

# 2016

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## NOAA's Lightning Safety Awareness Efforts – What We've Accomplished in 15 years

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**Abstract—** Lightning is one the top storm-related threats in the United States. Over the past 30 years, the National Weather Service (NWS) has documented more than 1400 lightning fatalities in the U.S. based on statistics through 2015 (NOAA, 2016). In terms of storm-related deaths, lightning ranks third, with only flooding and tornadoes causing more deaths.

In 2001, the NWS and the National Oceanic and Atmospheric Administration (NOAA) teamed up with non-governmental organizations and individuals to try to reduce lightning deaths and injuries in the U.S. Since then, NOAA's "Lightning Safety Awareness Team" has worked to provide lightning safety information to local NWS offices, the media, emergency managers, teachers, and the public. The centerpiece of this effort is NOAA's Lightning Safety Web Site, which serves as a source of lightning safety information for these groups. Also, the NWS and its partners have designated the last full week in June as Lightning Safety Awareness Week. During this week, the NWS and NOAA work with the media and other organizations to highlight the dangers of lightning.

Since the Lightning Safety Awareness Campaign was started in 2001, lightning fatalities have steadily decreased in the U.S. This decline is likely due to an increased awareness of the dangers of lightning and the behavioral changes of those involved in vulnerable activities

*Keywords—lightning; lightning deaths; lightning safety*

### I. INTRODUCTION

The National Weather Service (NWS) has promoted weather safety and preparedness for many years. In 2001, the NWS formed a team to spearhead a national effort to make the public more aware of the dangers of lightning. The team included people from the NWS and NOAA, as well as non-governmental individuals with a knowledge and interest in promoting lightning safety. The overall goal of the campaign was to reduce the number of lightning casualties in this country. To accomplish this goal, the team worked to develop and assemble an array of lightning safety information and materials that could be used to promote lightning safety.

While the Lightning Safety Awareness Team developed lightning safety materials, NWS meteorologists who work at the 122 field offices were critical to the success of the campaign. The individual NWS offices were able determine the local threat, tailor the information for the local needs, and work with local media and organizations to get the information out to the public.

The NWS's partners have played a vital role in getting our safety messages out to the public. These partners include the broadcast and print media, national and local governmental agencies, national and local recreational organizations, and other interested individuals. In many cases, NOAA's Public Affairs Office and local NWS offices have worked with national and local media to provide interviews and lightning safety information for news stories.

### II. MYTHS, MISUNDERSTANDINGS, AND MISCONCEPTIONS AT THE START OF THE CAMPAIGN

In 2001, when the campaign began, lightning caused an average of 74 deaths per year (30-year average from 1971 to 2000). At that time, lightning ranked as the 2nd greatest storm-related killer in the U.S. Although NOAA and the NWS had published lightning safety materials for many years, the public still lacked an appropriate knowledge of the dangers of lightning. Unfortunately, young children often learned about lightning by watching the actions of adults who often lacked an understanding of the dangers of lightning. Also, broadcast and newspaper reporters often relied on safety information from emergency officials who also lacked an understanding of lightning. In addition, too often, lightning safety information focused on what to do in a dangerous situation, rather than how to avoid a dangerous situation.

#### A. When to Seek Safety

One of the common misunderstandings before the campaign began was when to seek safety from a storm. Often, people waited far too long, leaving themselves in a dangerous

and potentially deadly situation. Many people may have thought that the time to seek safety was either when it started to rain or after the first close lightning strike. Others may have been taught to look for signs of charge build-up (e.g., hair standing on end) as an indication of danger. These perceptions obviously led to casualties. Another problem was that many people thought storms were farther away than they actually were, and did not react soon enough to an approaching threat. Some people may have been incorrectly taught that the number of seconds between the flash and the thunder equated to the distance in miles from the approaching threat. As a result, people often failed to take the appropriate and timely protective actions.

