

Fire History Terminology: Report of the Ad Hoc Committee²

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It is often quite difficult to compare fire history studies conducted by different investigators because different terms may be used to refer to the same concept and the same term may be used to refer to different concepts. To help resolve this difficulty, an ad hoc committee was formed early in the course of the workshop with the task of (1) listing the most confusing terms commonly used in fire history studies, (2) determining which terms are actually synonymous, (3) suggesting which of several synonyms is the best term to use in future fire history studies, and (4) providing a definition for each of the preferred terms. The committee was composed of Martin Alexander, Stephen Arno, Kathleen Davis, H. William Gabriel, Edward Johnson, Michael Madany, William Romme, Gerald Tande, and Dale Taylor. The committee presented its preliminary report to all of the workshop participants during the concluding session, and a consensus was reached on the meaning and preferred use of several terms. Copies of the preliminary report were also distributed to several other fire history researchers who could not attend the workshop. Following a 3-week period during which several people made additional comments, this final version of the committee's report was written by William Romme. This is not meant to be an exhaustive fire history glossary nor a complete documentation of definitions as used in the literature. Rather it focuses on those terms that caused the greatest confusion at this workshop and are in greatest need of clarification. The individual papers in these proceedings do not necessarily use the terminology recommended in this report, as they were prepared before the committee was formed. However, it is hoped that the recommendations below will help to improve communication in future papers dealing with fire history.

We must add that although terminology can be a serious source of confusion, another major problem in comparing fire histories is related to differences in the size of our study areas. Concepts like fire frequency and mean fire interval take on very different meanings when applied to a 0.1-ha stand as opposed to a 100,000-ha park. We emphasize the importance of clearly stating the size of the area referred to by these terms. But there are still problems in comparison even if the sizes of the study areas are specified, especially when two study areas differ markedly in size. It may not be appropriate to extrapolate findings based on a small study area to a larger area, or vice versa.

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Not only are there probably differences in sampling intensity in large and small study areas, but extrapolation by simple multiplication or division may be quite misleading. For example, if there were 10 fires in a particular area during some time period of interest, it does not necessarily follow that there were 100 fires in an area 10 times as large. Similarly, if 10% of a 100,000-ha park burns each year, it is not necessarily true that 10% of every 0.1-ha stand burns each year. At this time, we can offer no solutions to these problems of study area size; we simply remind investigators of the problems, and urge caution in making comparisons or extrapolating results. Hopefully some future fire history workshop can resolve this difficulty.

The following terms are those for which a consensus was reached by the participants at the workshop. The preferred terms are given first, with other synonyms (if any) in parentheses:

1. FIRE OCCURRENCE (or FIRE INCIDENCE) = one fire event taking place within a designated area during a designated time (no units; either yes, a fire occurs, or no, a fire does not occur).

COMMENTS:

- (1) These terms have sometimes been used to refer to fire frequency (as defined below) with specific reference to some large study area, as opposed to fire frequency at a single point. This use is semantically inaccurate, however, as "occurrence" or "incidence" implies one event. Therefore, we recommend the term fire frequency (see below) for this meaning.

- (2) Neither synonym is clearly superior to the other, but only one term is needed. We recommend the term fire occurrence.

2. FIRE INTERVAL (or FIRE FREE INTERVAL or FIRE RETURN INTERVAL) = the number of years between two successive fires documented in a designated area (i.e., the interval between two successive fire occurrences); the size of the area must be clearly specified (units--years).

COMMENTS:

- (1) These terms have been used to indicate mean fire interval, etc. (see below), but we should distinguish between individual fire intervals and mean fire intervals.

- (2) None of these three synonyms is clearly superior to the others, but only one term is needed. For the sake of brevity, we recommend the term fire interval.
- (3) Writers should indicate whether a reported fire interval has been corrected by cross-dating the individual fire occurrences (see below).

3. MEAN FIRE INTERVAL (or MEAN FIRE FREE INTERVAL or MEAN FIRE RETURN INTERVAL) = arithmetic average of all fire intervals determined in a designated area during a designated time period; the size of the area and the time period must be specified (units--years).

COMMENTS:

- (1) None of these three synonyms is clearly superior to the others, but only one is needed. To be consistent with the term fire interval, recommended above, we recommend the term mean fire interval.
- (2) The frequency of distribution of fire intervals also should be examined. With highly skewed distributions, for example, the median fire interval or some other statistic may be more meaningful ecologically than the mean.
- (3) Hypothetical Example--"Fire occurrences in the years 1750, 1800, and 1900 were documented in a 10-ha study area, based on fire scar analysis corrected by cross-dating. Fire intervals of 50 and 100 years, respectively, were thus determined. Therefore, the mean fire interval in a 10-ha stand between 1750 and 1900 was 75 years."

Note that these fires may or may not have burned the entire 10-ha stand. All we know for certain is that 3 fires occurred somewhere within the stand during a 150-year period, and the average interval between successive fires in the stand was 75 years.

4. FIRE FREQUENCY = the number of fires per unit time in some designated area (which may be as small as a single point); the size of the area must be specified (units--number/time/area).

COMMENTS:

- (1) This term has been used in a more restrictive sense to indicate that the area referred to is a single point or a very small stand, while some other term (e.g., fire incidence or fire occurrence) is used in reference to a larger area. However, we recommend using only the term fire frequency for

areas of all sizes (with the size of the area clearly specified) because (i) if two different terms are used, it may not be clear which is appropriate in study areas of borderline size, i.e., bigger than a point but smaller than a large area; (ii) there is no semantic reason why the term frequency must be restricted to an area of any particular size; and (iii) it is semantically inaccurate to use terms like occurrence and incidence to refer to multiple events, as noted above.

