Beneficial Aspects of the Tropical Cyclone

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ABSTRACT

This paper deals almost entirely with beneficial rains. Records of drought severity in the climatic divisions of the states are examined. The rainfall data from tropical cyclones which have moved over drought-stricken areas are used to tabulate in graphical form the ones which have been most beneficial. Other benefits which have, on occasion, been derived from the tropical cyclone are enumerated.

1. Introduction

Very little has been written about the beneficial aspects of Atlantic hurricanes. A recent paper by Sugg (1967) deals with the economics, but only as it pertains to damages, cost of warnings, and the savings attributed through the warning services. There are no detailed accounts in our meteorological journals and texts of any economic or social gains directly attributed to the tropical cyclone. There is only an occasional and very

general reference to beneficial rains. This is the one benefit which occurs most often and offers the most to mankind. It is also a benefit which is easiest to analyze and the one which will be detailed in this paper.

2. Drought

It is quite obvious that rains, to be most beneficial, must fall on drought-stricken areas. But it is not so obvious just what constitutes drought conditions in the

State	Climatic Division	Palmer Index
*Conn.	Coastal	-3.78 to 1.32
N.Y.	Coastal	-3.16 to 1.20
N.J.	Coastal	-2.21 to .97
Del.	North	-2.20 to .58
Del.	South	-2.92 to .67
Mass.	Central	-2.11 to MSG.
N.J.	North	-2.43 to MSG.
N.J.	South	-2.71 to MSG.

Area of Drought — Approximately
20,000 Sq. miles.
Casualties ; 390
Damages ; \$100,000,000

FIG. 1. Graphical and tabular representation of drought conditions of climatic divisions prior to the hurricane of 9-16 September 1944. A portion of the tropical cyclone track with precipitation is also shown.

first place. Tannehill (1947), after several pages of discussion, concluded that "it is useless to attempt to give a precise definition of drought." He and others have used a percentage of normal rainfall over a period of time for the determination. Only recently, Palmer (1965) has developed a drought index—an important contribution that not only defines a drought but permits a running hydrological accounting of moisture anomalies. Palmer indexes are not available for the Gulf and Atlantic Coastal areas prior to 1930, but are the basis of the analyses in eight of the nine tropical cyclones included in this paper.

3. The determination of beneficial rainfall from a tropical cyclone

According to Palmer, the following increments of severity index determine the classes for wet and dry spells:

Index	
4.00 or more	Extremely wet
3.00 to 3.99	Very wet
2.00 to 2.99	Moderately wet
1.00 to 1.99	Slightly wet
0.50 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.50 to -0.99	Incipient drought
-1.00 to -1.99	Mild drought
-2.00 to -2.99	Moderate drought
-3.00 to -3.99	Severe drought
-4.00 or lower	Extreme drought

The Palmer indices for representative climatic divisions have been plotted in Figs. 1 through 9, Fig. 6 excepted. The data go back over many months preceding the date of the tropical cyclone and show the severity of the

drought just prior to the time that the hurricane made landfall. Only moderate, severe or extreme drought conditions have been considered. Furthermore, the Palmer index had to be -3.00 or lower (at least a severe drought) over at least one climatic division; the one that is plotted is indicated by an asterisk. Other climatic divisions, if any, that were experiencing a moderate, severe or extreme drought are tabulated in each case and the total areal coverage in square miles (approximate) of all divisions is shown. Other data include the date of the cyclone, maximum rainfall, damages and casualties. Storm rainfall maps, reproduced from the National Hurricane Research Project Rept. No. 3 by Schoner and Molansky (1956), Fig. 4 excepted, are shown with a portion of the storm track superimposed.

Drought conditions that preceded the August 1928 hurricane (Fig. 6) have been represented by percentages of normal rainfall. The graph shows Florida received only 77% of normal rainfall in 1927. Rainfall at Tampa and Miami was 85% and 78% of normal during the seven months prior to the time that the hurricane made landfall. Yet, the year ended showing that the Florida received 114% of normal rainfall. The yearly averages are taken from Tannehill (1947).

Fig. 10 summarizes the data of the nine tropical cyclones that have produced sufficient rainfall to have effectively terminated drought conditions over 10,000 mi² or more. Any measure of the benefits of these storms would have to be offset by the death and destruction that resulted in each case. For this reason the storms have been arbitrarily rated, by deaths, and secondly,

State	Climatic Division	Palmer Index
* S.C.	Northeast	-4.46 to 1.10
N.C.	North Piedmont	-3.56 to .95
Va.	Western Piedmont	-3.01 to 1.04
Va.	Central Mountains	-2.84 to 1.29
Va.	Southwest Mountains	-3.65 to .36

Area of Drought — Approx. 30,000 sq. miles
Casualties, 95 Damages, \$251,600,000

FIG. 2. Same as Fig. 1 except for 5-18 October 1954.