### *B. Reacting to the Threat*

Before 2001, much of the safety information had been focused on how to avoid the most dangerous situations, rather than how to be safe. For example, some of the more common safety guidelines were don't stand under a tree, don't stand in an open field, get out of boats, and get away from water. Also, since many people believed that lightning was attracted to metal objects and umbrellas, they thought that they could significantly decrease the chances of being struck by discarding metal objects and putting down umbrellas. In addition, there was also the belief that the crouching low to the ground provided a person with a significant level of protection.

### *C. Where to Go for Safety*

When the lightning safety campaign began, most lightning safety guidelines indicated that people should try to get to a safe shelter but failed to provide information on exactly what constituted a safe shelter. Many people believed that a shelter which provided protection from the rain would also provide protection from lightning.

### *D. Attitudes and Behavior*

One significant problem when the campaign began (and also now) is that people didn't want to be inconvenienced by the weather. People don't want to alter their plans based on the weather, or a forecast of the weather. In addition, men and boys are particularly reluctant to cancel, postpone, or end an activity unless the danger has actually arrived.

### *E. Media coverage of lightning incidents*

In 2001, many people were unaware of the number of lightning incidents because most lightning incidents received only local media coverage, if any at all. At the time, NWS offices typically relied on clipping services to find out about incidents and then documented lightning deaths and injuries in a publication called StormData, which was typically available two to three months after each incident. Consequently, much of the information on lightning deaths and injuries was not available in real time, often not reported by the media, and consequently the public was simply unaware of the number of lightning casualties across the country. In addition, the media had limited sources of accurate information on lightning safety.

At the time, there was no way for them to obtain up-to-date information on lightning deaths.

## III. GOALS OF THE LIGHTNING SAFETY AWARENESS CAMPAIGN

When the national lightning safety awareness campaign began in 2001, the overall goal of the effort was "to increase public awareness to the dangers of lightning through a coordinated national campaign." More specifically, the goal was to focus attention on the lightning threat so that people had a better understanding of the dangers associated with lightning. The NWS organized a group of individuals who worked to develop materials to be used in the effort. As part of the effort, the NWS initiated a national Lightning Safety Awareness Week, which included participation of NWS offices at both the national and local levels. One of the major accomplishments was the initiation of the national Lightning Safety web site. This site was established to serve as a national source of information on lightning and lightning safety. Materials were developed, promoted, and made available to the public and media at both the national and local levels through NWS web sites. Public information statements were issued from local NWS offices and local offices were also encouraged to promote lightning safety through seminars, interviews and radio/television broadcasts. Media response at both the national and local level was extremely good. Many broadcast meteorologists provided viewers with lightning safety information, particularly during Lightning Safety Awareness Week.

During the first year of the effort, the NWS focused on sports activities and partnered with the Professional Golf Association Tour for the initial kickoff event at a major golf tournament. "Lightning Kills, Play It Safe" was adopted as the NWS slogan with a focus on outdoor activities. The NWS printed posters with professional golfers Rocco Mediate and Vijay Singh, which were made available through local NWS offices throughout the country. In addition, the NWS developed a specific list of lightning safety recommendations for use with organized outdoor recreational sports events.

## IV. ACCOMPLISHMENTS OF THE LIGHTNING SAFETY AWARENESS CAMPAIGN

While many of the Lightning Safety Awareness Team's efforts have been focused on educating the public to the dangers of lightning, the ultimate goal of the campaign is to reduce the number of deaths and injuries. In order to accomplish this goal, it was necessary to change people's behavior when thunderstorms threaten.

Throughout the campaign, there have been many contributions that have led to an overall decrease in lightning fatalities (Jensenius and Franklin, 2006; Cooper, 2012). These have included the continued development and enhancements to the Lightning Safety web site, development of a standard lightning safety brochure for families, establishment of an online database of lightning fatalities (Roeder and Jensenius, 2012), updated analyses of recent lightning fatalities (Jensenius, 2016), Lightning Safety Awareness Week events,

and lightning safety toolkits for sports organizations and large venues. In addition, we've been able to partner with various organizations such as Little League Baseball to help get the safety information out to the public. While the initial campaign slogan, "Lightning Kills, Play It Safe," remains on some of the NWS outreach materials, the more general slogan, "When Thunder Roars, Go Indoors," is now our primary slogan.

