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MAN-CAUSED
FOREST FIRES
IN MONTANA

1946-1956

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Man-Caused Forest Fires in Montana

(1946 - 1956)

Man's use of forested areas in Montana has doubled during the past decade, and half a million dollars is being spent every year on forest fire prevention. The money is being used for public contact activities, radio and television time, educational work, and posters. This expenditure is directed primarily toward the prevention of man-caused fires. Still, 230 man-caused fires occur every year in Montana, burning an annual area of 5,000 acres. This loss is far too great to be tolerated.

It is difficult to place an exact monetary value of the loss because; not only is merchantable timber destroyed, but also the reproduction—crop of the future. The forest environment suffers because the soil is made less stable and erodes more easily. Loss to forest industry alone from forest fire is considerable. The average yearly income from primary forest products in Montana recently has been 15 million dollars, which is a substantial portion of the income of the state. If the income from forest products is to be increased at a rate necessary to keep pace with population increases, then all the forested areas must be kept in a productive condition.

It is the purpose of this analysis to show where the greatest concentration of man-caused fires exists in Montana, and to show what human activity causes them. The period under study is 1946 through 1956, eleven years.

Knowledge of specific areas where concentrations of man-caused fires occur, and the class of people causing them will benefit the agencies charged with responsibility for fire protection. This knowledge will enable these agencies to better concentrate their fire prevention campaign efforts toward the specific human activity responsible for fires.

The analysis revealed that concentrations of man-caused fires occurred in the following areas:—

East of Missoula (Clark Fork and Blackfoot River drainages)

North and northeast of Flathead Lake

Northwest of Anaconda

The **careless smoker** caused the greatest number of fires.

Source of data

Data for this analysis were obtained from fire occurrence records of the following agencies who protect forest lands in Montana from fire:—

Office of Montana State Forester

Responsible for Protection and Management of:—

Stillwater unit northwest of Whitefish.

Bigfork unit north and east of Bigfork.

Swan unit in the upper Swan River east of Flathead Lake.

Forest Protective Associations

These associations are charged with the responsibility of protecting forest lands from fire. Most of these lands are in private ownership, though some state & federal land is protected in this manner under contract. The associations are responsible to the Office of the State Forester.

Anaconda Fire Protection Service (A.F.P.S.)

This association, a part of the Anaconda Company, is charged with the responsibility of protecting forest lands from fire within a block northwest of Anaconda. Prior to 1955, this block was the Anaconda district of the Deerlodge National Forest.

Blackfoot Forest Protective Association (B.F.P.A.)

This association protects the area southeast of Missoula to Avon, north to Seeley Lake. The area west and north-west of Missoula is association responsibility contracted to the Lolo National Forest.

Northern Montana Forestry Association (N.M.F.A.)

This association protects the area southwest of Kalispell and west of Columbia Falls. The area southeast of Libby is association responsibility contracted to the Kootenai National Forest.

United States Forest Service

Responsible for Protection and Management of: —

National Forest land (federal ownership)

State and private lands within U. S. Forest Service protection unit boundaries.

Protective association contract (lands which are under contract with the associations)

National Park Service

Protects the land within National Park boundaries. The area included here is Glacier National Park and the part of Yellowstone National Park that is in Montana.

Bureau of Land Management

Protects forest land from fire on grazing districts, on public domain, and on state and private lands within its protection boundaries.

Bureau of Indian Affairs

Protects forest land from fire within Indian Reservations.

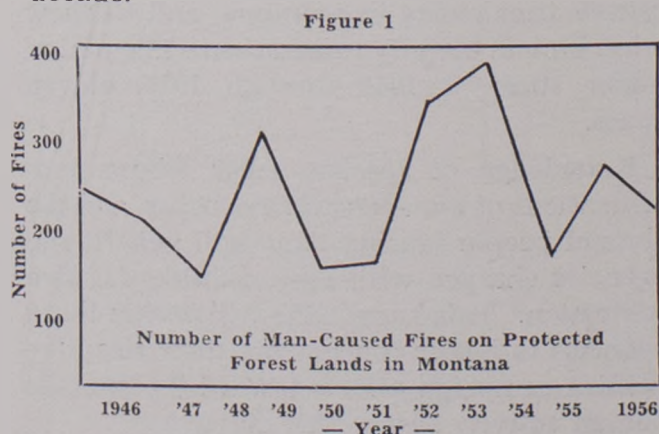
The greatest area of forest land under protection is in the National Forests. The following tabulation shows the number of acres protected by the various agencies, and the map shows the boundaries of each protective unit.

