Destruction of Fishes and Other Organisms on the South Texas Coast by the Cold Wave of January 28-February 3, 1951

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Source: *Ecology*, Vol. 32, No. 4 (Oct., 1951), pp. 731-736
Published by: Wiley on behalf of the Ecological Society of America
Stable URL: https://www.jstor.org/stable/1932740
Accessed: 18-01-2019 12:21 UTC

vation, which I made: and it will serve to prove the occasional encrease and diminution of the glaciers; contrary to the opinion of some philosophers, who advance that they remain always the same; and of others who assert, that they are continually encreasing. I think I may venture to assert, that both these positions are equally untenable; and it happens in this, as in many other subjects, that experience and truth are sacrificed to the supporting of a favorite hypothesis. Indeed the fact seems to be that these glaciers in some years encrease considerably in extent, while in others they recede; and of this I am perfectly convinced from the following circumstances:

"The borders of the valley of ice of the glacier of Montenvert, are mostly skirted with trees: toward its foot a vast arch of ice rises to near an hundred feet in height; from under which, the continued droppings from the melting of the ice and snow are collected together, and form the Arveron; which rushes forth with considerable force, and in a large body of water. As we approached the extremity of this arch, we passed through a wood of firs; those which stand at a little distance from the ice are about eighty feet high, and are undoubtedly of a very great age. Between these and the glacier, the trees are of a later growth; as is evident as well from their inferior size, as from their texture and shape. Others, which resemble the latter, have been overturned, and enveloped in the ice; in all these several trees, respectively situated in the spots I have mentioned, there seems to be a kind of regular gradation in their age, from the largest size to those that lie prostrate.

"These facts fairly lead, it should seem, to the following conclusions:—that the glacier once extended as far as the row of tall firs; that, upon its retiring, a number of trees have shot up in the very spots which it formerly occupied; that, within some years, the glacier has again begun to advance; and in its progress has overturned the trees of later date, before they have had time to grow up to any considerable height.

"To these circumstances, another fact may be added, which appears to me convincing. There are large stones of granite, which are found only at a small distance from the extremities of the glacier. These are vast fragments, which have certainly fallen down from the mountains upon the ice; have been carried on by the glacier in its encrease; and have tumbled into the plain upon the melting or sinking of the ice which supported them. These stones, which the inhabitants call *Mareme,* form a kind of border, towards the foot of the valley of ice, and have been pushed forward by the glacier in its advances; they extend even to the place occupied by the larger pines."

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DESTRUCTION OF FISHES AND OTHER ORGANISMS ON THE SOUTH TEXAS COAST BY THE COLD WAVE OF JANUARY 28–FEBRUARY 3, 1951

INTRODUCTION

The South Texas Coast in the general region of Corpus Christi is at the same latitude as Tampa, Florida. Cold polar fronts push as far south here as at any place on earth. These are the well-known Texas northers of fact and story. Occasionally they are strong enough to cross the Gulf of Mexico and over the Isthmus of Tehuantepec down to Nicaragua on the west side.

Texas has approximately 3,500 square miles of bay waters. These waters are shallow, the average offshore depth being 6 to 8 feet. The bays are connected with the Gulf of Mexico by relatively narrow passes, there being only five of any size along the 360 miles of shoreline. Due to these physiographic features and the extremely rapid onset of the northers, accompanied by sharp drops in water temperature, occasionally mortalities of marine life are caused. Gunter (1941, 1945) has recorded instances. In some cases destruction attains catastrophic proportions. Observations throughout the years have indicated that the amount of destruction depends on several things beside the low temperature attained.

In this paper the writers wish to describe the effects of the cold wave of January-February, 1951, in and around Aransas Pass, one of the major passes of the Texas Coast. It lies about 21 miles due east of the city of Corpus Christi, and 130 miles north of Mexico.

DATA

On January 28 the norther struck at about 5 o'clock in the afternoon. It came in gradually and temperatures dropped slowly that night. The wind slowly increased next day and the next night, attaining a speed which varied from 25 to 40 miles an hour. Temperatures dropped below freezing on January 29 and remained below freezing for five days. The minimum temperatures recorded at the Corpus Christi Weather Bureau station from January

29 to February 3, in consecutive order, were: 25, 22, 22, 18, 20 and 19° F. In the citrus belt of the Rio Grande Valley, 125 miles to the south, temperatures fell to a little below 19° F. and extensive damage was done. Ranchers reported some losses of cattle but these were not severe. In length of time the cold held on and the low temperatures attained, this cold spell compares only with the great freezes of 1890 and 1882 on the South Texas Coast. Along the lower parts of the coast it broke all previous records.

