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THE DEADLIEST ATLANTIC TROPICAL CYCLONES, 1492-1994

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1. INTRODUCTION

The legacies of Atlantic tropical cyclones span many cultures and thousands of years. Early evidence of these storms predates extant weather records. Geologists believe that layers of sediment at the bottom of a lake in Alabama were brought there from the nearby Gulf of Mexico by storm surges associated with intense hurricanes that occurred as much as 3,000 years ago (Liu and Fearn 1993). Similarly, sediment cores from the Florida west coast indicate exceptional freshwater floods during strong hurricanes more than a thousand years ago (Davis et al. 1989).

Perhaps the first human record of Atlantic tropical cyclones appears in Mayan hieroglyphics (Konrad 1985). By customarily building their major settlements away from the hurricane-prone coastline, the Mayans practiced a method of disaster mitigation (Konrad 1985) that, if rigorously applied today, would reduce the potential for devastation along coastal areas (e.g., Pilkey et al. 1984; Sheets 1990).

Many storms left important marks on regional history. In 1609, a fleet of ships carrying settlers from England to Virginia was struck by a hurricane. Some of the ships were damaged and part of the fleet grounded at Bermuda (The Encyclopedia Americana 1994). The passengers became Bermuda's first inhabitants and their stories helped inspire Shakespeare's writing of *The Tempest* (Carpenter and Carpenter 1993).

In several incidents, tropical cyclones destroyed otherwise invincible colonial armadas (Millas 1968; Hughes 1987). The French lost their bid to control the Atlantic coast of North America when a 1565 hurricane dispersed their fleet, allowing the Spanish to capture France's Fort Caroline near present-day Jacksonville, Florida. In 1640, a hurricane partially destroyed a large Dutch fleet apparently poised to attack Havana. Another naval disaster occurred in 1666 to Lord Willoughby (the British Governor of Barbados) and his fleet of seventeen ships and nearly 2,000 troops. The fleet was caught in a hurricane near the Lesser Antilles. Only a few vessels were ever heard from again and the French captured some of the survivors. According to Sugg (1968), the 1640 and 1666 events secured, more or less, control of Cuba by the Spaniards and Guadeloupe by the French. More than two centuries later, commenting on the Spanish-American War, President McKinley declared that he feared a hurricane more than the Spanish Navy (Dunn 1971). McKinley's concern translated to a revamped United States hurricane warning service, forerunner of today's National Hurricane Center (NHC).

Some historical events left scars. In 1495, the small town of Isabella, founded on Hispaniola by Columbus, became the first European settlement destroyed by a hurricane (Carpenter and Carpenter 1993). Other communities would suffer a similar fate.

There is even conjecture that a hurricane was responsible for the mysterious disappearance of the original Roanoke Island settlement (i.e., the "Lost Colony") in 1588 (Hunter 1982). More certainly, in 1886, the town of Indianola, Texas was destroyed by a hurricane. It was never rebuilt. The 1900 "Galveston" hurricane severely damaged much of that city and, with it, Galveston's preeminence as the financial capital of that part of the country (e.g., Hughes 1990).

Surviving quantitative documentation about specific storms generally begins late in the 15th century during the period of New World exploration. A succession of chronologies brings the record forward to modern times (e.g., Poey 1862; Tannehill 1940; Ludlum 1963; Millas 1968).

Hebert et al. (1993) frequently update their popular statistical summary about hurricanes that affected the United States this century. Their study, which includes a tabulation of the largest United States losses of life caused by those storms, has no counterpart for earlier tropical cyclones or for casualties incurred elsewhere. In this presentation we extend their work, providing a catalog of Atlantic tropical cyclones[1] associated with loss of life during the period 1492-1994.

To document casualties and attendant circumstances we relied on books and articles about the weather, newspaper reports about storms, and accounts of shipwrecks. Some of these sources consulted hundreds or thousands of original documents. They provided an extensive, though admittedly not exhaustive, data base. Indeed, if current Atlantic tropical cyclone activity is representative of the past five centuries, then a staggering number of those systems (upwards of 5000!) developed during that period. Some storms were harmless. Others likely caused loss of life that was never documented, or was recorded in documents subsequently lost to deterioration with age, war, or fire (e.g., Marx 1983). It is hoped that still other cases not identified here will be uncovered in future investigations.

The catalog comprises two lists. The first list (Appendix 1), like Hebert et al. (1993), provides information about tropical cyclones responsible for at least 25 deaths. The second list (Appendix 2) identifies storms associated with loss of life that, while not quantified, may have reached at least 25, according to records about those events.

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[1] In this context, "Atlantic" will refer to the North Atlantic Ocean, Caribbean Sea, and the Gulf of Mexico.

2. TROPICAL CYCLONE TERMINOLOGY

The United States National Weather Service technical definition of a tropical cyclone (National Weather Service Operations Manual C-41 1993) is: "A nonfrontal, warm-core, low pressure system of synoptic scale, developing over tropical or subtropical waters and having a definite organized circulation." In practice, that circulation refers to a closed, counterclockwise (in the northern hemisphere) airflow at the earth's surface.

Meteorologists generally recognize three classes of tropical cyclones stratified by their highest one-minute average surface wind speed. **Tropical Depressions** have maximum wind speed less than 39 mph (and, in practice, generally greater than 20-25 mph). Maximum wind speed from 39 to 73 mph characterizes **Tropical Storms**. **Hurricanes** have wind speeds of at least 74 mph. Of the defining criteria, the closed nature of the circulation in weak systems, the thermodynamic structure, and the precise intensity cannot always be determined objectively. For this compilation, the publication *Tropical Cyclones of the North Atlantic Ocean* (Neumann et al. 1993) and the associated NHC "Best Track" data set[2] served as the final authorities for Atlantic tropical cyclone histories back to 1871.

These definitions are more quantitative than the terminologies of the past. Many early reports, especially from non-meteorological sources, referred to "hurricanes" without providing elaboration. Sometimes, hurricane meant any storm of apparently exceptional ferocity (such as a powerful high-latitude storm of non-tropical origin or a "severe" thunderstorm) that, perhaps, produced what we now consider hurricane *force* winds. Others used subjective terms like "a terrific gale" or winds "blowing a perfect hurricane" (e.g., Milner and Sowerby 1863). It is unclear in these instances whether the current requirements for a tropical cyclone were satisfied. Occasionally, however, an especially descriptive account added confidence to the interpretation, as in a summary printed in the 6 November 1761 issue of *Lloyd's List*[3]:

> **Capt. Young, arriv'd at Briftol from Guadalupe, came out the 17th of Sept. in Company with a Fleet of 26 Sail, moft of them for England, under Convoy of the Griffin Man of War, who was to fee them as far as Lat. 28; but on the 27th ditto, in Lat. 22, they met with a heavy Gale of Wind, which began at the N. W. and veered all round the Compafs to the**

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[2] Available from the National Climatic Data Center, Asheville, NC.
[3] This account, like several that follow in the text and in Appendix 2, is shown in an older style of English, presented by the source, where "f" sometimes represents "s".

> **S. E. in which the Fleet were fcattered, and feveral loft their Topmafts. The next Morning he faw only nine Veffels with the Man of War; and the Captain adds, That by the Smartnefs of the Gale, and the Wind's flying about round the Compafs, he apprehends it was the Tail of an Hurricane.**

Information about storm duration was helpful, too. The very long duration of the inclement weather described in the following passage is more consistent with a "cut-off" low than with a tropical cyclone:

> **Falmouth, 6th January. Arrived the Hyena, Captain Thompfon. Left St. Kitts on the 30th November, with about thirty fail of Veffels under her Convoy; but a Tempeft of Wind, on the 17th of December, in Lat. 32 feparated them; a Storm of an uncommon Sort, that lafted from that Period to this Day; the Damages of the Hyena are fo great, it was with difficulty fhe was brought into Port, and much is to be apprehended for the Fleet.** (*Lloyd's List*, 11 January 1782)

Accounts that included weather observations, such as ship reports based on the Beaufort scale (introduced in 1805) or barometric pressure measurements, helped to clarify the nature of some rough weather events. These data were most often found in meteorological studies, like Ludlum (1963) and Millas (1968), which provided many well-documented and corroborating descriptions.

This study adhered to several guidelines that minimized subjectivity and simplified the analysis. Every entry in the Appendices had a documented association with bad weather that was, or could reasonably be, related to a tropical cyclone. This requirement eliminated many cases from further consideration, even those where the remaining evidence (in the example below, the date and location of a loss of multiple ships) tempted us to attribute the disaster to a tropical cyclone:

> **The Duke of Cumberland,** (Captain) **Ball, a Letter of Marque of Briftol, laft from the Canaries for Virginia, was loft in September laft nine Leagues to the Southward of Cape Henry; the Captain, Surgeon and twenty three Men were drowned, and 21 faved. —about the fame time were alfo loft a Snow and a Brig, Names unknown, and all the Crew of the former perifh'd.** (*Lloyd's List*, 11 November 1757)

Wherever helpful, the data and descriptions provided by the sources are reprinted verbatim. (Unfortunately, by doing so, we also pass along some information that either originally [or over the years] was [re]recorded incorrectly. Conflicting accounts were noted in, and by, several sources and the associated uncertainties are reflected in Appendix 1. We hope, however, that by providing all relevant reference information, the reader will gain as thorough a documentation of the event as possible.)

Footnotes are included to point out special conditions. For example, the footnote "c" indicates that the tropical nature of a storm was in doubt for at least part of the event. Often, it applies to storms moving poleward from about 40-45°N, where weather systems generally encounter relatively cold ocean waters (<26°C) and tropical cyclones transform to "extratropical" cyclone status.

The track data of Neumann et al. (1993) show that Atlantic tropical cyclones are almost exclusively a warm-season event, as implied by the mariner's poem (Inwards 1898):

> **June—too soon.**
> **July—stand by.**
> **August—look out you must.**
> **September—remember.**
> **October—all over.**

The last line may be more ambiguous than helpful. In some Octobers, "all over" seems to describe the spatial distribution rather than a certain cessation of activity. The NHC officially defines the hurricane season to run from June through November. Tropical cyclones outside that period are relatively rare and mostly limited to low latitudes. In this study, when lacking evidence to the contrary, storms between December and May were eliminated from further consideration.

Only in obvious circumstances was a report purportedly about a tropical cyclone rejected outright. The following account refers to a "Hurricane", but the storm's date and location are inconsistent with our expectation of a tropical cyclone:

> **Plymouth** (England), **Jan. 5. Laft Night it blew a Hurricane; almost every Ship in the Harbour drove.** (*Lloyd's List*, 7 January 1791)

The concept of storm track and the difference between storm motion and circulation remained obscure until Benjamin Franklin's conclusions of the mid-18th century (see, Ludlum 1963, p. 22) were extended and formalized by Redfield (e.g., 1836), Reid (1841) and others. In addition, with communications generally limited for centuries to the line of sight, storms almost always moved faster than did the information about them. The first words about "The Great Hurricane" of 10-16 October 1780 did not appear in *Lloyd's*

List (published twice a week at that time) until the 19 December issue, and new reports appeared through 13 April 1781.

These limitations certainly contributed to the peril of people in the path of an oncoming storm. One impact on this study was to introduce uncertainty in some instances about whether contemporary storm accounts from a region referred to a single tropical cyclone or possibly to multiple systems. (The *Lloyd's List* issues from December 1780 through April 1781 describe losses in the Caribbean Sea and adjacent islands. We now know that in addition to the Great Hurricane, two more of this hemisphere's most notorious storms occurred in that region during October 1780; see, Millas 1968). Another example occurred in 1785 when a storm devastated the area from St. Croix to Cuba during the last week of August (*The Daily Universal Register*). On the 2nd of September, a "savage" storm struck the Delaware coast (Seibold and Adams 1989). Two disturbances could be responsible for these events. Alternately, the tracks of more recent storms suggest that a single tropical cyclone could have been the culprit. Cases where uncertainties persist about the number of storms involved were entered into the catalog and assigned the footnote "z".

3. CASUALTY INFORMATION

Losses over open waters--An ocean of trouble

The period under study saw a large and widespread increase in Atlantic coastal population. Available records, however, suggest that the population *on* the Atlantic was the most vulnerable to storms through the 18th century. These shipborne explorers, emigrants, combatants, fishermen, traders, pirates, privateers, slaves, and tourists made up the crews and passengers on an uncounted, but enormous number of local and transatlantic sailings. Most of the ships travelled to or from the ports of Spain, France, Great Britain, and the Netherlands. They usually proved no match for the intense inner-core region of a severe tropical cyclone.

> **It is doubtful if any sailing ship or any man aboard survived in this sector of a really great hurricane.** (Tannehill 1955)

In fact, to 1825,

> **more than five percent of the vessels in the** (West) **Indies navigation were lost due to shipwrecks; the biggest part due to bad weather...** (Marx 1981).