Agency	Protected Forest Land (1956)	
	Thousands of Acres	Percent of Total
Office of Montana State Forester	255	1
Blackfoot Forest Protective Association*	1,200	5
Northern Montana Forestry Association*	1,153	4
Anaconda Fire Protection Service	230	1
United States Forest Service (federal land)	16,637	65
State and Private by U. S. Forest Service	3,374	13
National Park Service	1,082	4
Bureau of Land Management	814	3
Bureau of Indian Affairs	1,130	4
*Includes area under U.S.F.S contract	TOTAL	100%
	25,803	

Excellent cooperation was given by these agencies in securing data and general information concerning the fire problems in their specific areas. This fire occurrence investigation emphasized the great value of keeping records about all fires, though it may appear at the time to be an irksome task. Information about the causative agent is very important and should be recorded at the time of each fire.

Figure 1 shows the total number of man-caused fires by years, and represents the total of all agencies listed above. There is a slight upward trend in the number of fires since 1946, but the variation between years is so great that the trend is not significant. It

is encouraging to note, that there has been a reduction of 36% in the number of annual fires per million acres protected during the period 1946-1956 compared to the previous decade.



Man's use of forested areas being doubled since 1946, has increased the fire risk because more people are using forested areas for recreation. People are now able to get into more timbered areas due to new logging roads. Complicating this situation is the fact that people are less familiar with woods environment due to their urban living, and are generally careful only to the extent of how much fire prevention material they have absorbed. Accelerated use has also aggravated the fire hazard condition because logging operations are creating slash fuels which are highly inflammable.

Increased risk and hazard naturally bring about more fires because weather conditions in Montana during the summer are such that fires can readily start and burn on many days. The fact that the number of man-caused fires has not increased proportionately to the increase of risk and hazard indicates that present day fire prevention efforts are becoming effective.

Man-caused fires are classified by all protective agencies into the following standard categories. —

Railroad Fires resulting from construction or maintenance of common carrier railroad right-of-ways; and from the operation of these railroads.

Lumbering Fires, except those caused by woods workers smoking, resulting from logging or sawmilling operations and the activities directly associated with these activities, such as building of logging roads. Also included here are fires caused by logging railroads which are not classed as common carriers.

Camper Fires resulting from small fires started for the purpose of cooking, warming, or providing light. These do not include fires started by railroad or logging employees in connection with their duties.

Smoker Fires caused by smokers who ignite fuels accidentally from matches or burning tobacco.

Debris Burning Fires resulting from burning to clear land for any purpose or

for rubbish, garbage, range, stubble, or meadow burning without the intent of the burner to have such fires spread to lands not intended to be burned. This does not include hazard reduction on right-of-ways, but does include logging slash disposal.

Incendiary Fires that are deliberately set with the intention of burning over land or damaging property not owned or controlled by the burner.

Miscellaneous Fires that cannot properly be classified under any of the above listed causes, or which are unknown as to cause.

Table 1 shows fires by years and causes. Careless smokers are responsible for the greatest number of fires. Wildfires resulting from camp and warming fires are next. Many of these are hunter fires that occur in the fall of the year when fuels are dry and protective forces are reduced to minimum standards. The only significant trend during this period has been a reduction in the number of railroad fires. This is due to the increased use of diesel locomotives and a concerted effort on the part of the railroad companies to reduce this type of fire. There have been a few more lumbering fires in the latter part of the period, due mainly because of the great increase in logging since 1950.