We noted four brown pelicans dead and heard reports of others. White pelicans are quite common in this region in the winter but no dead ones were heard of or seen. One dead Caspian tern was seen. On January 31 a common loon, *Gavia immer,* was found on the Gulf beach in a helpless condition and covered with ice. It was released on February 3 and swam away. Four myrtle warblers, *Dendroica coronata,* and one bluebird, *Sialia sialis,* were found dead during and after the freeze. They probably starved as well as froze, for the ground and all plants were covered with ice.

On February 9, one week after the freeze, a large leather-back turtle, *Dermochelys coriacea,* drifted ashore in the northwest part of Copano Bay at the town of Bayside, Texas. This turtle was a male measuring 6 feet and 8 inches long from nose to tail and was estimated to weigh around 500 pounds. This is a tropical species not particularly common anywhere and so far as we know this is the first written record from the Texas Coast, although it is not unknown to native fishermen. Possibly it died from natural causes but it seems strongly coincidental that an uncommon turtle of this size should come ashore right after the hard freeze.

The writers made notes on the fishes killed by examining the Gulf shore of Mustang Island for a distance of 3 miles, the south jetty of Aransas Pass, the shore of the ship channel leading to Aransas Pass, the harbor in the city of Aransas Pass, the northern shore of Aransas Bay along Live Oak Peninsula and the southern shore of Copano Bay along the same peninsula. Examinations of the Gulf beach and the jetties were made on February 1 and 2. Examinations of Aransas Pass harbor and Aransas and Copano bays were made on February 2 and 4. Some observations were made on the north shore of St. Charles Bay on February 4 and on the north shore of Copano Bay on February 10.

The fishes on the Mustang Island beach consisted almost solely of the hardhead catfish, *Galeichthys felis.* It was estimated that approximately 6,000 catfish lay along the beach over a distance of a mile and a half south of the jetty. South of that point they were scattered with only a few fish every 100 yards. The following dead fishes were also noted along this beach: the anchovy, *Anchoa mitchelli diaphana;* needle-gar, *Strongylura marina;* butterfish, *Poronotus triacanthus;* silverside, *Menidia beryllina peninsulae;* black drum, *Pogonias cromis;* yellowtail, *Bairdiella chrysura;* pinfish, *Lagodon rhomboides;* spiny boxfish, *Cyclicthys schoepfi;* and an unknown conger eel.

Along the jetties there were numerous catfish, a few speckled trout, *Cynoscion nebulosus,* a few drum, *P. cromis,* and a number of sheephead, *Archosargus probatocephalus.* The numbers ranged from 3 to 10 per yard. The yellowtail, *B. chrysura,* and the pinfish, *L. rhomboides,* numbered about two each to the yard. Anchovies dead and dying were present in large numbers. One cyprinodontid, *Fundulus similis,* was found alive but stranded. Closer gleanings for smaller fish in a short distance yielded a sea robin (*Prionotus*), three seahorses (*Hippocampus hudsonius*), one midshipman (*Nautopaedium porossisimum*), six graysnappers (*Lutjanus griseus*), one mullet (*Mugil cephalus*), two *P. triacanthus,* one needlegar, ten *C. schoepfi,* two butter hamlets (*Hypoplectrus unicolor*), one worm eel (*Myrophis*), and 18 Louisiana pipefish (*Syngnathus louisianae*).

The ship channel leading into the city of Aransas Pass had black drum and speckled trout scattered along the shores. People were picking up trout. Some had collected as much as three bushels. Several hundred dead anchovies were seen in one spot. Nevertheless, on the whole few cold-killed fishes were seen along this channel.

On February 2 in the Aransas Pass harbor a few hundred people were fishing along the shores with ordinary casting rods and 3-pronged hooks or grabs instead of the usual bait. They hooked onto the dead and inactive trout and several large catches were made. Fish were also taken in dip-nets or merely raked in with oars. Several people made catches amounting to 40 or 50 pounds. Most of these fish appeared not to be dead but merely in a stunned or inactive condition. Numbers of them probably would have survived. The shores of the harbor at this time were lined with a good many pipefish, pinfish, ribbonfish (*Trichiurus lepturus*), croakers (*Micropogon undulatus*), and flat croakers (*Leiostomus xanthurus*). On February 4 the shores were lined with a much greater number of small dead fishes. Their numbers amounted to approximately 30 per yard. A count along one yard of the shore showed 24 *L. rhomboides,* 2 yellowtail (*B. chrysura*), 2 striped mullet (*Mugil cephalus*), 1 silverside (*M. b. peninsulae*), and 1 flat croaker (*L. xanthurus*).