The total number of ship-related casualties associated with Atlantic tropical cyclones is unknown, but there are clues. Some perspective on the magnitude of ship losses worldwide is gained by

realizing that on the coast of England alone there have been a minimum of 250,000 wrecks (Cameron and Farndon 1984)! On the other side of the Atlantic, near New England, it was estimated that three out of every five sailors drowned during the period 1790 to 1850 (Snow 1943). Of course, many of these disasters were unrelated to the weather, while others are attributable to the brutal, cold storms of the North Atlantic winter rather than to tropical cyclones. Still, an account of one 17th century hurricane indicates the great magnitude of some losses blamed on tropical cyclones:

> **By these kind of Tempests the King of Spain hath lost at several times near 1000 sail of ships.** (in Ludlum 1963)

Similar disasters continued for another two centuries. Even as late as the 1830's,

> **...the annual loss of life, occasioned by the wreck or foundering of British vessels at sea, may, on the same grounds (i.e., 'the boisterous nature of the weather and the badness of the ships'), be fairly estimated at not less than One Thousand persons in each year...** (Parliament Select Committee 1839).

Steamship voyages contributed increasingly to the number of lost ships during the latter half of the 19th century. In 1875-76, "heavy weather" was blamed for the loss of 176 steamships. Over a longer period, 1840 to 1893, 7,523 people perished in 125 North Atlantic steamship disasters of all types (Garrett 1986).

The large number of ship losses was partially a consequence of the great number of ships that inadvertently encountered storms. Redfield's (1846) analysis of an 1845 hurricane off the U. S. mid-Atlantic coast contains, on one weather map, information from the logs of more than 50 ships within about 450 miles of the storm's center. There were likely other vessels in that area. Redfield suggested that the then-expanding electric telegraph could be used in the Atlantic ports of the United States to alert mariners of approaching bad weather. Unfortunately, occasional ship disasters related to Atlantic tropical cyclones continued into the early 1900's. Further technological advances in meteorology, communication, navigation, and the seaworthiness of ships makes such losses infrequent today.

Reference materials about specific ship losses range from non-existent to overwhelming. In some instances, where the sea claimed a lone ship or even an entire fleet, record of the cause and location of the catastrophe went down with the ship(s). Moreover, for centuries there were virtually no official records on lost

ships (Cameron and Farndon 1984). On the other hand, Marx (1983) wrote that:

> **if a team of one hundred researchers spent their whole lives searching through the more than 250,000 large legajos** (bundles) **in the Archive of the Indies** (at Seville), **I doubt that they could locate all the important documents concerning Spanish maritime history in the New World.**

Either way, we learned little or nothing about many lost or missing crews and the circumstances behind their disappearance. For this compilation, lacking contrary evidence, the crews and passengers of ships lost over *open waters* in tropical cyclones were counted as fatalities.

Coastal deaths

While losses over open waters have decreased of late, rapid growth of coastal communities over the past 500 years has meant an ever-increasing population at risk to tropical cyclones. As at sea, relatively primitive communication methods increased the possibility of disaster near the shoreline. Not until 1909 was the first *in situ* ship report of hurricane conditions received in time to assist coastal preparations (Garriott, 1910).

There are two primary components to the danger near the shore, coastal ship losses and storm surge disasters. It is estimated that 98% of the ships lost in the Western Hemisphere to 1825 wrecked in waters no deeper than 30 feet (Marx 1983). Proper disposition of many of these cases is uncertain. Undoubtedly, many mariners lost their lives while staying with their vessel until it was too late to reach safety. This seems especially true early on, as noted in the following examples, with the first passage about non-tropical cyclones:

> **for four winters after my appointment to the charge of the barracks at the above named place** (Yarmouth in Norfolk, England) **in 1803, I witnessed the loss of vessels with all their crews within a few yards from the shore....I witnessed His Majesty's gun-brig Snipe, stranded within 50 yards of the beach at the back of the pier, having 67 persons on board, who all perished...** (Parliament Select Committee 1839)
>
> **Came to anchor in St. Thomas's harbour, and landed the mails. Here the hurricane of the 2nd** (August 1837) **appeared to have concentrated all its power, force, and fury;**

> for the harbour and town were a scene that baffles all description. Thirty-six ships and vessels totally wrecked all around the harbour, among which about a dozen had sunk or capsized at their anchors; some rode it out by cutting away their masts, and upwards of 100 seamen drowned... (Reid, 1841).

In contrast, today's early warning system usually results in little or no loss of life aboard vessels that wreck on a coast or in a marina. In 1992 Hurricane Andrew, for example, only two boating-related deaths occurred in southeast Florida despite boat damage estimated at $0.5 billion (Mayfield et al. 1993). For purposes of this work, cases with ships lost on the coast or in port were excluded from the casualty lists unless explicit documentation of sufficient loss of life was found.

Storm surge, occasionally reaching heights of 20 to 30 feet, has been responsible for some of the largest losses of life associated with tropical cyclone at the coastline. Storm surge is the rise of water caused by the wind and pressure forces of a hurricane. These forces induce currents in the water. While the hurricane is in deep water, these currents produce little storm surge because converging water and the subsequent piling up is compensated by currents at greater depths moving water away. However, as the hurricane moves onto the continental shelf and makes landfall, the compensating currents are eliminated by the slope of the shelf and the shoreline, and the converging water rises. This rising water may over-top barrier islands or be funneled into bays and estuaries. In many cases, maximum storm surge heights measured relative to mean sea level have been recorded at the head of bays or even inland away from the shoreline. Generally, storm surge gradually rises to a peak and returns to normal, all in 6 to 12 hours. However, in intense or rapidly-moving hurricanes, rapid rises and falls on the order of minutes to an hour have been reported. Riding on top of the storm surge are waves which cause major damage when they break against structures.

Poor communication for many years left coastal communities virtually without warning of storm surge. In the United States, storm surge is blamed for 90% of hurricane-related fatalities (AMS 1973). Even with the many technological advances, much of the burgeoning coastal population of the Americas remains vulnerable to storm surge (Sheets 1990).

Inland deaths

Inland communities are also susceptible to tropical cyclone catastrophes. There, fresh-water flooding from excessive rainfall can lead to large numbers of deaths by drowning.

The number of inland deaths, indeed those near the coast and offshore as well, were only estimated by many of the references. Numerous entries in Appendix 1 appear rounded to the nearest ten, hundred, or even thousand. In addition, the data from many references suggest that the listed total is likely a lower threshold. For example, Millas (1968) indicates that there were 60 deaths in Dominica during a 1788 hurricane. He also presents a contemporary remark about Martinique from *The Gentleman's Magazine*:

> **...the number of persons who have lost their lives is so great, that we dare not mention what report estimates it at, for fear of exaggeration.**

Furthermore, there is evidence that casualty statistics were intentionally withheld by government officials on occasion (Perez). Hence, in some cases the actual number of deaths could be many multiples of the total shown in Appendix 1.

We also note that in the past several years the NHC has distinguished explicitly between deaths directly related to the forces of tropical cyclones (e.g., drowning due to storm surge) and those attributable only indirectly to the weather (e.g., due to a traffic accident on a rain-slickened road). For those systems, this study used only the direct death toll.

4. STORM LISTS AND STATISTICS

The catalog consists of two parts. Appendix 1 identifies Atlantic tropical cyclones documented as causing at least 25 deaths. Appendix 2 lists additional cases where the records suggest that the 25 count threshold may have been reached.

Storms causing at least 25 deaths

Appendix 1 contains three columns of information about each of 250 cases. The first column indicates the areas that experienced the greatest number of deaths. For events after 1949, it also contains the name of the cyclone. The second column provides the approximate range of dates[4] for the losses. The third column gives the total number of deaths and the source(s) of the information. (We note that some of these sources used the same original documents and, therefore, do not provide independent documentation.) A "+" indicates that totals from multiple sources were combined. Unless otherwise noted, the fatality totals

[4] Dates based on, or converted to, our current Gregorian calendar system which replaced the Julian calendar in the 16th century.

discussed below refer to the first (largest) number in the third column of Appendix 1.

The largest loss shown in Appendix 1 occurred in the Lesser Antilles in mid-October 1780, during The Great Hurricane. Estimates indicate that around 22,000 deaths occurred in that storm, with a total of about 9,000 lives lost in Martinique, 4,000-5,000 in St. Eustatius, and 4,326 in Barbados. Thousands of deaths also occurred offshore. Based on Appendix 1, the number of fatalities during The Great Hurricane of 1780 exceeds the cumulative loss in any year (except 1780) and, in fact, in all other decades (cf. Fig. 1a).

That hurricane also caused far more deaths than documented in any other storm. The second largest loss (the largest in the United States) came during the 1900 Galveston hurricane. Just after the storm, the Governor of the State of Texas estimated 12,000 fatalities (Lester 1900), but the storm summary of Ousley (1900) provides information supporting their "official" estimate of at least 8,000 lives lost. Three other storms killed around 8,000 people: 1974 Hurricane Fifi in Honduras; a 1930 hurricane in the Dominican Republic; and 1963 Hurricane Flora in Haiti and Cuba. In all, the list shows 39 instances of at least 1,000 fatalities among the 144 cases in which at least 100 lives were lost. The available documentation indicates that whenever there was a large loss of life from tropical cyclones, the predominant cause of death was drowning, not wind or wind blown objects or structural failures.

The Great Hurricane developed during mid-October. It was one of three tropical cyclones to kill more than 1,000 people *that month*. About 90% of the cases in Appendix 1 could be assigned to a specific month without ambiguity. Of those, about 40% occurred in September, 30% in August and 20% in October. No other month had as many as 5% of those cases. September also had the most deaths (40% of the total), followed by October (30%), August (15%), and each of the other months with less than 5%. Hence, August has more cases than October, but the large number of lives lost during the two deadliest October storms (The Great Hurricane of 1780 and Flora) skew the fatality statistics sharply toward October.

The years with the most entries in Appendix 1 are 1909 and 1933, which each had 5 cyclones responsible for at least 25 deaths.

Apparently, the 1780 hurricanes occurred during a 10- to 20-year period notable for numerous deadly storms in the Atlantic (Fig. 1b)[5].

[5] *Lloyd's List*, a source of many late-1700's entries, has not yet been reviewed for the 1800's.

Figure 2 shows the number of deaths in Appendix 1 stratified by 100-year periods. The figure indicates that the number of deaths generally increased with time. The 1700's were an exception. Then, maritime losses between 1760 and 1790 dominated the relatively large total. The 71,000 deaths in the 1900's occurred despite improvements in hurricane forecasting, and communication and warning systems. The increase appears to be related to the increased population at risk along the coast and inland.

Storms that could have caused at least 25 deaths

The second list (Appendix 2) chronicles 192 tropical cyclone cases that could be associated with at least 25 deaths. It also provides excerpts which support that interpretation. It seems certain that some of these candidates met the criterion, but their losses are not quantified:

> in 1553, 16 ships of the New Spain Flota were "struck by a hurricane" and not again "ever heard from". (Marx 1983)
>
> in 1640, 36 vessels were affected, with 4 thrown on shore; "nearly all the sailors drowned, *excepting* 260 that were saved" (Millas 1968; italics added for emphasis)

In other cases, the losses appear more modest and it is likely that less than 25 deaths are associated with the storm:

> in 1850, a "pilot boat sank" (Carney and Hardy 1969; Stevenson 1989).

Appendix 2 excludes incidents where "few", "several" or similar diminutive terminology was used to indicate the number of deaths.

5. CONCLUSIONS

The areal distribution of the deaths based on Appendix 1 is shown in the following table; but, as described below, these totals indicate losses that are likely significantly lower than the actual losses.

It is interesting that over 90% of the offshore losses occurred more than 200 years ago (before 1790), as did all 12 offshore losses of more than 1,000 people. For the continental United States, the Galveston storm was responsible for about one-third of the deaths (using data in Appendix 1 only).

The areal totals indicate a large death toll across the region. They do not, however, adequately reflect the threat of the

Areal distribution of deaths due to Atlantic tropical cyclones listed in Appendix 1. Totals are rounded.

Location	Fatalities
Greater Antilles	45,000 (29%)
Offshore Losses	35,000 (22%)
Lesser Antilles	35,000 (21%)
United States mainland (Galveston storm: 8,000)	25,000 (16%)
Mexico and Central America	20,000 (12%)
Elsewhere (Azores, Bahamas, Bermuda, Canada, Cape Verde Islands, South America, Ireland)	1,000 (<1%)

The disposition of the many casualties from shipwrecks near shore into offshore versus land losses is not certain.

individual intense hurricane. We note that the five tropical cyclones at the top of Appendix 1 (1780 Great Hurricane, 1900 in Galveston, 1974 Fifi, 1930 in Dominican Republic, 1963 Flora) account for about one-third of all the deaths over the past 500 years in storms for which quantitative data on deaths has been found. In fact, the 10 deadliest storms, while representing less than 5% of the cases in Appendix 1 and less than 0.2% of all tropical cyclones since 1492, account for almost one-half of the deaths indicated in Appendix 1.