For the media, the lightning fatality database and statistical analysis of lightning fatalities continue to be valuable sources of information for stories on lightning safety and lightning incidents. In addition, a mailing list has been established so that information on lightning fatalities is known. The statistical database also allows the team to target the more vulnerable activities and segments of the population.

### V. RESULTS OF THE LIGHTNING SAFETY CAMPAIGN

While many of the misunderstandings that existed prior to the start of the campaign in 2001 may still exist to a lesser extent, the overall effort to reduce the number of lightning deaths has been successful. Fig. 1 shows the overall trend in lightning fatalities in the U.S. from 1996 through 2015 based on 5-year averages. As can be seen from the graph, the 5-year average decreased from 47 for the 5 years prior to the start of the campaign (1996-2000) to 26 for the most recent 5 years (2011-2015). This represents an overall 45% reduction in lightning deaths.

Fig. 2 shows the year-by-year lightning fatality statistics for both males and females for the 2000 to 2015 period, as well as statistics for the two genders combined. Not surprisingly, since males contribute most to lightning fatalities, the reduction in male deaths contributes most to the decline in the combined fatality rate. Linear regression lines were fit to the data for each gender and to the combined data. The slope of the regression line was used to determine the annual decline in the lightning fatality rate for each set of data. During the 15-year period, lightning fatalities declined at an average rate of 1.50

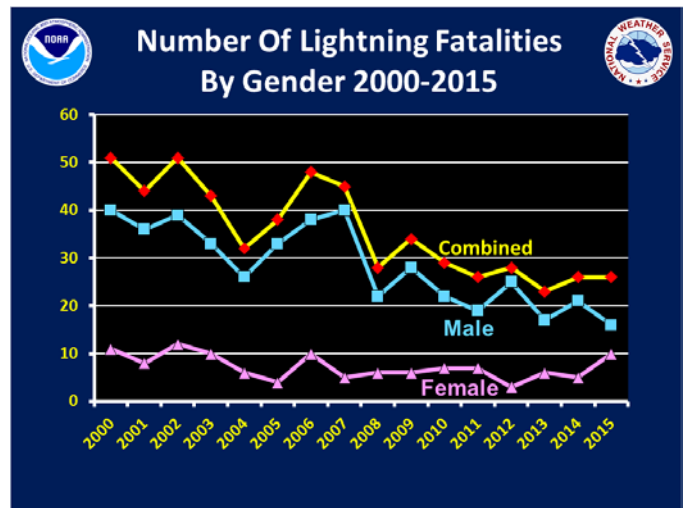


Figure 2. Number of U.S. lightning fatalities by gender.

deaths/year for males, 0.25 deaths/year for females, and 1.75 deaths/year for both genders combined.

Fig. 3 shows the change in fatality rates for various 10-year age groups from ages 10 to 69. Because of the low number of fatalities, graphs for the 0 to 10, 70 to 79, and 80 to 89 age groups are not shown. Clearly, an overall downward trend is seen in most age categories during the period. As with the gender graphs, the slope of a regression line fitted to the data for each age group was used to determine the average annual decrease/increase in lightning fatalities for each age category. Only the 50-59 age category saw a slightly increasing rate (+0.01 deaths per year) during the period. The remaining age groups between 10 and 69 had a decreasing lightning fatality rate (10-19: -0.31 deaths/year), (20-29: -0.38 deaths/year), (30-39: -0.35 deaths/year), (40-49: -0.40 deaths/year), (60-69: -0.09 deaths/year) during the 15-year period.

