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SHORT COMMUNICATIONS

HEAT DEATH OF LEAST TERN CHICKS ON THE GULFPORT, MISSISSIPPI, BEACH IN 1980

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ABSTRACT The Least Tern is among the smallest of the long-winged flyers and an indescribably ethereal impression emanates from it in flight. Thus great interest was generated when this tern began to nest on the mainland beach of Mississippi Sound about 12 years ago. In 1980, Least Tern chicks died in numbers on the beach and this generated considerable comment and some bombast. An upstate ornithologist announced that poison in the food chain was the cause, but no poison has ever been found in the carcasses of the dead chicks or in the water. The mortality of Least Tern chicks was not caused by Red Tide or disease and by a simple process of exclusion fell to the hottest summer the author ever saw on the Gulf Coast in 51 years, with air temperatures up to 107°F.

INTRODUCTION

The Least Tern, *Sterna albifrons*, appears white in its flight over nesting beaches along the river valleys of North America and the Gulf beaches to Massachusetts, but it has light touches of gray, black and brown. It ranges south to Peru, Brazil, and the Antilles, and north to Scotland, the Baltic and the large rivers of India, China, Japan, Russia, the Caspian Sea, and Africa to Australia. It also nests on various sea beaches and is scattered world wide in that habitat except for the cold zones (Reilly 1968).

It flies in a delicate manner, with its thinly tapered, swept back wings, and there is an indescribably ethereal impression given by these birds as they billow back and forth over their eggs and young. Even such a stern old observer as Oberholser (1973) says, "the Least Tern is extremely bouyant, swift and graceful." Thus, when these fairy-like birds began some 10 years ago to nest on the sand beach of the Mississippi Sound mainland shore within a few yards of U.S. Highway 90, the front thoroughfare of Gulfport, Mississippi, this development aroused the interest of hundreds of people.

Gunter (1957) reviewed the influence of temperate factors on marine organisms. Mammals and birds live at precise body temperatures that cannot vary much. Most poikilotherm organisms live within 4 to 7°F of the upper limit of ambient temperature that they can withstand, while the lower limit may be near freezing, 25°F or lower. For this reason, the trouts and related cold-water fishes in southern Canada and the northern United States sometimes die of heat stroke in natural waters.

The Course of Events

On June 26, 1980, Dr. Jerome C. Jackson found dying Least Tern chicks on the beach at Gulfport, which fact he announced to the local newspaper, *The Daily Herald*, along

with the pronouncement that poison in the food chain was the cause. The writer took issue with that and stated in *The Daily Herald* on July 3 that no poison or pesticide would be found. From that day to this no poison has been reported in the carcasses of Least Tern chicks, although presumably a thorough search was made at Mississippi State University. Six autopsies were made at the Gulf Coast Research Laboratory and no poisons have been found in the waters of Mississippi Sound.

During the late spring and early summer no plankton blooms were seen in Mississippi by the Laboratory staff. These develop sometimes into classical examples of the Red Tide, and some were reported by local fishermen as little as 8 days before the dying terns were reported. For that reason the author suggested to the local newspapers that the Red Tide was a possible cause of death of Least Tern chicks, because of the poisonous amines that develop in these instances. However, autopsies of some of the tern chicks carried out at the Gulf Coast Research Laboratory showed no evidence of Red Tide involvement and the idea properly faded into a matter of no importance.

The author had also stated initially that perhaps the baby terns were dying of some viral or bacterial disease, but autopsies of dead tern chicks showed that disease was not involved.

J. G. Mackin, a former head of the Department of Biology of Texas A&M University, discovered several years ago that a rise of a few degrees in temperature caused unrecognized species of bacteria to parasitize the American oyster, *Crassostrea virginica*, in the winter. With these facts in mind, the writer began to suspect that heat was playing a more than normal part in the lives of aquatic animals in the summer of 1980, when Jim Martin's fishing column in *The Daily Herald* reported that all sportsfish being taken in the lower Pearl River were covered with fungus.

The Temperature Record

Table 1 gives the official air temperature record for 11

TABLE 1.

Daily air temperature records at Biloxi, Mississippi in °F taken at 3:00 p.m.
for the months of June, July and August from 1970 to 1980, inclusive.