These statistics point to the tremendous repercussions that small track changes have had (and will have) on population centers at risk from a potentially deadly storm. A shift of about 50 miles in the track of the 1900 Galveston hurricane could have meant far fewer deaths on that vulnerable island and (hence) overall. (This distance is comparable to the current average NHC 24-hour "across" track forecast error.) On the other hand, because of the growing population, there is an increasing number of highly susceptible regions which, only so far, have escaped such a catastrophic event (e.g., Sheets 1990). Damage statistics also illustrate this point. In 1992, Hurricane Andrew caused around $25 billion damage in South Florida (Rappaport 1993). An estimate indicates that a 20 mile northward shift of Andrew's track would have resulted in two to three times that much damage (Doig, 1992). Alternately, a southward shift of about 40 miles could have resulted in a negligible monetary loss to mainland Florida (but additional problems, including possible loss of life, for the less-populated Florida Keys).

The total number of deaths associated with Atlantic tropical cyclones of the past five centuries is likely much larger than implied by the data in Appendix 1. While it is a statistic that cannot be specified with confidence, a range for the total loss can be estimated. Appendix 1 provides a starting point and an

underestimate of the total loss. Using the first number in the column on deaths for each case (except using 8,000 for the Galveston storm), the total number of deaths obtained from the table is around 160,000.

To this, we add several considerations.

Appendix 1

(a). Many of the entries in Appendix 1 are minimum estimates (note the numerous ≥ or > symbols).

(b). We chose the first (largest) total in each case for Appendix 1 (except for the Galveston storm). In some cases, a smaller total could be more accurate.

(c). Some storms with footnote c in Appendix 1 may not have been tropical cyclones.

Overall, consideration (a) probably dominates. We estimate that the total for Appendix 1 is around 200,000.

Appendix 2

The number of entries in Appendix 2 is smaller than in Appendix 1 and some of these cases probably did not result in 25 tropical cyclone deaths. These storms are probably responsible for an additional number of deaths that is considerably less than 200,000.

Other events

(a). Greater than 25 deaths. We believe that most disasters responsible for very large losses are already documented in the Appendices, and that the remaining cases probably contribute less than 50,000.

(b) Less than 25 deaths. Based on information in *Monthly Weather Review*, the number of deaths associated with this item in the past 50 years is about 575. If this data is representative of the entire study period, then these losses are less than 10,000.

Based on the above, we speculate that the number of deaths in Atlantic tropical cyclones from 1492-1994 is between one-third and one-half million. Factors contributing to the uncertainties noted above include relatively few references to losses in Mexico and Central America and incomplete information about losses from Spanish ships in the 1500's-1700's and to slaves and natives of the region. There are sources that could provide more definitive information, including old newspapers reviewed in a more systematic manner. This phase of the research is underway.

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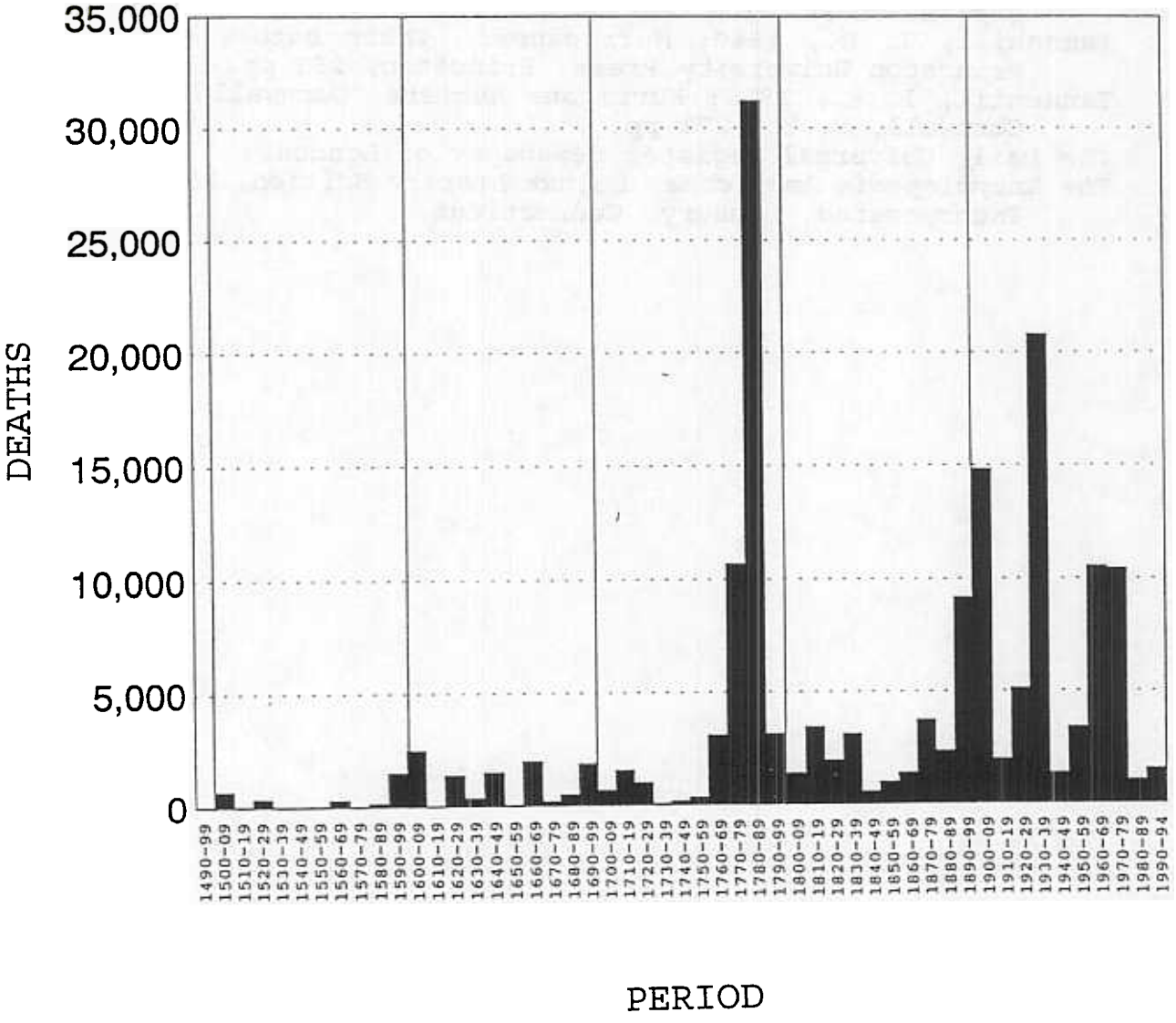

Fig. 1a. Atlantic tropical cyclone deaths based on Appendix 1 and shown in 10-year periods (except for 1990-94).

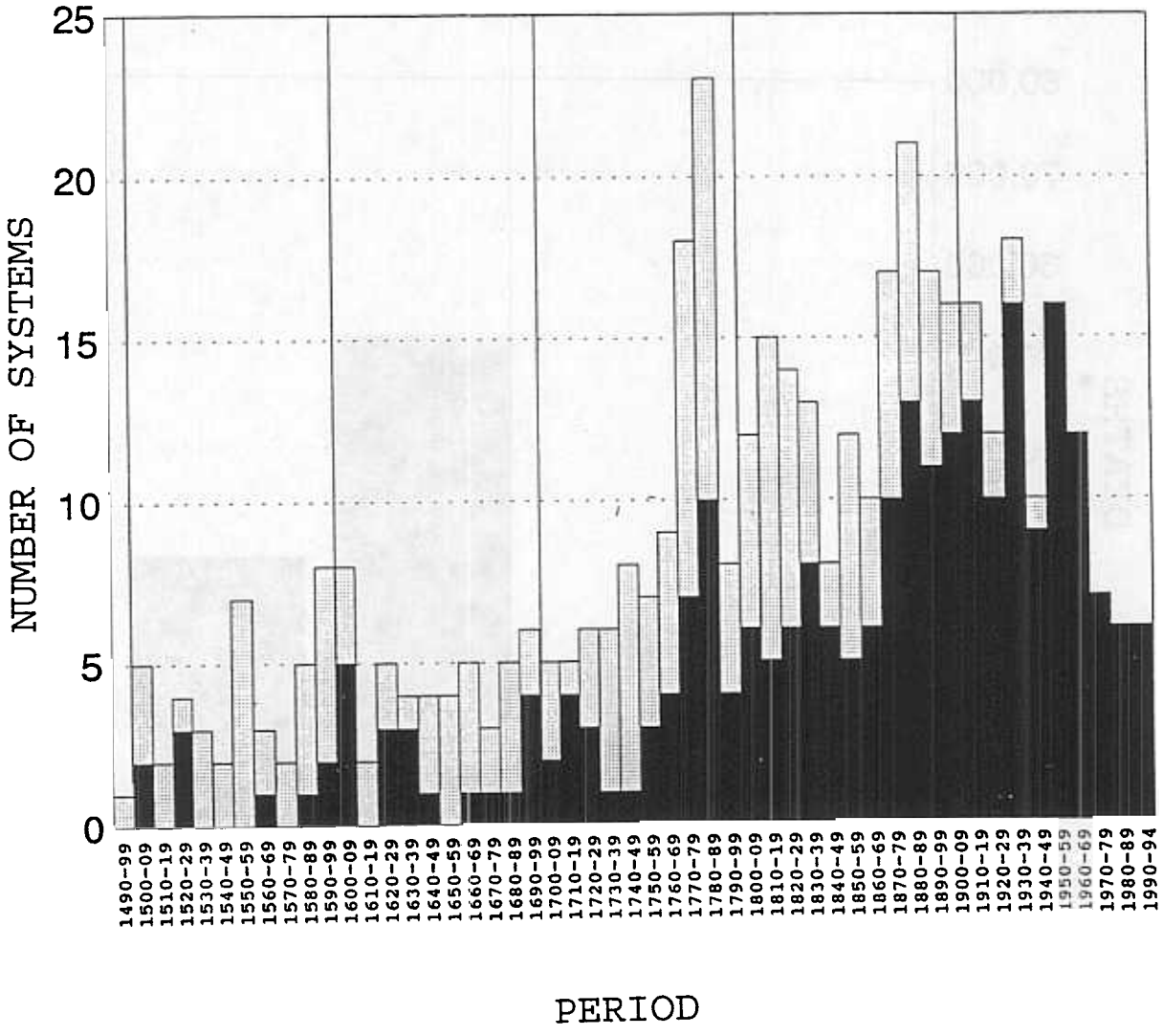

Fig. 1b. Number of Atlantic tropical cyclones listed in Appendix 1 (dark shading) and Appendix 2 (light shading), shown in 10-year periods (except for 1990-94).

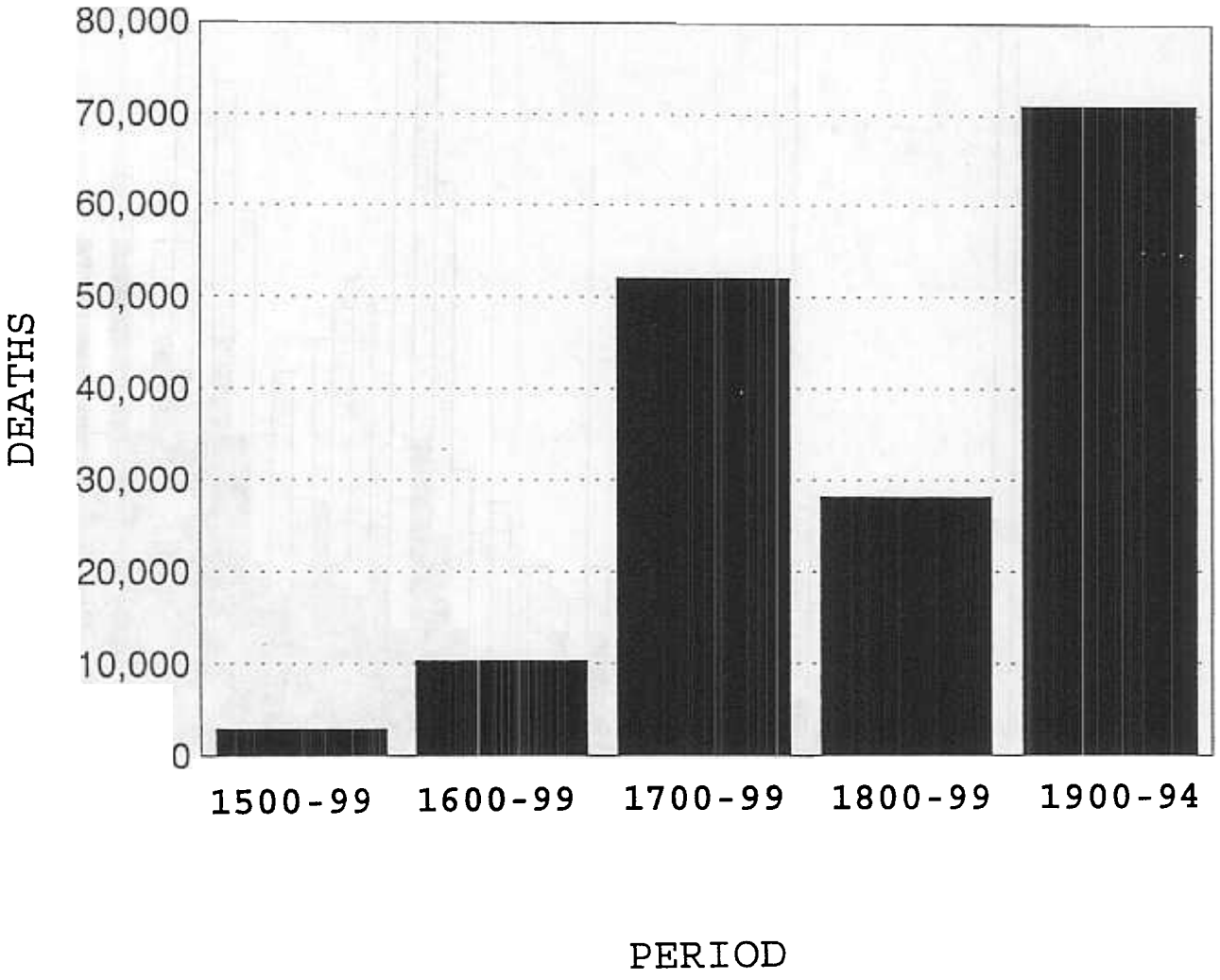

Fig. 2. Atlantic tropical cyclone deaths based on Appendix 1 and shown in 100-year periods (except for 1900-94).