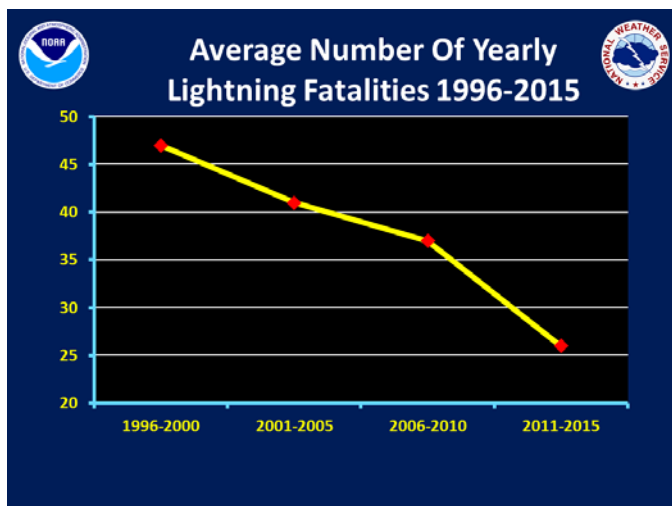


Figure 1. Average number of U.S. lightning deaths for 5-year periods from 1996 to 2015.

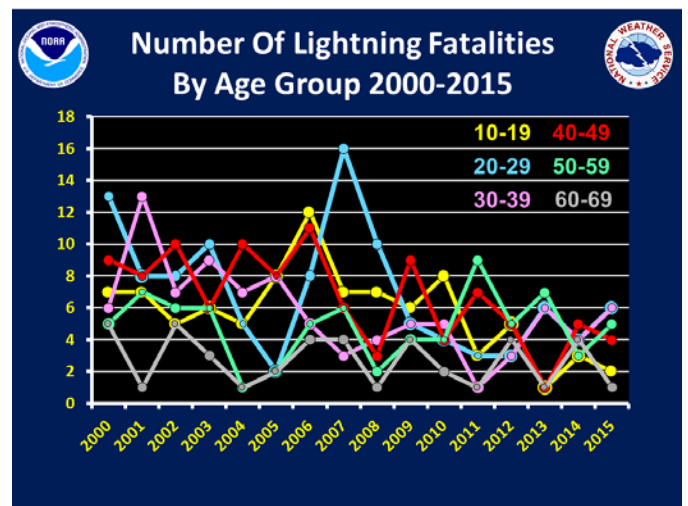


Figure 3. Number of lightning fatalities by age group from 2000 to 2015.

Because of the large variations in individual years, the regression lines were also used to determine an expected value for each age category prior to the start of the campaign in 2000 and for the most recent year, 2015. Fig. 4 shows the expected values for 2000 in yellow and the expected values for 2015 in red. The difference between yellow and red lines represents the expected difference in lightning deaths between 2000 and 2015 based on the observed trends. The age categories between 10 and 49 showed significant reduction in lightning fatalities while the age categories above 50 showed little or no reduction.

Fig. 5 shows the number of lightning fatalities by month for 2000 through 2015. The months of June, July, and August, which typically see the greatest number of fatalities, all show declines in fatality rates during the period. Regression lines indicate yearly declines of 0.30 deaths/year for June, 0.38 deaths/year for July, and 0.68 deaths/year for August. The large decrease in the death rate for August is likely due to some rather high August fatality numbers in the early years of the campaign. Only minimal changes are seen for the months of May and September.

Information on the activities of the victims involved in fatal incidents has been collected since 2006 (Jensenus, 2016). These activities were broken down into three main categories (leisure-related, work-related, and daily/weekly routine-related activities) and unknown. Fig. 6 shows how lightning deaths for these categories have changed between 2006 and 2015. During the period, leisure activities contributed to about two-thirds of the lightning deaths. A regression analysis indicates that the death rate for leisure activities declined by about 0.90 deaths/year during the period. Daily/weekly routine-related deaths declined by 0.88 deaths/year while work-related deaths declined by 0.15 deaths/year.

The leisure-related fatalities were further broken down into various sub-categories of the leisure activities. Several of these are shown in Fig. 7. Water-related activities contributed most