The north shore of Aransas Bay yielded little fish during either examination. At the time of the cold wave it was a lee shore and fish would have drifted to the south. However, considerable numbers of mullet, speckled trout,

sheephead, black drum and redfish later drifted to shore on this bay north of Fulton. Large strips of mush ice were seen on some of the shores of the offshore islands on February 2.

Dead fishes were not present on the shores of Copano Bay in spectacular amounts on February 2. However, closer examinations showed that in some places great numbers of anchovies, *Anchoa mitchelli diaphana,* were present. Other fishes seen were croakers, yellowtail, sheephead, the hake (*Urophycis floridana*), the small eel (*Myrophis punctatus*), the shad, (*Signalosa mexicana*), the naked goby (*Gobiosoma bosc*), pinfish, puffers (*Sphoeroides*), stargazer (*Astroscopus*), and striped mullet. Larger fishes continued to come ashore up to three weeks after the freeze. These were trout, redfish and drum. On February 10 the exposed tidal flats on the north shore of Copano Bay showed considerable numbers of speckled trout, striped mullet, black drum and gizzard shad (*Dorosoma cepedianum*).

Few fish were seen along the shores of St. Charles Bay although large numbers were reported to be floating in the middle of the bay.

Examinations of parts of Karankaway Bay, Matagorda Bay and the Laguna Madre were made three weeks to a month later. Fish carcasses, especially the larger ones, were still much in evidence. Thousands of mullet were seen and possibly more of this species were killed than of any other fish. In some shallow ponds near the bays the cyprinodontid, *Cyprinodon variegatus,* were wiped out.

Considerable numbers of invertebrates were observed along the shores of Copano Bay. There were thousands of the little flat crab, *Petrolisthes armata,* and a considerable number of blue crabs, *Callinectes sapidus.* Commercial shrimp, *Penaeus aztecus,* and spider crabs were also observed. The snapping shrimp, *Crangon,* was very abundant. Two dead squid, *Loligo brevis,* were seen. Along the Gulf beach one *Penaeus aztecus* and two molluscs were the only invertebrates seen. One of these was the gastropod, *Phalium granulata,* and the other was the pelecypod, *Noeta ponderosa.* Following the cold spell oyster tongers brought up large numbers of stone crabs, *Menippe mercenaria,* in an inactive condition among the tong loads of oysters. Windrows of commercial shrimp, *Penaeus aztecus,* were reported on the islands of lower Aransas Bay, but were not observed by us.

After the freeze several pictures of dead fishes in the Laguna Madre were published in the papers. Here the fish were piled up in windrows several hundred yards long. These extended for a distance of some thirty miles along the upper Laguna shore. Damage was less in the lower Laguna. Figure 1 is a series of pictures of fishes killed in the Laguna Madre. They were taken by marine biologists of the Texas Game, Fish and Oyster Commission, to whom we are indebted for permission to use them.

Discussion

There are a dozen or more papers reporting mortality of marine organisms caused by cold in Florida, Texas, the Bermudas and Denmark. References not previously cited in the papers referred to above are: Blegvad (1929), Johansen (1929), Smidt (1944) and Verrill (1901).

There is no doubt that the fishes and other animals reported in this paper were killed by the cold. Numerous others were inactivated and rendered temporarily helpless. It further seems clear that, although several million fish were killed along the Texas Coast by this record-breaking cold wave, the destruction of marine life was not more severe than the spell of 1940 previously reported (Gunter 1941). In our opinion it was less. In addition to our own observations, we checked with six game wardens and commercial fishermen. Opinion ran 5 to 1 that the 1940 freeze was more damaging to marine life. The cold spell of 1947 also did considerable damage according to all general reports. The cold wave of 1949 caused less destruction to marine life. It went unrecorded in the literature except for reference to destruction of certain elements of the chaparral on land (Gunter 1950).

A comparison of observations by the senior author during the two spells indicates that mortality was greater in Copano Bay, Aransas Bay, Aransas Pass and along the Gulf beach during the 1940 freeze. Following the 1940 cold wave windrows of dead fishes were present in the Laguna Madre and also down the Mexican Coast. During 1940 the temperature of the open bay fell to 39° F. and there was considerable ice along the shore. During 1951 the lowest temperature reported in the open bay was 38° F. and there was also considerable ice along the shores. Although the air temperatures in 1951 were considerably lower, the cold did not remain any longer than in 1940 and the water temperatures were about the same during both spells. Marine biologists of the Game, Fish and Oyster Commission estimated in newspaper reports that 60 to 90 million pounds of fish were killed in 1951. Exact estimates are difficult, but there is no doubt that destruction was enormous.