APPENDIX 1

Atlantic tropical cyclones causing at least 25 deaths

Lower case footnotes refer to supplementary information in Notes to Appendices (pages 35-38). Upper case footnotes indicate sources listed in References to Appendices (pages 39-41).

	NAME & AREAS[a] OF LARGEST LOSS	APPROXIMATE DATES	DEATHS AND DATA SOURCE(S)
1.	MAR, STE, BAR, offshore	10-16 Oct 1780	>22000[B], 22000[M,L,s], >20000[AC]
2.	Galveston (Texas)	8 Sep 1900	≥12000[C,j], >8000-12000[AA,i], >8000[H]
3.	FIFI: Honduras	14-19 Sep 1974	8000-10000[AE], 3000-10000[R], >3000[G]
4.	Dominican Republic	1-6 Sep 1930	8000[AD], 4000[K,R], 2000[G,AC,R,T,BC,aq]
5.	FLORA: Haiti, Cuba	9/30-10/8 1963	8000[G], 7193[A,R], 7191[BC], >7186[R]
6.	Point Petre Bay (MAR)	6 Sep 1776	>6000[BD]
7.	Newfoundland Banks	9-12 Sep 1775	4000[L,z,c,aw]
8.	Puerto Rico, Carolinas	8-19 Aug 1899	>3433[(I,J)+AV+CG,m], >3064[(T,R,BC)+AV+CG]
9.	FL, GUA, PR, TUR, MAR	12-17 Sep 1928	>3411[R+AF+BB+I+BL,b]
10.	Cuba, CI, Jamaica	4-10 Nov 1932	>3107[AR+AU,ad], 2569[R], >2500[G], 2500[AC]
11.	Central Atlantic	16-17 Sep 1782	>3000[AX,BU,c,at,z]
12.	Martinique	Aug 1813	>3000[BD,z]
13.	El Salvador, Honduras	4-8 Jun 1934	>3000[W], >2000[T,ae], 506-3006[R]
14.	Western Cuba	21-22 Jun 1791	3000[M,J,BC], 257[Y], >30[AP]
15.	Barbados	10-11 Aug 1831	2500[B], 1525[B], >1500[L,AC,T,BC,BI,ah]
16.	Belize	6-10 Sep 1931	2500[BB], ≥1500[R], 1500[G,AC,T,BC]
17.	HAI, HON, offshore JAM	19-25 Oct 1935	>2150[T,af], 1168-2168[R+W], 1000-2000[AC]
18.	DAVID: DR, Dominica, US	8/29-9/5 1979	>2068[R], >2063[G]
19.	Offshore Florida (?)	1781	>2000[BP,z]
20.	South Carolina, Georgia	27-28 Aug 1893	2000-2500[X], 1000-2000[D,A,R], >1000[T]
21.	Eastern Gulf of Mexico	17-21 Oct 1780	2000[AP]
22.	Cuba	7-8 Oct 1870	2000[AH], 1000[V], ≥136[AG]
23.	Louisiana	1-2 Oct 1893	2000[D,T,R], 1800[A]
24.	Guadeloupe, Martinique	14-15 Aug 1666	<2000[M,J,AG,AJ,d,z]
25.	Martinique	Aug 1767	1600[I]
26.	Mexico	28 Aug 1909	1500[T,BW], 1000-2000[V]
27.	W Cuba, Straits of FL	Oct 1644	<1500[M,e]
28.	Guadeloupe, Puerto Rico	26 Jul 1825	>1300[BK], >500[I], 374[I,T,AY], 372[BC]
29.	Offshore Nicaragua	1605	1300[M,ak]
30.	GORDON: HAI, FL, CR, DR	8-21 Nov 1994	1145[CA,bc]
31.	Jamaica, Cuba	2-5 Oct 1780	≥1115[AR+M,w], >415[M], 42[BB]
32.	Straits of Florida	5 Sep 1622	>1090[M,z], 590[M]
33.	Gulf of Mexico	early Nov 1590	>1000[BD,c]
34.	Offshore Barbados	27 Sep 1694	>1000[BD]
35.	S Bahamas, Straits of FL	30 Jul 1715	>1000[BD], 1000[M]
36.	Havana (Cuba)	15 Oct 1768	>1000[Y,AG,AJ,BB,BC], >100[M,n], 43[B,AK]
37.	Veracruz (Mexico)	1601	1000[M,c]
38.	HAZEL: HAI, US, GRE, CAN	5-13 Oct 1954	1000[G], 600-1200[AD], 575-1175[R]
39.	INEZ: Caribbean, Mexico	9/27-10/1 1966	1000[R]
40.	Cuba, PR, Turks Islands	1-5 Sep 1888	921[R+I]
41.	St. Thomas, Puerto Rico	29 Oct 1867	>811[I,BC]
42.	Texas, Cuba	16-17 Sep 1875	800[BS,q], 180[C], 176[R,A,BW]
43.	Cuba, offshore Bermuda	20 Oct 1926	709[(N,AI)+V]
44.	Martinique, TUR, PR	18-22 Aug 1891	703[R], >700[I], 700[BC]
45.	Georgia, South Carolina	27 Aug 1881	>700[A], 700[D,R]
46.	New England	21 Sep 1938	(682-700)[BX], 600[D,R], 494[R]
47.	JANET: Mexico, BEL, BAR	22-28 Sep 1955	681[R], 538[G]
48.	FL Keys, S Texas, Cuba	9-14 Sep 1919	>(600-900)[(D,R,BW)+AI]
49.	MAR, DOM, New Eng., BAH	14-19 Aug 1788	>(600-700)[AH+AV+J,f]
50.	Offshore Martinique	Oct 1695	>600[BD,z]

51.	W Atlantic, Nova Scotia	24-27 Aug 1873	>600[V], ≥600[AQ], 223[R,AQ], 128[BS]
52.	Southwest Caribbean Sea	1708	578[M]
53.	AUDREY: SW LA, N Texas	27 Jun 1957	550[R], >509[F], 390[D,R]
54.	Atlantic	10 Aug 1591	501[J,AG,AJ,z]
55.	Offshore DR	11-12 Jul 1502	>500[H,BE]
56.	Offshore Puerto Rico	1720	>500[M,BD]
57.	Georgia, SC, NC	7-9 Sep 1804	>500[A,CF], 500[AV], >84[L]
58.	Florida east coast	1683	496[BP,c]
59.	Dominica	9 Sep 1806	457[Y], >300[BL], ≥131[T,BC]
60.	Martinique	13-14 Aug 1766	440[M,BL], 400[BL], >100[Y], 90[(AJ,BC),v]
61.	North Carolina	11 Sep 1857	≥424[AV+CI], >400[L]
62.	Florida Keys	2-3 Sep 1935	409[R], 408[D], 405[R]
63.	SE TX, Gulf MX, CU, JAM	12-17 Aug 1915	≥405[R+AR], ≥403[R+AI+AR]
64.	Jamaica	8 Sep 1712	>400[AR]
65.	Jamaica, Cayman Islands	8-9 Sep 1722	400[M,AG,AJ,T,BC,z]
66.	Louisiana	10-11 Aug 1856	400[A], 320[X], <200[S], >155[L], >250[BS]
67.	U.S. east coast, W ATL	14-15 Sep 1944	390[D,R]
68.	Offshore SC, BAH, TUR	9/30-10/3 1866	>387[V+AH], >383[V+BH]
69.	St. Vincent, Barbados	10-11 Sep 1898	383[B+BB], 283[B]
70.	DONNA: Florida, PR, BAH	4-5 Sep 1960	>364[R+I,t]
71.	Louisiana, Mississippi	20 Sep 1909	353[CB], 350[D,R,T]
72.	FL, N Gulf States, BAH	16-21 Sep 1926	349[BS+V+AN], 265[D+V+AN], 264[R+V+AN]
73.	GILBERT: MX, JAM, HAI	9-14 Sep 1988	327[(G,R)+CA]
74.	Cuba, offshore Florida	12-18 Oct 1944	318[G,R], 300[N]
75.	HILDA: Mexico, Cuba	11-16 Sep 1955	304[G,R]
76.	Gulf of Mexico	21 Oct 1631	≥300[BD,(BF,c,al)]
77.	South Carolina	27-28 Sep 1822	300[L], 200[A,X,R]
78.	Bahamas, PR, DR, FL	23-27 Jul 1926	>287[AM+R,x]>212[AM+R], 60[BB]
79.	Near Cape Canaveral (FL)	1563	284[BP,c]
80.	Hispaniola, PR, Jamaica	8/28-9/3 1772	>280[M+I+AR+BN,z,av], 280[BD]
81.	Mississippi, LA, Jamaica	24-29 Sep 1915	≥279[(D,R,BW,CB)+AR]
82.	HATTIE: Belize	26-31 Oct 1961	275[G,R], 264[BB], 262[BC]
83.	ALLEN: Haiti, US	4-7 Aug 1980	259[G], 249[F], 236-261[R]
84.	CAMILLE: MS, LA, WV, VA	17-18 Aug 1969	259[R]
85.	CHARLIE: Jamaica, Mexico	15-20 Aug 1951	≥257[R]
86.	Puerto Rico	26-27 Sep 1932	257[I], 225[G,I,R,BC]
87.	St. Lucia, Dominica, BAR	21 Oct 1817	>(251-252)[AH], >200[BD]
88.	Cuba	Sep 1623	250[BP], 150[M]
89.	CLEO: Lesser Antilles	22-26 Aug 1964	217[R], 213[BC], 200[G]
90.	MX, offshore GRE, JAM	16-23 Aug 1944	≥216[R], ≥116[R], 116[G]
91.	JOAN: NIC, CR, COL, VEN	14-22 Oct 1988	216[G,g]
92.	Mexico	19-20 Sep 1944	203-303[R], 200-300[G]
93.	Guadeloupe	1 Sep 1821	>200[Y], 200[P]
94.	Dominica, DR	20-23 Sep 1834	>200[BA,BC], >100[AG]
95.	Upper Texas coast	Nov 1527	200[F,z,c], 191[R], 162[CH,bd]
96.	Barbados	10 Aug 1674	200[J,AG,AJ,T,BC]
97.	St. Kitts	Before 10 Nov 1758	200[BD,BN,au,z]
98.	Cuba	23-25 Sep 1894	200[V]
99.	Jamaica	17-19 Nov 1912	200[AL], >142[AR], 142[BB], 100[G,T,BC]
100.	DIANE: US NE states	16-19 Aug 1955	200[R], 184[D]
101.	Southeast Florida, Cuba	17-18 Oct 1906	>193[V+(R,D),u]
102.	Cayman Islands, JAM, MAR	8-15 Aug 1903	>188[AH], >183[AH+(AR+BB)], >149[AH+AF]
103.	Tampico (Mexico)	24 Sep 1933	184->200[V]
104.	BRET: VEN, NIC, COL	7-11 Aug 1993	184[R]
105.	Jamaica	10/31-11/1 1744	≥182[M], 182[J,AG,AJ]
106.	Island near Nevis, Cuba	17 Aug 1669	≥182[CC,z]
107.	Delaware coast	2 Sep 1785	181[BQ,z]
108.	Isabel: Puerto Rico	6-7 Oct 1985	180[R,c,p], ≥(86-500)[AM]
109.	Cuba, TUR, S Texas	8/30-9/5 1933	≥179[W+(D,BW),o]
110.	Georgia, SC, NC	2 Oct 1898	179[A], >(150-180)[R]
111.	North coast of Colombia	1504	175[BD,c]
112.	Dominica	20 Sep 1806	>165[J,z]