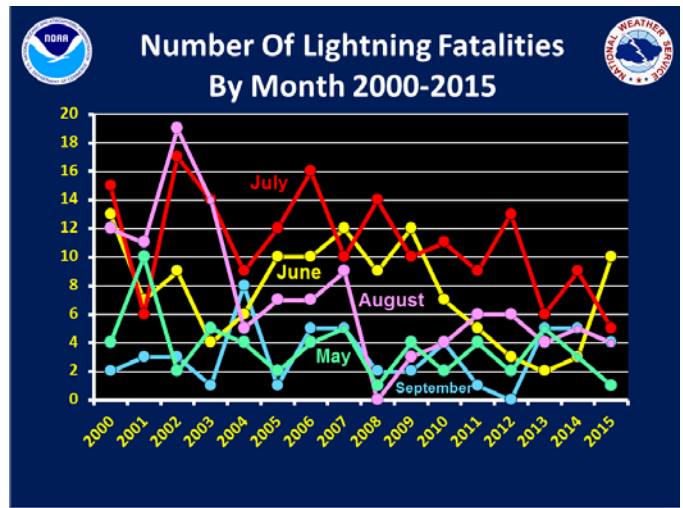


Figure 5. Number of lightning fatalities by month from 2000 to 2015.

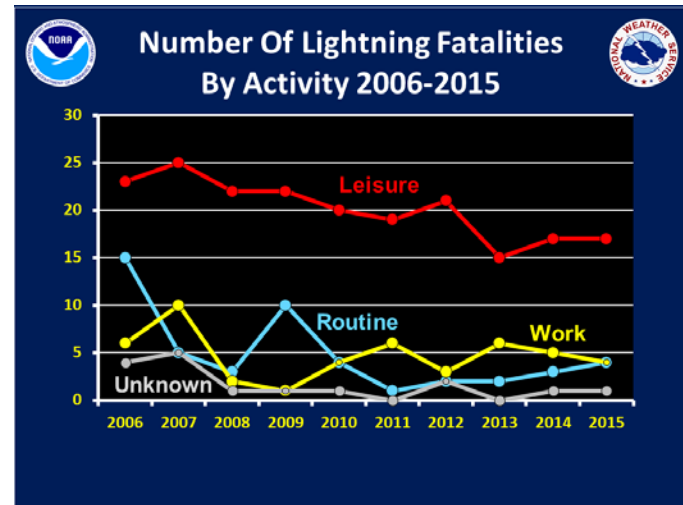


Figure 6. Number of lightning fatalities by activity from 2006 to 2015.

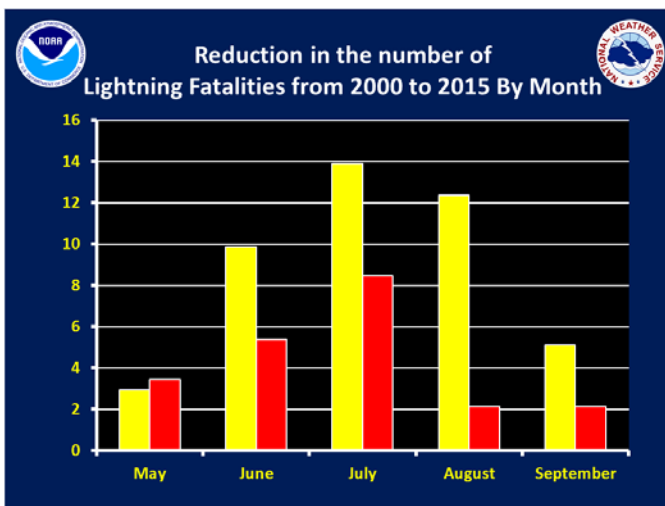


Figure 4. Expected number of lightning fatalities for 2000 and 2015 as determined by regression analysis.

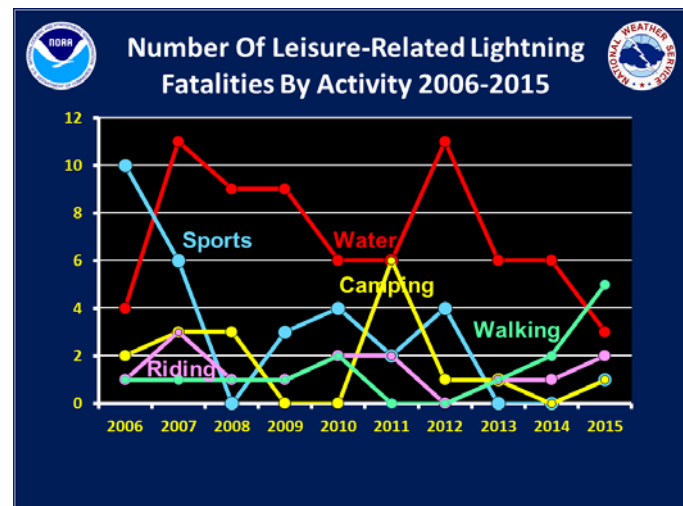


Figure 7. Number of lightning fatalities for several leisure-related activities from 2006 to 2015.

