go back and change the specific cause of a fire 20 years ago. The best that can be done is to ensure quality of the original observation itself, before it gets entered into the database. Certain tools might aid in the process, such as GPS for pinpointing location, but even here the GPS device has to be functioning properly and the readings have to be transcribed correctly. Incomplete records also lead to lost information. For all of the incomplete specific cause records discussed in the previous section, it is doubtful that these can be recovered.

To ensure quality fire occurrence records, there must be reasons or incentives to establish and maintain a quality database. It needs to be understood that these records are no longer just for money tracking purposes; that there are indeed a multitude of reasons for a quality database – for both management and scientific uses. The most important one for now may be the justification of the way of doing fire business and agency accountability. Can federal wildland fire agencies point to a national database of fire occurrence and say with confidence that the management decisions being made are based on quality data?

Our recommendation is that the federal fire agencies work on both a comprehensive quality historical database and a process for improving the quality of the original observation.

2. Agency standardization – In examining the historical database it did not take long to realize that different agencies do business in different ways. One example would be the inconsistent method of recording a fire location, such as latitude/longitude versus TRS versus UTM coordinates. The most obvious discrepancy is the statistical/general cause description differences between the USFS and DOI agencies, though the specific cause descriptions are effectively consistent. A fully logical reason as to the need of substantial differences between agencies in how data are recorded is not obvious.

Our recommendation is that the federal fire agencies create and adopt a uniform recording procedure for fire occurrence across all agencies, and encourage states to utilize the same method.

3. Timeliness – It can take a few months after the end of a calendar year for fire reports to be entered into the federal electronic databases. For studies of historical fires, this is probably not a critical issue. However, it seriously inhibits within season analyses related to assessments or planning. It may be desirable to perform some scientific tracking of fire activity and real-time studies as to how this activity might be related to physical elements such as within the atmosphere or an ecosystem. Thus, it would be highly desirable to have real-time access to fire occurrence information.

Our recommendation is that the federal fire agencies create and adopt a system for improved real-time additions to a national fire occurrence database that can be readily accessible.

4. Metadata – Metadata is information about the data. It is crucial for scientific analyses so that the researcher can understand the processes of observing, recording and archiving the data. It can be important for fire management too, such as in answering a question about how a particular process was done. For example, if fire reporting forms have changed over the years, when and in what way? If there was a mass data entry process by prisoners or some other work force, when did this take place, and what was the quality assurance process utilized? For non-fire users of these data, are the field codes well documented and readily available (e.g., it seems that BLM cause codes are only available on the web to agency personnel)? Have any quality control processes of historical fire data been well documented? The list of important metadata can be quite lengthy.

Our recommendation is that the federal fire agencies undertake a process of acquiring and documenting appropriate metadata to make readily available in support of the current historical and future national fire occurrence database.

5. Database basics – The good information currently in the federal databases is of high value. This information provides resolve for many of the fundamental questions related to fire business, such as when, where, how, who and perhaps hints at why, though this is primarily a philosophical question. No doubt though, even all of the current information is probably not complete for all of the specific questions and issues that have been or might be raised in the future. The primary database question might then be; does the information in the existing database, even if it were of high quality, address all of the current and potential issues of fire business?

Our recommendation is that a national workshop be organized to address the various issues and aspects of a national fire occurrence database, comprised of both management and scientific representatives, to establish fire occurrence information needs.

6. A database for all – No one really knows all of the uses of a fire occurrence database, because many of these uses have not yet been foreseen. But an examination of activity for recent

years would reveal a number of diverse uses and analyses including budgetary accounting, fire danger, weather and climate relationships, suppression resource requirements, fire use planning and impressing on congress and the public that there is a national fire problem. Scientists know well that the best means to ensure the gaining of knowledge for everyone's benefit is through open data sources. This is a policy that the fire agencies should adopt. No one is suggesting that the fire information is or has been a secret. But the lack of a comprehensive, well documented, and readily available database basically has the same impact of a secret database. Despite its high potential value, the difficulty in acquiring the information has a negative impact on society.

Our recommendation is that a national interagency wildland fire occurrence database be established that is readily available to both fire management agencies and the public.

There are likely specific recommendations that other agency personnel and scientists could offer, including our own additional ones over time as analyses proceed. In the meantime, we hope that NWCG and others finds this list intriguing and useful for starting discussion on the future of national wildland fire occurrence data.