113.	W Cuba, FL Keys, CI	10-11 Oct 1846	>164[AB+AJ+L+AT+BZ+(AK,AP),bb]
114.	North Carolina, Virginia	2-6 Sep 1775	>163[(R,AV)+BD+BN,ax,z]
115.	East Texas	12-13 Oct 1886	150[T,A],126[BS,ao]
116.	Massachusetts	6 Oct 1849	143[BX],27[L,c]
117.	JAM, PR, Cuba, St. Croix	24-29 Aug 1785	>142[AO,z]
118.	Near STT, SW Atlan., PR	2-3 Aug 1837	>141[AW+AY]
119.	Labrador coast, W Cuba	8-15 Oct 1882	140[AQ,c],≥36[R]
120.	Central Atlantic	9 Oct 1913	135[BS,ap]
121.	Mississippi, AL, NW FL	27 Sep 1906	134[D],133-134[R]
122.	Florida, Georgia, SC	28-29 Sep 1896	>130[A],114[T,R],>100[T],100[AV]
123.	JAM, near HAI & DR, HAI	9-13 Nov 1909	>130[W+AR,c],>97[W+AH]
124.	AGNES: US NE states, CU	19-22 Jun 1972	129[R+D]
125.	Hispaniola	12 Sep 1724	≥121[BD]
126.	Between JAM and England	Aug 1803	121[BY]
127.	Atlantic (?)	Before 3 Dec 1779	120[BN,c,z,ay]
128.	Roanoke Island (NC)	1588	<116[BR,an,c]
129.	North Carolina, Bahamas	11 Sep 1883	106[R,l]
130.	Gulf coast, NC	3-10 Oct 1837	≥105[BH+L+CI,s]
131.	Offshore Mexico	26-27 Sep 1600	≥103-<940[BD,c,ai]
132.	South Carolina, NC	15 Sep 1752	103[L+CG],28[R+CG]
133.	Cuba, Southwest Florida	13-18 Oct 1910	≥101[W+D]
134.	Cuba	4-5 Oct 1844	101[AK],>100[T]
135.	Jamaica	1692	>100[AR,ab]
136.	Honduras	23 Sep 1787	>100[M],100[M,J,AG,AJ,AX,BC]
137.	Cuba	27-28 Aug 1794	>100[AH+BP]
138.	Jamaica	17-18 Oct 1815	>100[AH,y]
139.	Puerto Rico	5 Sep 1852	>100[AH,ac]
140.	Montserrat to VI	28-29 Aug 1924	>100[R],34[BB]
141.	FRANCELIA: Guatemala	8/28-9/4 1969	>100[G],100[R]
142.	Belize	2 Sep 1787	≥100[AO]
143.	Martinique	4-5 Sep 1713	100[B,z]
144.	Georgia	14-15 Sep 1824	100[L],≥83[L]
145.	Dominican Republic	25-28 Sep 1908	98[G]
146.	Charleston, SC	14 Sep 1700	≥97[L]
147.	DIANA: Mexico	5-8 Aug 1990	96[R]
148.	ALMA: Honduras, Cuba, FL	4-8 Jun 1966	90[R]
149.	Cuba	13-14 Jun 1904	>87[W]
150.	Curacao, PA, US E coast	9/21-10/5 1877	>84[AB+V+CF,r],<=16[AG]
151.	Windward Islands, BER	8-15 Sep 1921	>80[R+R]
152.	Near NC Outer Banks	21 Aug 1863	80[V]
153.	Newfoundland Banks	26 Aug 1883	80[R]
154.	Dominican Republic	22-24 May 1948	80[R,c]
155.	CARRIE: SW of Azores	21 Sep 1957	80[R]
156.	ELOISE: PR, US, HAI, DR	13-24 Sep 1975	80[R]
157.	Jamaica, Cuba, Florida	22-29 Sep 1917	≥78[AR+R+W]
158.	BETSY: SE Florida, SE LA	7-10 Sep 1965	76[R]
159.	GERT: Mexico, HON, NIC	14-21 Sep 1993	76[R]
160.	Cuba, Bimini	23-29 Sep 1935	74[W],49[R,T,BC]
161.	Western Cuba	near end Oct 1525	73[H],>72[M],72[BD]
162.	US E coast waters, Cuba	21-24 Oct 1878	>72[R+AI+AQ+AV],>71[R+AI+AV]
163.	Jamaica	15-16 Aug 1933	≥70[AR]
164.	South Carolina	16-17 Sep 1713	70[L,z]
165.	Rio Grande Valley	4-6 Aug 1844	70[L,T,A,BW]
166.	EMMY: Azores	3-4 Sep 1976	68[R]
167.	Near St. Augustine (FL)	29 Aug 1880	68[V,BH]
168.	Mexico	15 Sep 1933	≥63[W]
169.	Near Tortola, Montserrat	Aug 1809	≥62[BY+AO,z]
170.	Offshore Mexico	12 Sep 1600	>60-<897[BD,ai]
171.	Off US SE coast, FL	11/30-12/2 1925	≥60[AM+R],50[A]
172.	Maritime Provinces	22-24 Aug 1927	≥60[V+R,c]
173.	Cuba	Oct 1527	70[BO,z,am],60[M,I]
174.	CAROL: US NE states	31 Aug 1954	60[D,R]

175.	BEULAH: TX, N MX, MAR	5-22	Sep	1967	≥59[R], ≥58[R+BL]
176.	New England	3-4	Oct	1841	≥58[L,c]
177.	Martinique, SW Atlantic	7/26-8/3		1837	≥57[AW,ag]
178.	U. S. mid-Atlantic coast	15-17	Sep	1903	≥57[V]
179.	Cuba	9/20-10/1		1895	≥56[V]
180.	S BAH, FL, FL Straits	15-16	Jul	1733	≥56[M,z]
181.	HUGO: GUA, MON, SC	17-22	Sep	1989	56[BT], 49[R]
182.	ALICE: NE MX, TX	24-26	Jun	1954	55[R]
183.	Offshore central FL, VA	20	Oct	1870	>52[BP+AV]
184.	Off Bermuda			1832	52[BY,c]
185.	South Texas	6-7	Sep	1921	51[BW,c,az]
186.	SE Florida, LA, MS	17-19	Sep	1947	51[D,R]
187.	DOROTHY: Martinique, DOM	20	Aug	1970	51[BC], <=51[R], [AF,BL]
188.	Newfoundland Banks	23-24	Aug	1935	>50[R,c]
189.	Bahamas	4-5	Sep	1883	≥50[AG]
190	Cape Cod (Massachusetts)	1	Nov	1778	(50-70)[BX,ba,c,z]
191.	Barbuda	25	Oct	1760	50[M]
192.	North Carolina	1	Sep	1772	50[L,AV,z]
193.	Dominica	8/28-9/1		1916	50[V,AH]
194.	Georgia, SC, NC	11-12	Aug	1940	50[D,R]
195.	Honduras	23-28	Sep	1941	50[G,R]
196.	Louisiana	11	Aug	1860	≥47[L]
197.	NC, coastal Virginia	18	Aug	1879	≥46[CG+AV]
198.	CARLA: Texas	10-12	Sep	1961	46[D,R]
199.	Louisiana	19	Aug	1812	≥45[L,z]
200.	North-central Atlantic	8	Sep	1897	≥45[V]
201.	Louisiana, MS, Alabama	27-28	Jul	1819	≥43[L]
202.	Offshore US E coast	23	Aug	1806	42[AV]
203.	Velasco (Texas)	21	Jul	1909	41[D,R,BW]
204.	Western Atlantic	6-7	Sep	1853	≥40[BS,as]
205.	U. S. mid-Atlantic coast	9-12	Sep	1889	≥40[R], 40[A]
206.	Western Cuba	5	Oct	1634	40[M,BD,aj]
207.	St. Marks (Florida)			1758	40[A,z]
208.	Freeport (Texas)	13-14	Aug	1932	40[D]
209.	Puerto Rico	15	Sep	1626	≥38[M,I]
210.	Near Cape Florida (FL)	7	Sep	1838	≥38[BP]
211.	HILDA: Louisiana	3-4	Oct	1964	38[D,R]
212.	ELLA: HAI, CU	8/30-9/6		1958	37-39[R]
213.	South Carolina	4	Sep	1834	37[L]
214.	Northeast Gulf of Mexico	26	May	1863	37[V,c]
215.	W Atlantic, US east coast	24	Aug	1635	≥35[BX+AV]
216.	Mississippi	15	Sep	1821	≥35[S]
217.	Trinidad, CU, VEN, JAM	6/27-7/3		1933	≥35[R+W+AR]
218.	BETSY: GUA, PR	11-12	Aug	1956	≥34[R+I], 34[G+I], 27[BC]
219.	Cuba, Florida Keys	10-11	Oct	1909	≥34[W+Z+R]
220.	Gulf of MX and states	4-10	Jul	1916	≥34[W]
221.	Southwest Louisiana	6	Aug	1918	34[D,R,CB]
222.	North Carolina, MA	2	Nov	1861	≥33[L+(AV,CF)+H]
223.	Western Cuba	27	Aug	1826	33[BY,c,z]
224.	Near Maritime Provinces	19	Jun	1959	33[R,c]
225.	Southeastern Bahamas			1609	≥32[BV,z]
226.	FRAN: Cape Verde Islands	15-17	Sep	1984	31[CA]
227.	ALBERTO: Georgia, AL	4-7	Jul	1994	30[CA]
228.	Offshore Yucatan	10-13	Aug	1880	≥30[R+V], 30[BS,ar]
229.	Jamaica	18-19	Aug	1880	≥30[B,AR], ≥12[AQ], 12[R]
230.	EDITH: Nicaragua, Aruba	6-11	Sep	1971	30[G,R]
231.	GILDA: Honduras	25-27	Sep	1954	29[R]
232.	Indianola (Texas), Cuba	17-20	Aug	1886	>28[R+X+AI], >20[AQ+AI]
233.	Virgin Islands	13-16	Aug	1793	≥28[AH+BN,h]
234.	South Carolina, Florida	11-13	Oct	1893	28[R+R]
235.	Tobago	11	Oct	1847	≥27[O]
236.	Virgin Islands	21	Aug	1871	≥27[I]

237.	Coastal New England	9-13 Oct 1878	≥27[R]
238.	Offshore Jamaica (?)	23 Sep 1799	27[BG,c]
239.	Texas, Gulf of MX, JAM	15-19 Aug 1916	27[V+R],25[V+AH]
240.	DORA: Mexico	12 Sep 1956	27[R]
241.	U.S. mid-Atlantic coast	7-13 Sep 1854	≥26[AS]
242.	NC, SC, offshore Bahamas	11-15 Jul 1916	≥26[V,c]
243.	Bahamas, Florida	14-16 Sep 1945	≥26[R]
244.	Cuba, Alabama	25-31 Aug 1950	≥26[W+R]
245.	SW Atlantic, CU	9/26-10/9 1873	26[V,aa]
246.	ANDREW: FL, LA, Bahamas	23-27 Aug 1992	26[R]
247.	SC, offshore NC, GA	24-25 Aug 1885	≥25[R+V]
248.	Georgia, South Carolina	27-29 Aug 1911	25[R]
249.	Louisiana	25-26 Aug 1926	25[D,R]
250.	CONNIE: North Carolina	11-13 Aug 1955	25[D]

APPENDIX 2

Atlantic tropical cyclones that may have caused at least 25 deaths

Lower case footnotes refer to supplementary information in Notes to Appendices (pages 35-38). Upper case footnotes indicate sources listed in References to Appendices (pages 39-41).