A warming fire left burning starts creeping in forest fuels

Table 1—Number of Man-Caused Fires by Years and Causes

Year	— Number of Fires —							Total
	Railroad	Lumbering	Camper	Smoker	Debris Burning	Incend-ary	Misc.	
1946	68	13	33	80	20	3	25	242
1947	32	8	45	75	24	3	20	207
1948	15	2	47	60	8	1	8	141
1949	61	7	69	95	27	4	40	303
1950	37	9	25	40	22	2	15	150
1951	20	6	26	53	25	0	26	156
1952	50	14	81	116	39	6	34	340
1953	52	24	89	132	46	4	43	390
1954	20	11	36	47	18	0	20	152
1955	19	24	64	69	34	2	46	258
1956	12	5	45	62	23	2	42	191
Average	35	11	51	75	26	3	29	230
Percent of total	15%	5%	22%	33%	11%	1%	13%	100%

Fire occurrence is of course influenced by weather, fuel, and topography. There are many instances where fires either started or did not start depending on the severity of burning conditions at the time, there being an igniting agent present. Nevertheless, two items are increasing: —Man's use of the forest and money spent on fire prevention. Since there is no striking downward trend in the total number of man-caused fires, it behooves us to be as effective with fire prevention

methods as is possible by concentrating on the area where more fires occur and upon the human activity most responsible. The analysis indicates that concentration on the careless smoker is of first importance.

Until the unsmoked portions of cigarettes are made inflammable, the responsibility of preventing smoker-caused fires rests with the individual smoker. Therefore, the protective agencies' greatest opportunity for preventing the smoker caused fire lies in personal contact with those likely to be careless with smoking material—the public user of the forest. This is admittedly one of the most difficult tasks to perform in fire prevention work. It is emphasized here with the hope that additional attention can be given to personal contacts with forest users.

The number of man-caused fires that occurred each year on the areas protected by the various agencies is listed in Table 2. The U.S. Forest Service handles an average yearly number of 137 fires. The Blackfoot Forest Protective Association handles a yearly average of 40. The greatest number of fires, 390 occurred in 1953.

The average yearly number of man-caused fires by causes for the protective agencies is shown in Table 3. The large number of smoker and camper fires for areas protected by the U.S. Forest Service reflects the in-



A cigarette carelessly tossed into the dry grass starts a fire

creased use of these areas for forest recreation. The high number of smoker fires for the state and private lands has resulted from the increased access due to additional roads in these areas with the corresponding use pressure by the public. Most of the railroad fires have occurred in the lower country.

To get a little better idea of just who starts fires classified as smoker, camper, and miscellaneous; a detailed analysis was made of these three categories. This analysis reveals that sportsmen and travelers cause 71% of the smoker and camper fires. The travelers are not necessarily all foreign to Montana. It is often impossible to distinguish between local and foreign for this traveler group, and the unknown smoker fire is ever present due to lack of conclusive evidence.

Many of the fires classified as campfires are hunter warming fires, built away from regular camping areas in the fall of the year. There is often the feeling in the fall that the fire season is over and that a fire need not be extinguished before leaving it. These fires, starting in more remote areas, are likely to become large due to time required for travel to them.

Picknickers are another division of the camper classification, and are a continued cause of fires, for they often leave areas in a hurry without making sure their fires are out.

The analysis of the miscellaneous category shows that children cause 30 percent of these fires. It seems to be a matter of curiosity and boredom rather than carelessness in this case. Constant teaching and proper examples in home and school offer the best answer for reducing fires of this origin.

Fires listed as "buildings" may come from construction of buildings, remodeling, or from burning buildings, and sparks from flues. Included here also are burning vehicles and aircraft. Hot ashes are also dumped indiscriminately without any regard to fire prevention. All of the above specific risks are a part of the man-caused fire problem, but in each of them, carelessness is the prime reason.

Now, where are the locations of greatest concentrations of man-caused fires in Montana? The highest concentration of fires exists on the area northwest of Anaconda.