Deliverables

The NIFMID and SACS databases contain numerous descriptor fields about the fire occurrence. In NIFMID there are up to 60 fields that can be reported such as unit id, cause, and total area burned. In SACS there are up to 170 fields that can be reported, many similar to NIFMID, but others that might be used with a prescribed fire for example. However, after we downloaded these data, we did not extract out all of the fields. Our subset of interest included those fields given in Table 7. We then performed a QC analysis only on fields that were related to either temporal or spatial reference. Thus, there are potentially 230 fields for which a QC analysis could be performed if desired. The list in Table 7 may be expanded in the future, but for now simply reflects our current project needs.

Table 7. Field types retained from NIFMID and SACS fire occurrence databases combined for the coarse quality control analysis.

Field	Field Description
1	Latitude
2	Longitude
3	Fire discovery date
4	Total area burned (acres)
5	Statistical/general cause
6	Specific cause
7	State
8	Agency
9	Flag

In addition to this report, our deliverables consist primarily of two products – the flagged dataset and graphics from this report. The flagged dataset will be made available once our planned internal analyses are complete. Contact the individuals in the forward of this report for information. We plan to make available during January 2003 on the CEFA web site all of the graphics from this report. These plots may be freely used for presentations, reports, and discussion, though we request that CEFA and/or this report be referenced in conjunction with the information usage. The graphics will be available in the education section of the CEFA web pages (http://cefa.dri.edu).

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Appendix A

USFS and DOI cause codes for wildland fire occurrence. USFS codes are from the Firestat User's Guide, Version 5.2, Appendix A, January 2002. DOI codes are courtesy of Susan Goodman at the BLM National Science and Technology Center, and Corey Grant at the National Interagency Fire Center. BLM codes are apparently not published except at an agency web site for internal use only. However, there is very close agreement in codes with those reported in the National Park Service Fire Occurrence Users Guide V.1.25.0030, November 26, 2001. The primary differences between BLM and NPS are 1) BLM specific cause 4 is exhaust, while NPS subsets powersaw exhaust (code 4) and other exhaust (code 5), 2) BLM lumps together cooking and warming as code 8, while NPS separates these into codes 8 and 9, respectively, and 3) NPS uses codes 20 and 21 for smoking out bees/games and insect/snake control, respectively, which are not indicated as BLM codes. Combining BLM and NPS codes allows for a nearly direct match with USFS, except for some slight differences in naming convention and codes 30 through 32. USFS code 30 represents other, whereas DOI subsets this into other – unknown (code 30) and other – known (code 32). Additionally, DOI code 31 represents a volcanic cause. The final primary difference between USFS and DOI is that USFS uses three cause categories – general, statistical and specific, while DOI only uses two cause categories – general and specific. There are several substantial differences between the USFS statistical and DOI general cause codes.

USFS general cause.

Code	Description
1	Timber harvest
2	Harvest other products
3	Forest/Range management activities
4	Highway
5	Power, reclamation
6	Hunting
7	Fishing
8	Other recreation
9	Resident
0	Other

USFS statistical and DOI general cause.

Code	USFS	DOI
1	Lightning	Natural
2	Equipment use	Camp fire
3	Smoking	Smoking
4	Campfire	Fire use
5	Debris burning	Incendiary
6	Railroad	Equipment
7	Arson	Railroads
8	Children	Juveniles
9	Miscellaneous	Miscellaneous

USFS and DOI specific cause

Code	USFS	DOI
01	Lightning	Lightning
02	Aircraft	Aircraft
03	Burning vehicle	Vehicle
04	Exhaust-power saw	Exhaust – power saw
05	Exhaust-other	Exhaust – other
06	Logging line	Logging line
07	Brakeshoe	Brakes
08	Cooking fire	Cooking fire
09	Warming fire	Warming fire
10	Smoking	Smoking
11	Trash burning	Trash burning
12	Burning dump	Burning dump
13	Field burning	Field burning
14	Land clearing	Land clearing
15	Slash burning	Slash burning
16	Right-of-way burning	Right-of-way burning
17	Resource management burning	Resource management burning
18	Grudge fire	Grudge fire
19	Pyromania	Recurrent
20	Smoking out bees or game	Smoke out bees/game
21	Insect/snake control	Insect/snake control
22	Job fire	Employment
23	Blasting	Blasting
24	Burning building	Burning building
25	Power line	Power line
26	Fireworks	Fireworks
27	Playing with matches	Ignition devices
28	Repel predatory animals	Repel predators
29	Stove fuel sparks	House/stove flue sparks
30	Other	Other (unknown)
31		Volcanic
32		Other (known)