AREAS OF GREATEST LOSS	DATES	NOTES
251. West Indies	1495	"When the hurricane reached the harbor, it whirled the ships round as they lay at anchor, snapped their cables, and sank three of them with all who were on board."[CD]
252. Bahamas	Jul 1500	two caravels with all their crews "swallowed up" in a storm[M,BO]
253. Honduras	16 Sep 1502	"a boat sent to the shore was, in returning, swallowed up by a sudden swelling of the sea, with all on board..."[BO,c]
254. DR	12-14 Aug 1508	"...many men were lost in this city and in the greater part of this island..."[M]; "destroying...the entire population of Buenaventura" (on 3 August [Julian calendar?])[AD]
255. Puerto Rico	Jul 1515	"death of many Indians"[J,I]
256. Near Jamaica	1519	18 men from caravel survived a "hurricane"[CD]
257. NC	Jun 1526	"...Spanish brigatine was lost off Wilmington, North Carolina..."[AV]
258. Puerto Rico	31 Aug 1530	"Uncounted number of deaths by drowning."[AY]
259. Puerto Rico	1537	"many slaves were drowned"[M,J,I,c,z]
260. NW Cuba	1537	2 ships lost[BD,c,z]
261. DR	20 Aug 1545	killed "many", "large number of" people[M,AD,z]
262. Mexico	1545	loss of life from vessel wrecked in "norther"[BD,c,z]
263. Off FL Keys	1550	Spanish nao (ship) **Vitacion**, 200 tons, "lost during a hurricane."[BP]
264. Gulf of HON	1551	"ship with many persons...all drowned"[M]
265. Texas	1553	16 ships of the New Spain Flota were "struck by a hurricane" and not again "ever heard from."[BD]
266. Cuba	Nov 1554	"...the admiral's ship was sunk..."; a small caravel sank with all but two people drowning[M,z]
267. Mona Passage	1554	Spanish nao wrecked during hurricane[BE,c,z]
268. Off FL	19 Sep 1559	"great loss of life...by a tempest from the north"[BD,z]; "great loss (less than 1,500) of seamen, passengers"[CH]
269. Off NW FL	1559	6 Spanish ships lost "in a hurricane"[BP,z]
270. NC (?)	1564?	"...none of the people survived..." from a wreck on the coast[AV]
271. FL E coast	22 Sep 1565	"...surely (several French vessels) must have been lost."[M] "In a severe storm, most of the French vessels were lost at sea"[BP] on unknown date, but apparently in same storm. 529 surviving soldiers and sailors accounted for from original 600.[CH]
272. FL coast	1571	**San Ignacio**, 300 tons, and **Santa Maria de la Limpia Concepcion**, 340 tons, "lost on the Florida coast during a storm....only a few survivors."[BP,c]

273	Gulf MX, MX		1574	4 ships sank in a "bad storm". 5 perished from one of the vessels; loss on others unknown. Ships were part of New Spain Flota that left Spain on 29 June.[BD]
274.	Bahama Channel		1586	Loss of two 120-ton Spanish navios attributed to hurricane.[BE] Six or seven others lost, including the **San Juan**, 120 tons.[BP]
275.	FL E coast		1589	A ship of the fleet commanded by Perez de Olesbal wrecked. "Forty of her crew were rescued."[BP,z]
276.	BAH Channel near	9 Sep	1589	4 ships "struck by a hurricane" sunk in Bahama Channel[BD,z]; two were the **Santa Catalina** and the **Jesus Maria**[BP]
277.	BAH Channel	Sep	1589	Four-day storm, "On the first day alone a total of ten naos were swallowed by the sea."[BE,z]
278.	Atlantic near end	Aug	1591	22 vessels perished[J,AG,AJ,z]
279.	At sea		1591	"Over a hundred ships, galleons and merchant ships...were wrecked, their crews drowned, their riches lost."[CD,z]
280.	Coastal FL		1591	Encountering storms, "29 ships were lost, many on Florida's coast"[BP,z]
281.	Atlantic mid	Aug	1591	five or six of a group's largest ships and all their crews were lost[J,AJ,z]
282.	At sea		1591	Spanish nao lost in Atlantic or Caribbean Sea[BE,c,z]
283.	At sea		1594	ship lost in Caribbean Sea[M]
284.	HAI, DR, CU		1605	"loss of three ships"; "...some men escaped..."[M]
285.	Cumana (VEN)		1605	"four galleons" lost near Santa Margarita[M,h]
286.	Atlantic	Jul	1609	one ship "sank immediately"[H,z]
287.	Near Bahamas	4 Aug	1609	one ship sank[L,z]
288.	Offshore MX	30 Aug	1615	**San Miguel** sunk in storm. "Nothing was saved, not even the crew or passengers."[BD]
289.	Puerto Rico	12 Sep	1615	"algunas Muertes" (some deaths)[I]
290.	BAH Channel		1622	loss of 2 Spanish naos attributed to hurricane[BE,z]
291	Offshore FL		1622	Spanish nao **Santa Ana Maria**, 180 tons, "lost during a storm off the Florida coast"[BP,z]
292.	Off S PR	Oct	1638	2 British ships lost; two known survivors[BE]
293.	Western Cuba	11 Sep	1640	36 vessels affected; 4 thrown on shore; "...nearly all the sailors drowned, excepting 260 that were saved..."[M]
294.	Hisp. to FL	24 Sep	1641	8 ships lost and "many people perished"[M]; many ships lost in the Bahama Channel, and no survivors from 4 wrecked ships, with some survivors on a fifth ship along NE Florida coast[BD]
295.	Lesser Ant.	Sep	1642	men in 22 ships drowned[M]
296.	St. Kitts		1650	"...28 ships were thrown on the roadstead of St. Christopher, the sailors drowned..."[M]; "During two different hurricanes a total of twenty-eight merchantmen, a great number of lives...lost."[BD]
297.	Leeward Is.	23-24 Sep	1652	3 ships and crew missing[M]
298.	BAR, STV	13 Jul	1653	1 ship and crew lost; at St. Vincent, "death of many savages"[M]
299.	Guadeloupe		1656	"Every vessel at anchor in the roads was wrecked and most of their crews drowned."[J,Y,AG,AJ]
300	Antigua		1666	"During a hurricane 2 unidentified English

				warships were lost in English Harbor with a great loss of lives."[BD,z]
	Virginia	6	Sep 1667	"burying in the ruins much goods and many people"[AV]; many people lost their lives..."[L]
302.	Atlantic Before	23	Sep 1669	"Yesterday (26-30 Sep 1669) came in a Veffel from Rochel, telling us of a Report in that place that feveral New-found-land fhips have been lately cast away by ftorm."[CE,z]
303.	St. Kitts Before	9	Dec 1669	"...terrible Hurricane neer **St. Christophers**, by which 25 of our Merchant fhips and others have been cast away." Possibly related to 19 Dec 1670 (Julian date) report of "violent" hurricane for around eight hours at St Christophers "...about the end of September last."[CE,z]
304.	Offshore PR		1673	warship wrecked, "Most of the (500) pirates made it ashore to Puerto Rico..."[BD,c]
	Barbados		1675	"number of deaths...must have been considerable"[B]
	Martinique	3	Aug 1680	"During a violent hurricane...over twenty large French ships and two English ships were totally lost in Cul-de-Sac Bay and the loss of life was great."[BD]
307.	DR	15	Aug 1680	"submerged...many vessels...(including) twenty-five ships of France...causing the death of most"[M]; several Spanish ships lost as well.[BD]
308.	W Carib. Sea		1681	"loss of lives...considerable" from several ships[M]
309.	Nevis		1689	"A dreadful mortality swept away one-half of the inhabitants of Nevis."[J,AG]
310.	FL Keys	4	Oct 1695	offshore loss of 933 ton warship[M,z]
311.	NW Cuba		1696	"An unidentified navio was wrecked at Playa de Sabarimar, 7 leagues east of Havana, in 35 feet of water, during a storm..."[BD,c]
312.	Virginia, MD	18	Oct 1703	"several (vessels) driven to sea, and no more heard of."[AV,L]
313.	Havana (CU)		1705	4 men of war, "with most of their crews, were lost"[M,BD]
	US E coast	6	Nov 1706	14 ships foundered and "others were given up for lost."[AV,L]
315.	Cuba		Sep 1714	frigate **San Juan** lost[M,AP]
316.	Louisiana	12-13	Sep 1722	"During a hurricane...a large number of unidentified ships were sunk at and near New Orleans."[BD,z]
317.	Jamaica	2	Nov 1726	"Many lives lost with at least 18 at sea."[AR]
318.	NC	13	Aug 1728	All of crew lost from ship sunk off Okracoke Island[AV]; "only a few survivors" --no date[BD]; "Many ships were lost, one as far north as few miles off Ocracoke."[CF]
319.	Jamaica	1	Sep 1730	ship of war (carrying ex-President of Panama) lost[M]
	W'ward Pass.		1731	Most men on ship **Bridget and Kitty** perished. May be related to one death on **Dolphin** upset in 24 June squall.[M]
321.	Lesser Ant.	10-11	Jul 1733	crews of multiple ships lost; other losses on land[M,AP,z]; "a total loss of lives" from one ship at St. Kitts[BD]
322.	DR	9	Sep 1737	"carried away...negroes...into the sea"[AG,AJ]
323.	St. Kitts		Oct 1737	"During an October hurricane an English merchantman...was sunk at Basseterre and only one of the crew survived."[BD]

324.	Puerto Rico	11-12 Sep 1740	2 ships of war lost[M]
325.	VI, PR	27-28 Oct 1742	2 ships lost[M]
326.	Jamaica	20 Oct 1743	"...a great number of marines were drowned."[AG]
	Carib. Sea	1746	13 of 21 ships on way from Brazil to Lisbon "disappeared without a trace" in a hurricane.[BD]
	C Atlantic	26 Sep 1747	"The Fleet from Barbadoes, &c. on the 15th Ult. (Julian date) met with a violent Storm in Latitude 39 North, in which the **Lyme Man of War** of 20 Guns Overfet, and all the Crew except four Perifh'd....The **Homer,** Gardiner, from Barbadoes for Leverpool, and a ship for Falmouth, Founder'd at the fame Time, and only One Man from on board the Latter was faved."[BN,c]
329.	Gulf of HON	29 Sep 1749	"The Centaur, Snow, from the Bay of Honduras for Leghorn, met with a violent Hurricane foon after he left the Bay, in which he loft all the Mafts and Sails, and put into Carolina to Refit the 3d of November. —Capt. Cullam, of the Arthur, writes from the Bay on the 18th Sept. (Julian Calendar date) that the fame Storm put moft of the Veffels afshore at the Bay, but he rode it out without Damage, and that feveral Veffels for Europe & North America, fail'd from thence with Capt. Snow, who 'tis fear'd have met with the like or worfe Misfortune.[BN]
330.	MA, NC	8 Oct 1749	"During a hurricane...seven unidentified ships were wrecked on Martha's Vineyard and many lives were lost." Two merchantmen wrecked north of Ocracoke. The **John & Jane** "foundered 9 leagues seaward of the Cape Fear bar."[BD]
331.	Offshore NC	17-18 Aug 1750	4 Spanish vessels wrecked off Outer Banks[AV,BD]. No lives lost from the **Nuestra de Solidad**, with unknown losses from the **El Salvador** and two unidentified ships.[CI]
	St. Kitts	24 Jul 1751	"During a violent gale" the **Friendship** was wrecked and none of the crew survived.[BD] Vessel identified as a brig; storm apparently also felt off Havana.[BN]
	Cuba	26 Sep 1752	"During a hurricane...sixteen unidentified ships were lost near Havana."[BD] The **Speedwel** "fuppos'd" to have been lost[BN]
334.	Off Florida	22 Oct 1752	Ships lost in "Hurricane": **Alexander**, **Lancafter**, **Dolphin**, **Q. Anne**, **May**, **Rhode Island**, **Stratia**, a Spanish schooner, and three other vessels[BN]. Ships missing: **Mary and Prifcilla**, **Pompey**, **Phillis** (7 drowned), **Three Friends**, **Kingfton**, **Ruby**, **Bofton**, a schooner, a ship, and a Spanish Man of War[BN]; 12 ships lost in "Gulf of Florida"[BD]; Also affected North Carolina.[BN]
335.	TX, Gulf MX	4 Sep 1766	During a "hurricane", 5 ships wrecked on Galveston Island, and a "...majority of the treasure and persons on these ships were saved."[BD] One merchantman vessel from the Spain Flota possibly lost in the Gulf of Mexico in storm alternately indicated as on the 1st-4th, or in the middle of