This general area gets very heavy use from the public. Smoker and Camper and Miscellaneous fires are prevalent. Fuels are such that small fires spread rapidly.

Table 4 shows number of fires per million acres protected by the several protective agencies. This analysis affords a common basis of comparison and reveals concentrations of fires. The area east and northwest of Missoula shows a concentration. Railroad fires have been quite numerous here, but are decreasing. This part of the state is subject to heavy public use. The areas north and northeast of Flathead Lake show a concentration of fires. Here is a relatively small area under protection on which recreation use and logging is concentrated.

The National Forest areas shows a lower concentration of man-caused fires. They are generally larger areas of higher elevation and more inaccessible, with less human activity compared to the lower country. Of the National Forests, however, the Deerlodge shows the greatest concentration of man-caused fires. On the Deerlodge Forest, the area northwest of Anaconda shows the greatest concentration per million acres protected.

Special Emphasis Area

The area northwest of Anaconda, under the special protection of the Anaconda Fire Protection Service, has been chosen for further analysis. It is a place where there is heavy use from the public due to dense population centers, and it is an area under a close protection system and compact enough for study. Sixty percent of the man-caused fires here have resulted from smokers and campfires: 33% from miscellaneous causes; and 7% from debris burning and incendiary. Many of these fires occur in the fall of the year during the hunting season. They are either caused by cigarettes or by warming fires.

Experience has shown that this area receives a large concentration of hunters from the Butte-Anaconda population centers. This situation, plus the fact that there is a feeling on the part of many persons that the fire danger is past by the time hunting season opens, results in many smoker and camper fires. Often, at this season, there is a skiff of snow on the ground during the early part of

TABLE 2
Number of Man-Caused Fires by Years and Protective Agency

Agency	— Number of Fires —												
	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	Ave.	
State of Montana	4	4	6	6	7	5	4	7	8	15	5	6	
Blackfoot Forest Protective Association	41	30	29	72	54	41	52	70	19	23	15	40	
B.F.P.A. under U. S. Forest Service contract	28	27	8	24	8	16	29	30	15	7	7	17	
Northern Montana Forestry Association	16	11	8	15	9	7	19	20	11	20	8	12	
N.M.F.A. under U. S. Forest Service contract	12	11	5	20	6	9	17	12	5	14	7	9	
Anaconda Fire Protection Service	-	-	-	-	-	-	-	-	-	-	13	19	16
U. S. Forest Service National Forest Land	66	52	52	69	27	32	106	127	46	120	70	67	
State and Private by U. S. Forest Service	59	44	17	55	23	35	76	78	35	35	42	44	
Flathead Indian Reservation	9	11	4	12	8	4	21	24	9	0	8	8	
Other Indian Reservations	3	10	3	11	5	0	7	7	0	0	4	4	
Bureau of Land Management	2	4	3	3	2	4	5	7	0	5	0	3	
Glacier National Park	2	3	6	15	1	3	3	5	4	6	6	5	
Yellowstone National Park (Mont.)	0	0	0	1	0	0	1	3	0	0	0	0	
TOTALS	242	207	141	303	150	156	340	390	152	258	191	230	

Table 3
Average Annual Number of Man-Caused Fires by Causes and Agency

Agency	— Average Number of Fires Per Year —							Tot.
	Rail-road	Lumber-ing	Camper	Smoker	Debris burn.	Incen. diary	Mis.	
State of Montana	.7	.5	1.6	2.2	.7	0	.8	6.5
Blackfoot Forest Protective Association	19.3	1.7	7.0	5.0	3.4	.7	3.4	40.5
B.F.P.A. under U. S. Forest Service contract	4.1	.2	2.0	8.2	2.1	.2	.7	17.5
Northern Montana Forestry Association	.2	2.0	1.3	4.0	2.6	0	2.2	12.3
N.M.F.A. under U.S. Forest Service contract	.7	.3	1.0	4.1	1.3	0	2.1	9.5
Anaconda Fire Protection Service	0	0	4.0	5.5	.5	.6	5.4	16.0
U. S. Forest Service National Forest Land	2.2	3.3	24.6	25.4	4.7	.5	6.8	67.5
State and Private by U. S. Forest Service	5.9	1.6	6.5	16.0	6.6	.4	7.4	44.4
Flathead Indian Reservation	.7	.8	1.4	2.0	2.4	.2	1.0	8.5
Other Indian Reservations	.4	.3	.2	1.5	.8	0	1.2	4.4
Bureau of Land Management	.2	0	.4	1.6	.5	.1	.1	2.9
Glacier National Park	.8	0	1.0	1.4	.4	.1	1.2	4.9
Yellowstone National Park (Mont.)	.2	0	.1	.1	0	0	0	.4