Date	1970			1971			1972			1973			1974			1975		
	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug
1	83	90	91	85	90	78	84	88	87	86	91	90	85	85	90	85	88	81
2	82	96	92	84	87	86	83	89	89	85	92	85	84	87	87	85	90	81
3	85	97	90	87	89	87	87	90	90	87	94	89	86	87	88	86	90	89
4	84	96	90	89	87	88	89	90	95	87	91	89	86	88	86	87	89	82
5	81	88	90	88	89	89	91	89	97	87	91	85	86	88	86	88	95	86
6	83	90	91	88	84	89	92	86	95	86	89	89	87	85	87	90	95	86
7	84	93	91	86	87	90	98	87	94	86	85	89	87	85	86	89	88	85
8	85	94	90	88	89	89	92	89	93	86	90	88	86	87	85	87	99	84
9	85	94	90	88	89	89	87	90	91	87	96	90	87	91	88	85	87	84
10	85	89	91	88	88	89	88	89	92	86	96	91	88	93	89	87	91	85
11	84	87	89	90	89	92	87	90	91	88	97	90	85	93	90	87	90	87
12	87	82	86	90	93	93	86	90	92	87	95	90	86	98	91	83	88	87
13	88	88	88	91	94	92	86	87	92	88	93	85	86	94	90	85	86	89
14	95	89	89	92	92	93	87	88	89	89	87	90	87	89	88	89	88	89
15	91	90	89	92	95	92	87	89	88	90	91	89	87	89	88	86	87	90
16	86	89	86	90	94	94	88	88	89	89	92	85	90	89	88	85	87	90
17	88	89	88	90	90	92	90	89	90	89	94	89	90	89	93	87	82	90
18	93	90	89	88	91	89	92	90	88	90	95	91	86	89	90	89	88	90
19	94	89	88	88	91	90	90	92	95	91	96	91	85	91	92	89	86	90
20	92	90	86	87	90	89	98	89	100	90	90	92	93	94	91	90	90	90
21	91	89	88	90	93	88	98	88	99	89	90	95	90	92	90	88	88	89
22	90	85	90	94	88	89	92	93	94	90	91	94	88	92	87	88	87	87
23	92	87	89	89	87	89	87	90	90	90	96	89	89	91	91	87	88	88
24	88	89	85	86	88	89	91	91	90	93	95	90	88	91	90	87	86	89
25	80	87	87	87	88	87	93	89	90	93	90	92	82	89	88	86	89	89
26	88	88	85	91	89	89	92	89	91	91	89	90	83	87	88	87	91	90
27	90	90	84	88	88	91	92	90	92	90	88	88	84	90	87	87	94	92
28	88	91	83	87	89	91	92	90	92	92	90	92	86	93	88	85	90	92
29	89	91	87	87	89	92	92	91	89	92	92	88	85	93	88	85	85	90
30	88	91	88	87	89	87	89	86	88	92	90	86	85	93	88	86	85	90
31		92	89		81	85		86	87		93	88		90	88		81	89
Avg.	87.3	90.0	88.4	88.5	88.9	89.3	90.0	89.1	91.6	88.9	91.9	89.3	86.6	90.1	88.6	86.9	88.6	87.7
Date	1976			1977			1978			1979			1980					
	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug			
1	84	87	94	90	90	92	88	91	92	85	95	91	85	99	92			
2	84	88	81	92	94	91	85	96	92	85	90	90	85	94	90			
3	85	87	90	92	94	87	82	95	96	86	91	91	86	92	90			
4	83	88	89	90	99	85	84	92	99	84	91	92	89	91	91			
5	83	85	89	92	89	89	86	92	96	85	95	94	92	92	99			
6	80	90	89	94	93	89	86	91	90	87	94	94	91	94	95			
7	82	85	91	92	97	90	87	91	89	88	91	93	90	100	96			
8	83	85	91	88	98	90	85	90	86	89	90	91	95	94	92			
9	89	88	97	88	95	90	88	90	79	89	86	89	96	95	93			
10	89	87	94	98	89	88	88	90	82	88	86	92	86	93	91			
11	86	86	88	98	89	87	86	88	83	88	83	90	92	97	92			
12	90	90	93	94	88	90	91	89	86	85	81	88	94	100	92			
13	89	90	92	93	93	89	92	90	87	85	88	88	95	100	93			
14	89	91	90	90	96	90	91	90	87	86	90	89	91	100	92			
15	87	90	95	90	95	90	88	90	89	86	90	93	89	102	92			
16	87	93	95	91	92	88	88	89	90	84	93	92	89	103	90			
17	86	92	95	91	91	89	87	93	91	85	93	91	89	96	90			
18	86	90	92	90	92	88	86	91	90	86	94	90	93	95	91			
19	87	90	91	90	91	88	88	90	91	87	84	89	92	94	92			

TABLE 1. (Continued)

Daily air temperature records at Biloxi, Mississippi in °F taken at 3:00 p.m. for the months of June, July and August from 1970 to 1980, inclusive.

Date	1976			1977			1978			1979			1980		
	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug
20	83	89	91	91	90	88	87	90	91	89	87	92	92	89	96
21	87	92	93	92	91	87	88	88	93	91	89	92	89	87	99
22	85	93	91	92	89	87	92	88	92	89	89	92	90	86	99
23	87	93	91	90	92	85	95	89	92	89	88	90	90	96	100
24	87	94	94	91	91	82	96	89	94	90	88	89	90	89	97
25	87	95	95	93	91	87	93	86	92	90	84	88	90	90	92
26	85	95	92	93	90	88	91	90	90	86	88	87	90	87	92
27	84	93	90	91	89	87	92	89	90	88	89	90	87	89	91
28	91	92	80	90	90	87	96	90	90	90	89	90	88	88	90
29	90	91	90	90	91	87	97	88	88	95	90	90	90	89	89
30	87	94	94	90	90	89	96	87	88	NA	91	91	98	95	90
31		92	90		93	89		89	90		91	90		94	92
Avg.	86.1	90.2	91.2	91.5	92.0	88.2	89.3	90.0	89.8	87.4	89.3	90.6	90.4	93.5	92.9

years for the months of June through August. This was the maximum daily temperature and was taken at 3:00 p.m. by Mr. Jerry Knebel of the City of Biloxi. From 1970 through 1979 the mean temperatures for June, July and August were 87.3, 90.0 and 89.5°F. For the year 1980, the means were 90.4, 93.5 and 92.9°F or 3.6% greater than for the previous 10 years. This is an extreme change in long time averages. In view of the great changes on the whole physiological process caused by a few degrees change of body temperature, this could cause a very great change brought by a relatively small environmental change.