- (2) Hypothetical example: "Intensive fire-scar sampling, corrected by cross-dating, produced evidence of 100 fire occurrences during the last 50 years in a 10,000-ha National Park. At one point within the Park (i.e., a single fire-scarred tree) there was evidence of 10 fires during the same 50-year period. Therefore, the fire frequency during the last 50 years in a 10,000-ha study area was 100 fires/50 years/10,000 ha, or an average of 2 fires/year/10,000 ha. The fire frequency at a single point during the same time period was 10 fires/50 years/point, or an average of 0.2 fire/year at a point, or 1 fire/5 years at a point."
- (3) Fire frequency in a large area indicates only the number of ignitions in that area during some time period; it reveals nothing about the sizes of the fires or their ecological effects. When referring to a large area, therefore, the amount of area burned per unit time may be more meaningful than simply the number of ignitions per unit time. With very small areas or single points, however, the number of fires per unit time is useful information.

5. CROSS-DATING = correcting the chronology determined from an individual tree-ring sample by comparison with a master tree-ring chronology developed for the area (no units).

COMMENTS:

- (1) This term has been used to refer to the process of correcting fire dates in a master fire chronology by adjusting individual sample dates to correspond to dates obtained from nearby fire-scarred trees. However, the term should not be used except in reference to a master tree-ring chronology for the area.
- (2) When reporting fire dates determined by dendrochronological methods, it is important to distinguish between fire dates that have been corrected by cross-dating and fire dates that have been estimated without cross-dating.

6. MASTER FIRE CHRONOLOGY (or COMPOSITE FIRE INTERVAL) = a chronological listing of the dates of fires documented in a designated area, the dates being corrected by cross-dating (defined above); this master fire chronology is compiled from several individual fire chronology sources (e.g., individual trees, stumps, stands, or written fire records), and is then used to determine fire frequency, mean fire interval, and other fire history parameters; the size of the area must be clearly specified (no units).

COMMENTS:

- (1) Neither synonym is clearly superior to the other, but only one is needed. We recommend the term master fire chronology.
- (2) If a master fire chronology is constructed without correction of individual fire dates by cross-dating, this should be clearly indicated by calling it an "un-cross-dated master fire chronology" or some similar term.
- (3) Many of the master fire chronologies previously reported in the literature have not been corrected by cross-dating.

7. FIRE SENSITIVE TREE = a species with thin bark or highly flammable foliage that has a relatively greater probability of being killed or scarred by a fire (no units). A FIRE RESISTANT TREE is a species with compact, resin-free, thick corky bark and less flammable foliage that has a relatively lower probability of being killed or scarred by a fire.
8. FIRE SCAR SUSCEPTIBLE TREE = a tree of any species that has already been scarred by fire at least once and has a relatively greater probability of being scarred by the next fire (no units).

COMMENTS: The term fire susceptible tree has been used to express this meaning, but for clarity the tree should be referred to as fire scar susceptible.

9. STAND-REPLACING FIRE (or STAND-RENEWING FIRE or STAND-DESTROYING FIRE or STAND-REGENERATING FIRE) = a fire which kills all or most of the living overstory trees in a forest and initiates forest succession or regrowth (no units).

COMMENTS: None of these four synonyms is clearly superior to the others, but only one is needed. We recommend the more neutral term stand-replacing fire.

The following terms were also discussed at the workshop, but no consensus was reached regarding their precise meanings or the preferred synonyms. They are useful terms, but because they may

be used in different ways by different investigators, each writer should clearly specify his/her intended meaning.

- A. FIRE CYCLE or FIRE ROTATION = the length of time necessary for an area equal to the entire area of interest to burn; the size of the area of interest must be clearly specified (units--years/area).

COMMENTS:

- (1) These terms have sometimes been used with reference only to stand-replacing fires. However, there is no semantic reason why the terms could not be used with reference to non-stand-replacing fires as well.
- (2) Note that the entire area of interest need not necessarily burn; some portions may burn more than once while other portions do not burn at all, as long as the sum of hectares burned by each individual fire equals the total number of hectares in the area of interest.
- (3) This concept has sometimes been referred to as the natural fire rotation. In these cases the intended meaning of the word "natural" should also be defined.
- (4) This is a useful concept, and one synonym or the other should be adopted for general use. However, participants at the workshop expressed strong preferences for both terms, and no consensus could be reached.

- B. FIRE INTENSITY and FIRE SEVERITY. There was considerable disagreement about the meanings and uses of these terms, which probably are not synonymous. Some argued that fire intensity should be used only in a strict thermodynamic sense (i.e., units of energy released/area or length of fireline/time), while fire severity should be used to indicate the effects of a fire on the ecosystem (e.g., changes in the forest floor, the canopy, the total photosynthetic area, etc.). Others argued that in fact we rarely can measure the actual energy release of a fire, but we can readily determine its relative intensity by examining its ecological effects. Thus, it is appropriate to call a stand-replacing fire a high intensity fire, and to call a fire that produces little mortality a low intensity fire, there being nothing to gain by introducing an additional term like fire severity. Writers should be careful to define these terms whenever using them.

- C. FIRE PERIODICITY. This term is often used, but we could arrive at no consensus as to its meaning. It was difficult even to produce a tentative definition, so writers should be very explicit about what they mean by the term.