Smoker		Camper		Miscellaneous	
Group	%	Group	%	Group	%
Hunters & Fishermen	46	Hunters & Fishermen	45	Children	31
Travelers	25	Travelers	27	Unknown	23
Local	15	Picknickers	15	Buildings	18
Unknown	14	Youths	6	Ashes	17
		Unknown	7	Power Lines	8
				Exhausts	3

the day. It may melt soon allowing fuels to dry out enough to ignite and burn. The presence of the light snowfall makes persons feel that no fire danger exists, and that cigarettes and warming fires may be carelessly used.

Well over half of the miscellaneous category fires during the period were caused by children. These were from playing with fire in some cases, but in a surprising number of cases were started just to "see what would happen".

Special emphasis by the Anaconda Protection Service is being given here to school children through the use of movies and the Smokey Bear medium. Local civic organizations in the city of Anaconda are being especially cooperative in helping suggest ways of reaching people with the fire prevention message.

The area protected by the Anaconda Fire Protection Service is serving as an experimental area to try additional fire prevention schemes—the effort being to reduce the number of man-caused fires. Three new ideas are being tested in this area. They are:

1. The formation of "Keep Montana Green" clubs within the local Chamber of Commerce organization.

2. A concentrated program of movies and demonstrations on Forest Fire Behavior for school children immediately before their school closes for the summer.

3. Use of local Mine and Smelter Workers' Union publications as a means of furthering the fire prevention message.

The main problem, however, is to determine whether or not additional fire prevention measures such as these are effective. Evaluation of these measures is difficult because the number of fires varies widely from year to year due to weather. This variation in number of fires may obscure the results of prevention work so much that "number of fires" alone is not an adequate criterion of prevention work effectiveness. The alternative left then, to evaluate prevention efforts, is to learn if the actual number of fires that occur in a given month is greater or less than could be reasonably expected for a given weather situation during the same time.¹

This estimate of expected fires can be made by correlating fire occurrence with past Burning Index ratings.² Burning Index reflects weather and fuel conditions that are measures of the ease with which fires start. The higher the rating, the easier it is for fires to start after ignition, and the more there are likely to be. The method used for correlating burning index ratings and fire occurrence is as follows:

For a given month, daily burning index ratings (0 to 100) are totaled, and the number of man-caused fires that occurred during that month is divided by this sum. The quotient is the "risk rating" for the month³. The number of fires that can be expected for a given month is this risk rating multiplied by the monthly sum of the daily burning index ratings. The more severe the fire weather, the higher the burning index rating sum, and therefore, the greater would be the number of expected fires.

The expected number of fires should normally be raised slightly for periods of predicted additional risk such as holiday use, week-ends and hunting seasons. The risk in the Anaconda area was about as constant throughout the week as any area in Montana because of

¹Crosby, John S., "Probability of Fire Occurrence can be Predicted", Central States Forest Experiment Station, U.S.D.A., Columbus, Ohio, Aug. 1954.

²Burning Index is a rating scheme devised to measure the burnability of fuels. It takes into account moisture content of fuels, wind, and relative humidity. These factors are properly weighed according to their effect on burnability, and are given a value of from 0 to 100.

³Lindenmuth, A. W., and Keetch, J. J., "A Measure of the Severity of Fire Seasons", Fire Control Notes, 2 (1), 1950.