Furthermore, between June, July, and August 1970 and 1979 (a period of 920 summer days over 10 years) there was one day only (20 August 1972) when the temperature equaled 100°F. But in 1980 there were 7 days with 100°F or more, with five of them in succession.

On July 26, 1980, the temperature on a bank clock in Ocean Springs, Mississippi, on Highway 90 registered 107°F at 3:00 p.m., which is the highest air temperature the author has seen during 51 years on the Gulf Coast. At that time he remarked that the clock was broken, but it was not. On the same day, *The Daily Herald* reported the air temperature in Gulfport at 106°F and that in Long Beach at 105°F. Considering the distance apart, some 20 to 30 miles down the beach to the west, these temperatures were remarkably similar. This occurred after the deaths of the baby terns were first noted, but it was a continuation of the same hot spell. There is little doubt about the killing heat in the open sand-scapes that constitute the nests of the Least Terns. Table 2 gives the mean temperatures for each month.

During the preceding weeks chickens were dying all over Texas, the midwest and down into Arkansas, and at least 200,000 were reported killed in Mississippi. Following this hot spell there were some cooling rains and the deaths of domestic fowl as well as those of Least Terns came to an end.

Least Terns also nest on Ship Island, Horn Island and Deer Island, the latter being just off the mainland. Some deaths were reported from Deer Island, but none from Horn and Ship and these differences were advanced by a local amateur ornithologist as indication that heat was not the cause of the mortality. However, the sea beaches of Horn and Ship Island, both being offshore barrier islands, are always cooler in the summer than the mainland shore of Mississippi Sound and usually there is a breeze from the sea in the warmer months, which keeps the sea beach cool. To the contrary, cold spells push right to the beach in winter, growing a little warmer as the beach is approached and then the air becomes warmer unless the wind is hard from the north. This regime and the arrangement of sea and land temperatures on the Gulf were explained by Collier and Hedgpeth (1950).

TABLE 2.

Air temperature means by months for the years 1970 through 1980 at Biloxi, Mississippi

	Jun	Jul	Aug
1970	87.3	90.0	88.4
1971	88.5	88.9	89.3
1972	90.0	89.1	91.6
1973	88.9	91.9	89.3
1974	86.6	90.1	88.6
1975	86.9	88.6	87.7
1976	86.1	90.2	91.2
1977	91.5	92.0	88.2
1978	89.3	90.0	89.8
1979	87.4	89.3	90.6
1980	90.4	93.5	92.9
Avg.	87.3	90.0	89.5

The northern Gulf of Mexico coast of the United States is in the cool, wet part of the Carolinian biogeographic zone of the subtropics and as such it experiences cold spells that kill fishes (Gunter 1947, Overstreet 1974) and also heat waves that raise the water temperatures in shore ponds to 35.0°C and a little above (Simpson and Gunter 1956). The meteorologist Reiter (1981) has recently explained the excessively high temperatures of 1980 in the south central states in terms of jet streams influenced by the Rocky and Himalayan Mountains in an article, entitled "The Tibet Connection." He did not mention a single temperature, but there is no doubt of the excess heat. He said, "The 1980 summer heat wave in the south-central United States was marked by a persistent anticyclone in the same area. Meteorologists suspect that this phenomenon was triggered by the Rocky Mountains (which the jet stream tends to cross with an anticyclonic curvature). The anticyclone's persistence was most likely caused by the combined effects of an unchanging pattern of large-scale airflow waves between Tibet and the Rockies, surface temperatures over the Pa-

cific, and feedback from the heat wave itself. The dry and hot soil of the south-central United States acted on the atmosphere as a giant furnace, heating up the lower troposphere and thereby extending the deflecting effects of the Rockies on the tropospheric airflow patterns farther to the east and southeast than is normally the case."

I saw the dying tern chicks one time. They were characterized by neck twisting, which poultry raisers call wry-neck. The medical term is torticollis.

If we may take a broader view, evolutionists are coming to see that the process takes place by beats or jumps with long intervening periods of little change. This fits in with the idea of Taylor (1934) pointing out the increased stress brought about by years of extreme range in environmental factors, such as heat, cold, high salinity, low salinity, and drought. This can also be related to cases of mass mortality in the sea.

In summary, it would appear that excess heat from the substrate was the cause of the death of Least Tern chicks along the Gulfport beach in 1980.

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