			September.[BN]
	Guadeloupe	6 Oct 1766	"...twelve inbound slave ships from Africa (to Isle de Saints) were also totally lost."[BD]
337.	NW FL	23 Oct 1766	"...all the Crew drowned except three" in the brig Wetherill during "a moft terrible Hurricane"[BN]
338.	Coastal NC	21 Sep 1767	"number" of vessels lost in "violent storm"[BN]
	Coastal NC	5-6 Sep 1769	"The Neptune, Watts, from N. Carolina to London, failed on the 4th of September laft being the day before the violent ftorm on that coaft, and its thought that all perifh'd."[BN] "...one entire street of houses was washed away, along with several residents."[CG]
340.	DOM, STK	30 Aug 1772	"causando muertes" (causing deaths); "matando gran numero de personas" (killing great number of persons)[I,z,av]
	Louisiana	2 Sep 1772	**El Principe de Orange** "was struck by a hurricane...and wrecked at the entrance of the Mississippi River, where she quickly went to pieces, only six survivors."[BD]
342.	Caribbean	31 Jul 1775	English merchantman **Gill**, sailing from St. Eustatius to St. Vincent Island, sank during a "hurricane"[BD,BN]
	Caicos Is.	2 Nov 1775	"During a hurricane...at least eleven merchantmen and several English warships were lost in the Windward Passage near the Caicos Islands."[BD]
	Off Florida	Jun 1777	Spanish man-of-war foundered in "hurricane....all hands lost."[BP]
345.	C Atlantic	10 Sep 1777	"The Ariadne, Ruffel, from Dominica to London, foundered at Sea in a Gale of Wind on the 10 Ult. the Crew and Paffengers were faved. Five others of the Fleet were miffing next Morning."[BN,c]
346.	Cuba	28-31 Oct 1778	"greatest loss of human lives by drowning"[M]
347.	Louisiana	18 Aug 1779	All but one of a fleet of Spanish warships sunk by a hurricane.[BD]
348.	Martinique	28 Aug 1779	"many lives lost"[BD,z]
349.	US coast	Before 8 Oct 1779	"The Mary, Pippard, from St. Kitts to New-York, was overfet in a Whirlwind, a few Leagues from Sandy-Hook, the vessel and Cargo entirely lost. Alfo at the fame Time was loft, a Brig with Rum, for Antigua."[BN,z]
350.	Atlantic	Before 3 Dec 1779	brig lost in gale[BN,c,z]
351.	Jamaica	1 Aug 1781	"A powerful hurricane drove not less than 120 vessels ashore and destroyed a large number. Amongst the 120 were 30 British men of war. Many lives were lost on these ships...and more than twenty bodies were recovered." More losses on shore.[AR,z]
352.	Atlantic	29 Oct 1781	"The Peach and Plenty, _____, from Cork to the West Indies, overfet in a hard Gale of Wind the 29th of October, and all the Crew perifhed, except one..."[BN,c,z]
	Atlantic (?)	Aug-Sep 1782	"The Corfaire, St. Juan Nepomuzeno, Capt. Gallardo, failed from St. Andero for the Havannah 15th August, and foundered in a violent Storm the fame Day in Sight of the Port; the Crew and Paffengers all

			drowned."[BN,c,z]
354.	Atlantic	Oct-Nov 1782	ship foundered in passage from Haiti to Europe[BN,c,z]
355.	US E coast	19 Sep 1783	"The Mercury, Herpin, from Dunkirk to Philadelphia, was lost in a furious Gale of Wind the Night of 19th September laft on Cape May; the Captain, Mate, and all the Crew, except feven Men, drowned."[BN,z] Lloyd's List has nearby ship losses on 19 September and 11 October.
356.	Delaware	Fall 1783	"During a gale in the fall, nine large unidentified ships were wrecked at Cape Henlopen and many lives were lost."[AD,c,z]
357	US E coast	Fall 1783	"The John and Nelly, Bailey, from New-York to Charleston, left New-York the 22d of Sept. and is fupposed to have foundered in the feveral Gales of Wind that happened on the Coaft the beginning of October, as fhe has not since been heard of."[BN,c,z]
358.	Jamaica	30-31 Jul 1784	"many" and/or "numerous" lives lost[M,Y,AJ,AR,z]; 2 drowned from the **Hanover Planter**, half crew lost from the **Industry**, and "most of people perished from two unnamed vessels".[BN]
359.	Curacao	1784	"During a hurricane that struck at Curacao Island, several large ships were wrecked in the main harbor and others forced to sea, where they were lost without a trace."[BD,z]
360.	Cayman Is.	1785	"...many lives were lost."[AT,z]
361.	Barbados	2-3 Sep 1786	many persons were killed in the ruins of their own houses[M,AJ]
362.	Jamaica	20 Oct 1786	7 deaths plus "A fmall fhallop, wrecked off Gun Key; every foul perifhed" and all but 1 lost from a plantain boat[AO]
363	Coastal NC	10 Apr 1789	"In the Albermarle Sound area there was on this date 'a very violent gale of wind, with an amazing rise of tide, supposed to be about 9 feet above common high water mark.' A number of ships...were lost along the Outer Banks; at least two of these wrecks resulted in the death of the entire crew."[CF,c]
364.	Lesser Ant.	1-2 Aug 1792	"many" lives lost in St. Kitts and Antigua[J,AG,BC]; "great loss of life" from ten ships in St. Barthelemy and only two survivors from a Spanish brig sunk between St. Kitts and St. Eustatius[BD]
365.	Jamaica	27 Jun 1794	"The Prize Ships from St. Domingo to Jamaica, met with a fevere Gale of Wind on the 27th June, one of which was totally lost near Kingston..."[BN]
366.	Jamaica	30 Jul 1794	"Lives lost."[AZ]
367.	NC, VA	2 Aug 1795	"...a fleet of eighteen Spanish ships, sailing from Havana to Spain, was struck off Cape Hatteras, an undisclosed number of these ships were lost."[BD] A ship sank off Cape Charles"[AV]...with a total loss of lives"[BD]
368.	SW Atlantic	9 Oct 1800	25 saved from **Galgo**, "upset in a squall, in lat. 21°, long. 61° west."[BY,c]
369.	Offshore VA	29 Sep 1806	schooner **Charming Mary** found partially submerged[AV,z]
370.	Spanish Main	17 Oct 1807	From the **Firefly**, "all except the Surg. & 3

			men (lost when vessel)...foundered in a hurricane off the Spanish Main."[BY]
371.	Puerto Rico	17-19 Aug 1809	"Great...death toll"[AY]
372.	C Atlantic	27 Aug 1809	"The **Express** cutter, together with several of the fleet, is supposed to have foundered....(and) several people on wrecks... were seen to go down..."[AH]
373.	Off PR	3 Aug 1809	"**H.M.S. Lark**, of 18 guns, foundered...and all her crew, except one man, perished..."[AJ,AO,z]
374.	Jamaica	15 Aug 1810	"Some lives lost at sea."[AR]
375.	SC	10 Sep 1811	"many were killed"[Q,CF]
376.	Cayman Is.	1812	"women of East End left widowed" when husbands lost at sea[AT,z]
377.	Barbados	22-23 Jul 1813	"some lives lost,....numbers of persons were killed..."[Y,z]; at least 18 dead and 8 missing[AH]
378.	Jamaica	7/31-8/1 1813	"many lives lost"[AR,z]
379.	NC	3-4 Sep 1815	"...storm caused great damage and loss of life in Onslow." 4 deaths in one storm surge incident.[CG]
380.	New England	23 Sep 1815	"the loss of life so heavy that the newspapers did not have space enough to give all the details of the marine disasters"[BI]; "impossible to estimate loss of live in Providence...but it was extremely heavy."[BY] "about twenty persons were drowned or killed"[BJ]; at least 20 deaths[BK]
381.	Puerto Rico	1816	2 dead on land; part of crews from 3 ships perished[J]
382.	Jamaica	8-12 Nov 1818	"heavy loss of life on ships....some loss of life on land"[AR]
383.	VI	21-22 Sep 1819	"serious loss of life"[Y]; "apprehensive that many, many lives have been lost, in addition to the great number already ascertained."[AH]
384.	Offshore VA	20-22 Oct 1822	schooner foundered off Richmond[AV]
385.	New York	4 Jun 1825	schooner **Hornet** foundered, "...with loss of her entire crew."[AV]
386.	Coastal NC	17-18 Nov 1825	"The schooner Harvest was wrecked...and five or more persons lost in what may have been a late season hurricane."[CF,c] 5 of 15 people on board were lost and row boat carrying rescuers overturned in surf.[CI]
387.	Cuba	1826	"...el general Laborde perdio su escuadra en Cuba o costa del sur" (General Laborde lost his fleet in Cuba or the southern coast)[AP,z]
388.	Cayman Is.	1826	"women of East End left widowed" when husbands lost at sea[AT,z]
389.	Chesap. Bay	26 Aug 1827	"...the vessel (**Flag**) lost all hands and the passengers perished."[AV]
390.	Near Bermuda	13 Sep 1828	3 ships lost[AJ]
391.	Off STB	26 Oct 1829	"...two vessels slipt their anchors and went to sea. One returned, and the other has not since (4 Nov 1829) been heard of."[AH]
392.	Florida	15-16 Aug 1830	"...off Cape Florida...several ships were lost..."[AW]
393.	BAR, DR	3 Sep 1835	"The mail boat, **Lady Lunn**, was capsized and sunk; one man saved." 2 boats driven to sea from Barbados not heard from after 11 days.[AW] 3 deaths on **Matilda** near Dominican Republic.[AH]
394.	Cayman Is.	1836	"women of East End left widowed" when hus-

			bands lost at sea[AT]
395.	NC	18 Aug 1837	"...several vessels have been lost, one of them, with the crew..."; ship Palambam foundered[AW]
	MX E coast	1 Nov 1838	"Three United States vessels were lost, and the crews of two of these perished."[AJ]
	Coastal NC	12-15 Jul 1842	many ships lost and many persons drowned[Q,CF]; "Two unknown vessels were capsized...their entire crews lost, and seven men who went out later...were also drowned....No authentic information has come to light which would give...the number of persons drowned; it is sufficient to say that the hurricane of July 12, 1842 was one of the worst in the history of coastal Carolina."[CI]
398.	Offshore VA	7-8 Sep 1846	several vessels lost offshore Virginia[AV]
399.	NC	24 Aug 1850	"pilot boat sank"[Q,CF]
400.	DR	18 Aug 1851	"many casualties"[AD]
401.	Offshore VA	12 Sep 1851	Schooner **Free Trade** capsized. "Nothing heard from the persons on board, and it was feared that they were lost."[AV]
402.	Jamaica	6-8 Nov 1852	"many lives lost on ships in ports"[AR]
403.	E TX coast	18 Sep 1854	"Two people were killed. The steamer **Kate Ward** and crew were lost..."[R]
404.	Tampico (MX)	6 Aug 1855	"The loss and damage done to goods was very heavy, and the destruction of life and property was no less severe."[AS]
405.	DR	26 Aug 1855	"many casualties"[AD]
406.	W Atlantic	10 Jul 1861	The **Bowditch**, while "...in a tremendous hurricane, was boarded by a sea, which.... washed all hands overboard." Only the captain survived.[V]
407.	US E coast	3 Aug 1867	2 deaths plus "all perished except the captain" from a brig.[AV]
408.	E TX coast	1-3 Oct 1867	"many", "number" of lives lost[F,R]
409.	New England	8 Sep 1869	1 death in MA and "all except one man perished" from schooner **Helen Eliza** in Maine.[BX]
410.	E TX coast	2-3 Oct 1871	2 deaths plus steamer foundered and "all hands were lost with the exception of one man."[R]
	W Atlantic	19-20 Oct 1873	schooner **Enterprise** "feared lost during the storm"[AV]
412.	PR, NC	13-17 Sep 1876	"...19 deaths reported, but historians suspected the Spanish Government withheld actual damage and death toll data."[AY] 2 drowned in Onslow County, NC and "from Okracoke to Rocky Mount, reports were gathered of killed and injured citizens."[CG]
	DR-HAI-FL-PA	1-13 Sep 1878	"considerable loss of life"[AG,AI]; 9 deaths FL to PA, plus, at Aux Cayes "...a number of persons were killed", while "in the towns of Aquin and Cavaillon...a large number of lives lost."[R]
	Haiti	25-28 Sep 1878	"American brigatine was wrecked at Tiburon and all hands lost."[R]
	Gulf MX (?)	24-28 Oct 1879	schooner from Pensacola "...completely wrecked and lost all her crew but two men."[R]
416.	US E coast	16-21 Nov 1879	"some lives lost"[R]
417.	SE TX coast	12-13 Oct 1880	"many lives lost"[F,BW]
418.	Cuba	5-6 Sep 1882	"buen numero de victimas" (good number of victims)[AI]
	Jamaica	6-8 Oct 1884	"drowning at least 8 people"[AR]