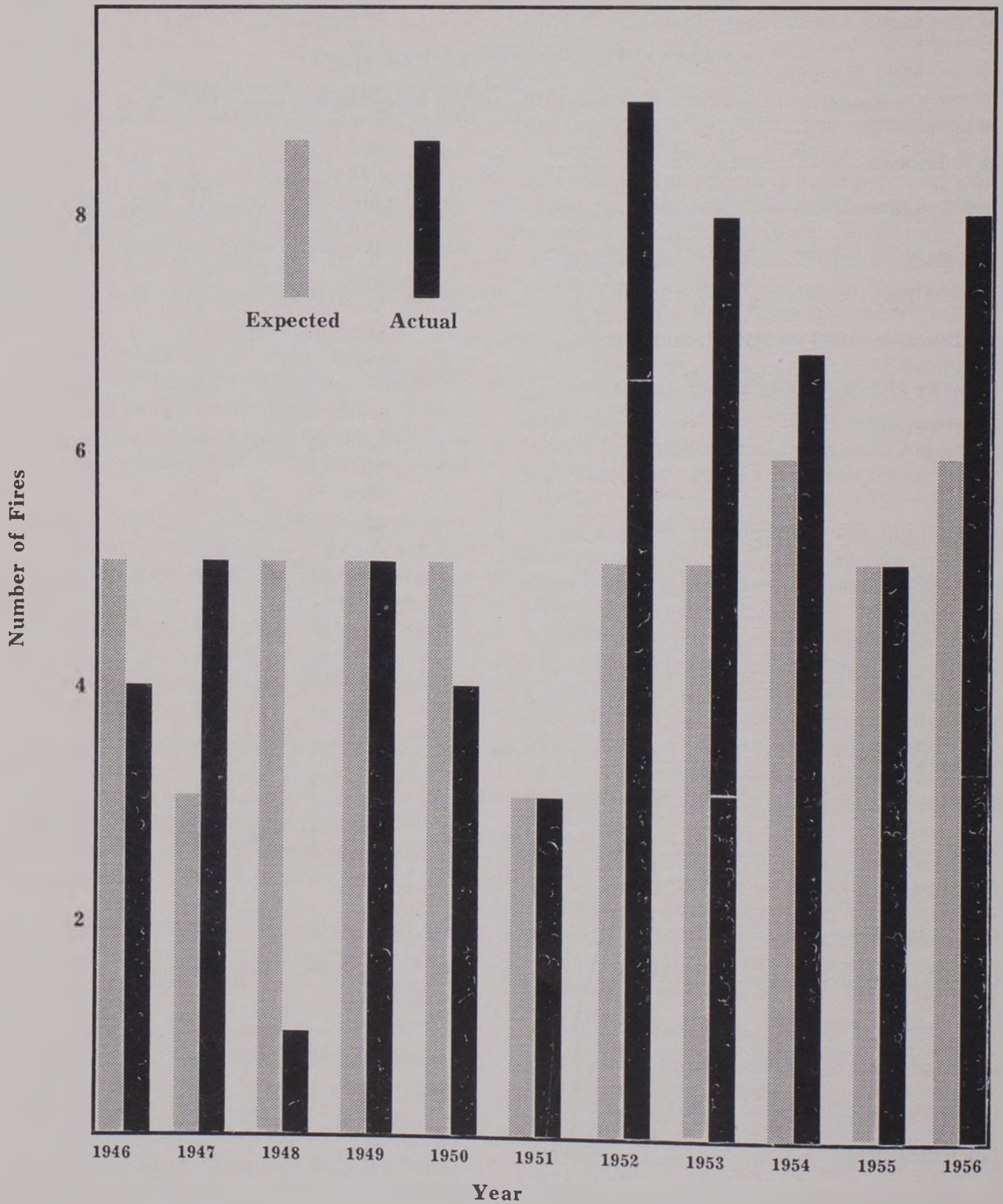
Table 4

Number of Man-Caused Fires Per Million Acres Protected by Causes and Agency
(total for the period 1946 - 1956)