to the leisure-related deaths. Included in the water-related leisure activities were fishing, boating, swimming, and beach activities. Regression analysis indicated that water-related lightning deaths declined at a yearly rate of 0.32 deaths/year. In comparison, regression analysis indicated that sports-related deaths declined at a rate of 0.74 deaths/year due mainly to the large number of sports-related deaths in 2006 and 2007. Although the numbers are small, the last several years have seen an increase in the walking/hiking deaths.

Of the water-related activities, fishing is the activity that contributed most to lightning deaths. Fig. 8 shows the number of fishing-related deaths from 2006 to 2015. Although there is much variation from year to year, overall, the regression analysis shows only a small decline (about 0.05 deaths/year) in fishing-related fatalities. It is noteworthy to point out that only 4 fishing-related deaths have occurred since the NWS began efforts to target fishermen with safety information in June 2013.

### VI. DISCUSSION

Lightning fatality data clearly indicate a downward trend in U.S. lightning fatalities since the NOAA/NWS campaign began in 2001. Although a reduction in fatalities was seen in many different stratifications of the data, the largest reductions seem to have occurred in the groups which contributed most to lightning fatalities. These groups include males, people between 10 and 70 years of age, people involved in leisure activities, and in particular water-related activities. Although the statistical analysis did not indicate a large decline in fishing-related deaths, the reduction in fishing-related fatalities in the most recent years may be a positive indication that those deaths are on the decline. As for months of the year, the greatest declines have occurred in June, July, and August when people tend to spend more time outdoors enjoying leisure activities.

These results would indicate that the overall efforts over the past 15 years to reduce lightning fatalities have been very successful. The overall efforts of NWS offices to get lightning

safety information out to the public have likely contributed greatly to this success. Also, the availability of information on the Lightning Safety web site and up-to-date information on lightning fatalities has provided the media much needed information for their stories.

### VII. CHALLENGES FOR THE FUTURE

With 20 to 25 million lightning strikes in the U.S. in a typical year and a population of 320 million people, lightning will continue to be one of the top storm-related threats. Without a continued effort to educate the public on the dangers of lightning, there is no reason to expect lightning fatalities to continue to decrease (or even remain at the same level). With an increasing population, and more people involved in vulnerable leisure activities, it will be a challenge just to keep the lightning death toll at the current levels.

### ACKNOWLEDGMENT

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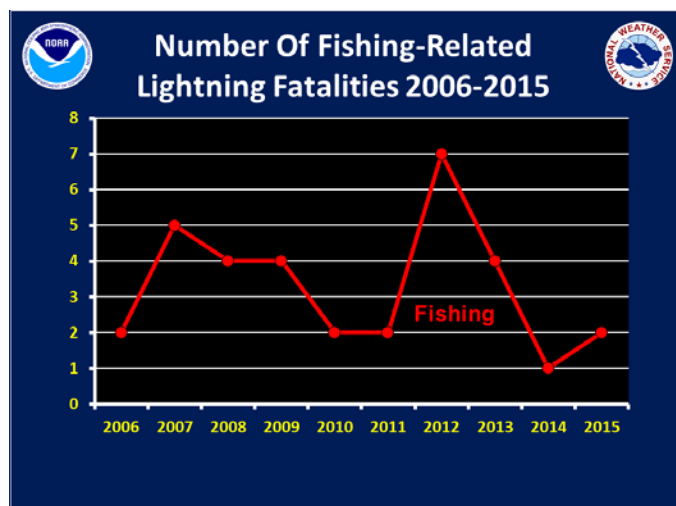


Figure 8. Number of fishing-related lightning fatalities from 2006 to 2015.