FIG. 3. Same as Fig. 1 except for 3-14 August 1955.

by damages. Connie produced rains over an estimated 80,000 mi² of drought-stricken land. This area was reduced to 60,000 mi², since there were 20,000 mi² flooded by the rains of hurricane Diane just about a week later. The "D" following the five climatic divisions in Fig. 3 indicates the divisions that have been deleted. So, what was initially a blessing for those in the five divisions turned out to be a disaster. It is principally this area that Dunn *et al.* (1955) write "...Connie set the stage for one of the most disastrous and costly floods of

record in the northeastern States." Had it not been for Diane and the relatively high number of deaths and fair amount of damage caused by Connie, this hurricane (Connie) would have been the most beneficial one ever to have affected the United States. It was, undoubtedly the greatest "drought breaker."

Damages were only minor and there were no deaths in three of the nine storms. Rain from the 20 June-1 July 1945 hurricane (Fig. 9) brought relief to an estimated 40,000 mi² and there were no deaths nor damages

FIG. 4. Same as Fig. 1 except for 16-19 September 1963.

FIG. 5. Same as Fig. 1 except for 23-31 August 1949.

attributed to this hurricane. Furthermore, the rains fell on one climatic division which was experiencing a most extreme drought; the Palmer index was -5.35 over the Florida Everglades and Southwest Coast—a value not exceeded anyplace in the analyses of the other eight storms. This tropical cyclone must be considered the most beneficial of the past four decades, if not the century.

Rains over any given acreage can be said to be more beneficial in recent decades than in the previous century because of the increased population and the greater amount of agriculture and other industries so dependent upon water. Lack of drought data in previous centuries would make it difficult to prove otherwise, but all things considered, the rains from the 20 June-1 July 1945 hurricane probably meant more to the nation's econ-

FIG. 6. Graphical representation of drought conditions in Florida prior to the hurricane of 3-12 August 1928. A portion of the tropical cyclone track with precipitation is also shown.

FIG. 7. Same as Fig. 1 except for 26 August-3 September 1932.

omy, in a positive sense, than any other tropical cyclone of record.

Fig. 11 is a composite of the nine tropical cyclones taken from Weather Bureau Tech. Paper No. 55 by Cry (1965).

4. Other benefits

Hurricanes have been beneficial to mankind in many

other ways. Fishermen know there are certain fishes and crustaceans that migrate in large numbers during abnormal directions and speeds of oceanic waters. Great increases in the lobster population have been observed in the Florida Keys after rough seas and high tides caused by hurricanes and it is thought that the migration takes place from remote distances or from depths which are normally inaccessible to the fishermen.

FIG. 8. Same as Fig. 1 except for 7-18 October 1932.

FIG. 9. Same as Fig. 1 except for 20 June–1 July 1945.

Hurricanes destroy slum areas. But it is only where new and strict building codes have been adopted that prevent rebuilding of the same sub-standard housing that social progress is realized. Unfortunately, in many

countries, there are no codes, nor real benefits—only losses.

Insects and rodents are frequently destroyed by the forces of the tropical cyclone. Perhaps the best example

FIG. 10. The nine tropical cyclones with death and damage figures and the estimated area, in thousands of square miles, where drought was terminated.

FIG. 11. Tracks of the nine tropical cyclones.

comes from L. D. Beadle.¹ He states that hurricane Betsy (1965) destroyed a large population of mosquitoes² on Dauphin Island, Ala., and sand deposition eliminated mosquito breeding areas.

Hurricanes have changed or influenced the courses of history. The two instances, referred to here, deal with colonial conquest and are taken from the research of Millás (1964). The forces under Dutch Admiral Jol were mighty enough to subdue Havana, and presumably Cuba, when they arrived near the Havana harbor in 1640. On 11 September the fleet of 36 ships was virtually destroyed by the northerly winds of a hurricane. The English Admiral Willoughby was killed and his fleet destroyed in the hurricane of 14–15 August 1666, which struck Guadeloupe. Survivors of this colonizing expedition from Barbados were taken prisoners by the French the following day. Domination by the French in Guadeloupe and by the Spaniards in Cuba was more or less firmly established and the hurricanes' benefits to these peoples are obvious.

5. Conclusions

Some tropical cyclones have the potential for great economic and social gains—gains much greater than the

accompanying losses. More details of these benefits are needed for better hurricane damage accounting. Such data will be invaluable in future years to those making hurricane modification decisions.

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² *Aedes sollicitans*.