— Number of Fires Per Million Acres Protected —								
Agency	Rail road	Lumber- ing Camp	Smoker	Debris burn.	Incen- iary	Misc.	Total	
State of Montana	32	36	57	142	48	6	54	375
Blackfoot Forest Protective Association	304	27	110	83	48	11	53	636
B.F.P.A. under U.S. Forest Service contract	94	6	46	182	48	2	20	398
Northern Montana Forestry Association	4	43	33	86	58	0	45	269
N.M.F.A. under US. Forest Service contract	11	8	26	74	27	2	42	190
Anaconda Fire Protection Service*	0	0	198	264	22	22	264	770
National Forests								
Deerlodge	2	2	38	42	7	1	4	96
Gallatin	2	1	29	35	2	1	9	79
Helena	0	1	27	11	4	0	9	52
Bitterroot	0	3	24	22	1	0	2	52
Kootenai	2	3	14	24	4	0	4	51
Cabinet	3	3	12	23	2	0	2	45
Lolo	3	3	16	11	6	0	5	44
Lewis and Clark	0	2	16	13	0	0	2	33
Flathead	0	3	7	11	4	0	5	30
Custer	0	0	11	7	3	0	6	27
Beaverhead	1	1	10	4	1	1	2	20
State and Private by U.S. Forest Service	19	6	22	55	20	2	25	149
Flathead Indian Reservation	16	22	40	24	32	2	28	164
Other Indian Reservations	6	6	6	25	14	0	21	78
Bureau of Land Management	2	0	7	22	7	1	2	41
Glacier Park	5	0	15	15	5	1	13	54
Yellowstone Park	1	0	0	0	0	0	0	1

*Two years data converted into full period ('46-'56) for comparison

Figure 2—EXPECTED AND ACTUAL FIRES
ANACONDA FIRE PROTECTION SERVICE AREA
 (Total—July, August, September)



the staggered shift arrangement for employment of so many persons in the Butte-Anaconda area. The rating was therefore used here without modification to compute expected fires for July, August, and September.

The average risk rating for the Anaconda Fire Protection District during the period 1946 - 1956 is:

.0016 for July
 .0021 for August
 .0014 for September

The following tabulation shows the average number of actual fires and the average number of expected fires per year for July, August and September for this area.

	Actual	Expected
July	1.5	1.5
August	2.0	1.9
September	1.8	1.4

Figure 2 shows that for 6 years, the actual fires were the same as, or less than expected; while for 5 years, the actual exceeded the expected.

The month of October presents a special problem. In most years, the daily burning index totals would be low enough so that for the month only one fire, or perhaps two, would ever be expected. In a short dry period, however, during the hunting season, several fires are likely to occur.

With the inexorable increase in the use of this area for outdoor recreation in the years to come, any trend whereby actual fires are less than expected fires definitely indicates that fire prevention campaign efforts are decidedly effective.

Summary

An average of 230 man-caused forest fires have occurred every year on protected forest lands in Montana during the past eleven years. Thirty three percent of these were from careless smokers; 22% from unextinguished camp and warming fires; 15% from railroads; 11% from inadequate care in debris burning; 13% from miscellaneous causes; 5% associated with logging and lumbering operations; and 1% from incendiaryists.

Further analysis of the smoker and camper fire revealed that hunters and fishermen cause 46% of these categories. Children were responsible for 31% of the fires classified as miscellaneous.

Concentrations of man-caused fires were found east of Missoula, north and northeast of Flathead Lake, and northwest of Anaconda.

The area northwest of Anaconda, under the protection of the Anaconda Fire Protection Service, was chosen to study the effectiveness of fire prevention campaigns. A scheme for correlating fire occurrence with burning index ratings shows that 53 fires were expected in this area from July 1 through September 30 during the last eleven years, and that 59 fires actually occurred.

Observance of the ratio between expected fires and actual fires gives a measure of the effectiveness of fire prevention efforts, the goal being for actual fires to be consistently less than expected fires.