420.	Cuba	17-24 Jun 1886	"no pocos ahogados" (not a few drowned)[AI]
421.	Cuba, JAM	28-29 Jun 1886	"algunas desgracias personales en mar y tierra" (some people died at sea and on land) from Cuba[AI]; "no less than 18 lives lost" in Jamaica[AR]
422.	Cuba	21-26 Aug 1886	"crushing many of their inhabitants"[AG]
423.	Cuba	11-15 Jun 1887	"algunos ahogados" (some drowned)[AI]
424.	Cuba	15-16 Jun 1889	"algunas...desgracias personales" (some people died)[AI]
425.	Cuba	28-29 May 1890	"buen numero de ahogados" (good number of drownings); "Se enviaron de la capital partidas de Bomberos, Marinos y Guardia civil. Buen numero de estos expedicionarios perdieron la vida." (Firemen, marines, and civil guard teams were sent from the capital. A good number of these crews lost their lives.)[AI]
426.	W Atlantic	28-30 Aug 1890	10 deaths from one ship; "loss of life" from another[R]
427.	Cuba	9-11 Jun 1892	16 deaths in Matanzas and "large" number in vicinity; 1 death in Havana[V+AI]
428.	Cuba	21 Oct 1895	"arrebato algunas vidas" (took some lives)[AI]
429.	Cuba	25-27 Sep 1897	"algunas desgracias personales" (some people died)[AI]
430	Cuba, JAM	28-29 Oct 1899	In Cuba, "algun(a)s...perdidas de vidas humanas" (some loss of human lives)[AI]; "many dead" in Jamaica[AR]
431	AL-LA coast	13-16 Aug 1901	"Only 10 persons are known to have perished, but more lives no doubt were lost....It is greatly feared that the loss of life among the fishermen and others...will be considerable."[R]
432	US E coast	Sep 1904	"A number of lives were lost..."[T,C]; "considerable loss of life"[R]
433.	Costa Rica	25-28 Jan 1905	"very severe hurricane...causing great loss of life"[R,C]
434.	Turks Is.	10-12 Sep 1908	"caused destruction of life"[R]; at least 19 deaths with 8 missing[AH+W]
435.	N Florida	3-4 Sep 1915	"small loss of life...confined to fishing and sponge vessels" near Jacksonville.[R]
436.	Jamaica	15-17 Aug 1916	"At least 17 persons left dead..."[AR]
437.	Puerto Rico	22 Aug 1916	2 ships missing at sea[I]
438.	Gulf of MX	28-30 Sep 1920	"among the vessels lost were...(two American ships with)...a large number of casualties"[R]
439.	Bahamas, FL	24-29 Sep 1929	10 deaths, not counting "many lives lost" in in Bahamas[R]
440.	Mexico, PR	10-16 Sep 1931	2 deaths in Puerto Rico, plus 300-ton steamer "sank with all hands lost, including a number of passengers."[R]
441.	Off NJ	7-8 Sep 1934	The liner **Morro Castle** caught fire and was abandoned in unsettled weather at the approach of a hurricane. "134 people died from burning, drowning and exposure."[BS,C]
442.	MX, Belize	5-11 Nov 1942	"Nine lives were lost...", but the "...total loss of life is still unclear."[R]

NOTES TO APPENDICES

[a] Conventional abbreviations were used for map headings (e.g., N for north or northern) and for American states. In addition, we employed C for central and the following: BAH--Bahamas, BAR--Barbados, BEL--Belize, BER--Bermuda, CAN--Canada, CI--Cayman Islands, COL--Colombia, CR--Costa Rica, CU--Cuba, DOM--Dominica, DR--Dominican Republic, GRE--Grenada, GUA--Guadeloupe, HAI--Haiti, HON--Honduras, JAM--Jamaica, MAR--Martinique, MON--Montserrat, MX--Mexico, NIC--Nicaragua, PR--Puerto Rico, STB--St. Bartholemy, STE--St. Eustatius, STK--St. Kitts, STT--ST. Thomas, STV--St. Vincent, TUR--Turks Islands, US--United States, VEN--Venezuela, VI--Virgin Islands.

[b] Alternately, 12 fewer deaths because Salivia (1970) has 300 and 312 for Puerto Rico. Most references cite Red Cross statistics of 1836 deaths and 1870 injuries in Florida. An additional reference (AC) with 1870 deaths in Florida may be in error. Flament and Martin, and Soulan (1994) have 1200 deaths for Guadeloupe. *Monthly Weather Review* adds 18 for Grand Turk and indicates others possible in Caribbean. Soulan (1994) adds 3 for Martinique. Snow (1952) has 1500-2500 deaths.

[c] tropical cyclone status in doubt for at least part of event

[d] Alexander (1902) notes "17 sail with 2000 troops...only two were ever heard of afterwards". Other references indicate that additional ships may have survived.

[e] 13 ships carried 1500 people; 10 ships sank

[f] Chapman notes "many lives were lost in New England." Alexander (1902) indicates only 1 person survived from the loss of an 18-cannon ship. Marx (1983) notes that "most of the town of Caravel (Martinique), along with the majority of the inhabitants, was swept into the sea" in September; this month may be in error, also disagreeing with the dates in *The Miami Herald*. Millas (1968) presents several reports on effects in the Caribbean region.

[g] 18 people missing (according to National Hurricane Center Preliminary Report on Joan)

[h] *The London Times* reported the loss of 28 of 42 slaves, with additional loss of some crew on board the **Bristol**. *Lloyd's List* indicates only 10 men saved during a period when slaves were sometimes not included in the statistics. In addition, *Lloyd's List* indicates "Three vessels, from Africa with slaves, are loft in the West Indies, in the late Hurricane."

[i] There are many estimates of the total. This one, based on the "official" summary in *Galveston in 1900* (Ousley 1900), is: 6000 in city of Galveston, 1000-1200 elsewhere on the island west of the city and more than 1000 on the mainland. Maximum estimates provided are 10000-12000. *Monthly Weather Review* indicates "Enormous loss of life...inland", as well. Most other references indicate a loss of at least 6000.

[j] "The loss of life occasioned by the storm in Galveston and elsewhere on the southern coast cannot be less than 12,000 lives..." Statement of Governor Sayres on 19 Sep 1900 printed in Lester (1900).

[k] 17 in Texas according to *Monthly Weather Review*; Hasling (1982) notes 38 deaths in Texas (some may be related to storm remnant)

[l] 53 in North Carolina according to Dunn and Miller (1964), Stevenson (1989), and Barnes (1995). *Mon. Wea. Rev.* reported "a large number of small craft were lost; in nearly all cases all hands perished" in Dominican Republic, and "great loss of life along the Exuma Cays"; Garriott (1900) indicates deaths in Dominica.

[m] Garriott (1900) and Alexander (1902) indicate thousands of additional deaths in Puerto Rico due to subsequent starvation. Stick (1952) and Chapman indicate at least 50 deaths in shipwrecks along coastal Carolina. Barnes (1995) has at least 30 along the coast of North Carolina and 14 inland in that state.

[n] Millas (1968) disputes accounts giving date as 25 October and deaths as more than 1000.

[o] 40 in South Texas according to Hebert et al. (1993) and Price (1956).

[p] The Miami Herald indicates at least 55 deaths on the 7th. The National Hurricane Center track begins at 0000 UTC on the 7th.

[q] Snow (1952) has 150 deaths at Indianola with the remainder elsewhere in Texas. However, "bastantes vidas perdidas" (quite a few lives lost) in Cuba according to Appendix of Gutierrez-Lanza in Sarasola (1928)

[r] in addition, "algunas perdidas de vidas" (some loss of life) in Cuba according to Appendix of Gutierrez-Lanza in Sarasola (1928); steamship Magnolia foundered off Hatteras"[CF]

[s] numerous estimates provide (sub)totals yielding a similar statistic

[t] may not include 5 in Anguilla mentioned explicitly by Salivia (1970) or at least some of 23 deaths in Leeward Islands noted in Weather Bureau Preliminary Report

[u] *Monthly Weather Review* of 1909: "In 1906 many hundreds of laborers were drowned..."

[v] Evans (1848) writes of more than 70 other deaths that year but does not relate them to a specific storm

[w] Seon has upwards of 1000 deaths in Jamaica, while Evans (1848) and Millas (1968) indicate 300 deaths there. Ludlum (1963) account has 200 in Savanna-La-Mar and "several white people and some hundreds of negroes killed...in the whole parish."

[x] *The Miami Herald* also reported more than 400 people missing in the Bahamas

[y] total based on *The London Times* report that "many seamen and white people drowned, with some hundreds of negroes." Alexander (1902), Garriott (1900), and Evans (1848) have 28 October as date.

[z] some early storms that qualified in more than one locale may have multiple listings if the storm track is unknown

[aa] 26 deaths from ship **Maisi**; in addition, "...numerous disasters were caused by it at sea...", according to *Monthly Weather Review*, possibly including 16 deaths in loss of schooner **Maine**. *The New York Times* reported one survivor of English brig **Gamay** (possibly foundered in same storm) picked up on 9 Oct in southwestern Atlantic.

[ab] "Hundreds said to be killed in a severe hurricane..." (Seon)

[ac] This total may come from two storms. According to the 3 November 1852 *The London Times*, "In Puerto Rico, heavy thunderstorms and hurricanes had been experienced, and over 100 lives were lost." Salivia (1970) indicates hurricanes on 5 and 22 (or 26) September and that the first "ocasiono muchas muertes" (occasioned many deaths).

[ad] Cayman Islands National Archive documents indicate 101 or 102 deaths of islanders, excluding their residents lost on Cuba. Other references have smaller totals for the Cayman group.

[ae] Tannehill (1938) indicates that this cyclone may have originated in the Pacific.

[af] Clark (1988) has 2150. Reference BC has ≥2000.

[ag] Reid (1841) reprints report that two hurricanes occurred in Santo Domingo in 1837, in some combination causing 3 drownings, plus "three Haytian vessels were also on the coast, and only one man saved."

[ah] References AG and AW have 1477 deaths.

[ai] Marx (1983) indicates that, in combination, the storms of 12 and 26-27 September 1600 caused about 1000 deaths.

[aj] Marx (1983) is not specific about date.

[ak] Marx (1983) is probably describing the same storm when indicating no survivors of 4 wrecks resulting from "a hurricane between Serrana and Serranilla banks" in 1605.

[al] Marx (1981), which has many of the same accounts as Marx (1983), refers to this storm as a "norther".

[am] Month not specified by Robinson (1848).

[an] Hunter hypothesizes that most of the settlers of Roanoke Island were killed by a hurricane. He indicates that of about 116 people on the island in 1587, some returned to England before the storm and a few of the settlers survived the storm.

[ao] Snow (1952) does not specify dates of month

[ap] According to Snow (1952), "On October 9, 1913 the immigrant ship **Volturno**, with 657 people aboard, burst into flames in a wild gale at sea halfway across the Atlantic....135 were lost." Neumann et al. (1993)--see References in Text--show a hurricane over the central Atlantic on that date.

[aq] Snow (1952) says at least 2000 deaths.

[ar] Snow (1952) has 20 August. The dates in several of his accounts conflict with dates of other sources.

[as] According to Snow (1952), "scores of lives were lost and seventy-five vessels were either sent to the bottom or dismasted." Also, a "brig was lost"[Q,CF]. The brig **Albermarle** was lost off Hatteras[AV,CI]. This event possibly related to "Two men overboard" from **Henry Horbeck** in "hurricane" at 38°N 56°W on 13 Sep.[BM]

[at] Ellms (1860) locates the disaster at 48° 33'N 43° 20'W, placing in doubt the tropical character of the storm. *Lloyd's List* (Oct 1782), however, has accounts of storm from the Jamaica Fleet at 43°N 48°W, and at 43°N 44°W. At the latter location, "...in a Gale of Wind from ESE...on the 16th in the Evening, when on the Morning of the 17th the Wind came out in an Inftant to N.W....the storm lafting for two hours." A very similar account from an officer on the **Ramilies** at 42.3°N and 48.9°W is reprinted in Redfield (1836).

[au] Reported in *Lloyd's List* on 10 Nov 1758. Possibly related to its later report of "hard Gale of Wind" which drove ashore and destroyed some vessels at Barbados on 23 August.

[av] Millas (1968) indicates that two hurricanes affected this area about the same time. If so, then the number of casualties associated with each is uncertain, e.g., *Lloyd's List* contains the report, "The Apollo, Manning, was totally lost at St. Kitts, in the late hurricane, and every foul on board, except one man drowned."

[aw] *Lloyd's List* has many accounts indicating a great many more than 500 deaths near Newfoundland. Some of the losses occurred on the northwest coast of Newfoundland and on the coast of Labrador. Hence, the total may be larger than shown by Ludlum (1963), but the storm may not have been entirely tropical, either. The dates from these sources do not match and the relationship between this entry and the other Sep 1775 storm(s) along the U. S. east coast and the storm reportedly at Hispaniola on the last days of August is not clear. See footnote ax.

[ax] Added to casualties noted in North Carolina is a *Lloyd's List* report of losses to ship crews off Virginia. They also indicate a ship lost off North Carolina. Dates for effects on North Carolina and Virginia may not be consistent. This is further confused by activity in the northwest Atlantic a few days later. See footnote aw.

[ay] *Lloyd's List* of 3 Dec 1779 contains the account "The Spitfire Privateer, Captain White, foundered in a Gale of Wind, and all the Crew, in Number 120, perished."

[az] Price (1956) has 51 deaths on 6-7 Sep., when the system was still a tropical cyclone. *Monthly Weather Review*, however, indicates at least 215 deaths from floods, all which came after the cyclone dissipated (and were associated with remnants of the cyclone).

[ba] Loss of some crew members on **Somerset** in "easterly storm (of) unusual fury." May be related to a 28-31 October system over Cuba.

[bb] Other subtotals based in part on Garriott (1900) give smaller total.

[bc] Based on 21 December 1994 Report No. 7 from the United Nations Department of Humanitarian Affairs, estimating 1122 deaths in Haiti. Earlier reports vary considerably from this figure.

[bd] Tebeau (1975) places this loss of a Spanish fleet in 1528.

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