This raises the question of why some cases of mortality are more severe than others, although the low temperatures may be nearly the same or may even fall lower in cases of lighter mortality. Storey and Gudger (1936) and Gunter (1945) noted that, for one thing, the destructiveness of cold waves depended upon the rapidity of the temperature drop more than upon the low attained. The facts seem to be

explicable on the basis of acclimatization. A comparison of the 1940 instance and that of 1951 yields the following information: In 1940 the cold spell was the first hard one of the season. It came on with extreme rapidity and air temperatures fell from 65° to 25° F. in four hours. The damage to fishes was enormous and was great enough to bring about a reduction of the commercial catch during the following year. In the winter of 1950–51 one cold spell brought freezing temperatures to the Texas Coast during the first part of December. Another freeze followed on January 6. These did not cause any mortality but could have caused many animals to leave the bays. The cold wave of 1951 came on gradually and there was one night without freezing temperatures. The air temperatures over the water fell to approximately 18° F. Thus, in 1951 the fishes might have been acclimatized by the previous cold spells and also affected comparatively less by the slow onset of the major one. Similarly, large numbers of them might have been forewarned by the same two factors and thus have made their escape to deeper and warmer waters. One of us (Gunter 1945) has previously shown that there is a cyclic movement of fishes and other marine animals from the bays into the Gulf of Mexico which starts every year at the onset of cooler temperatures in the fall. Party boat fishing for sea trout and redfish in the bays had practically ceased in January, 1951,

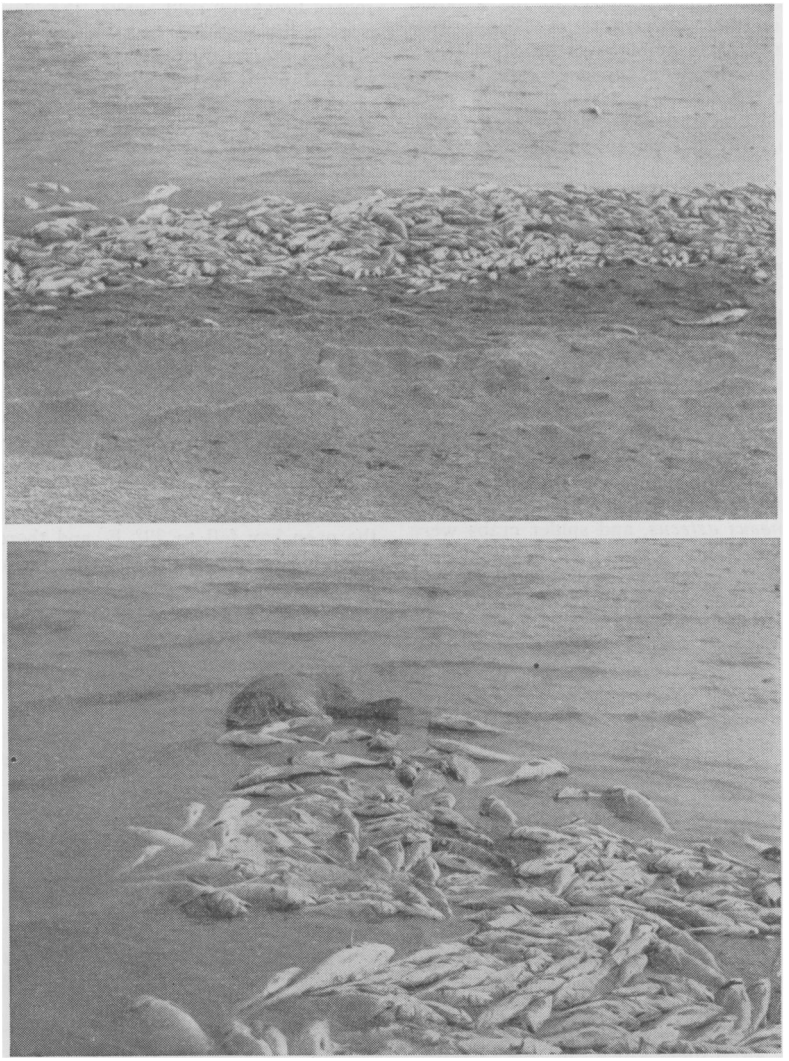

FIG. 1. (*Continued on facing page.*)

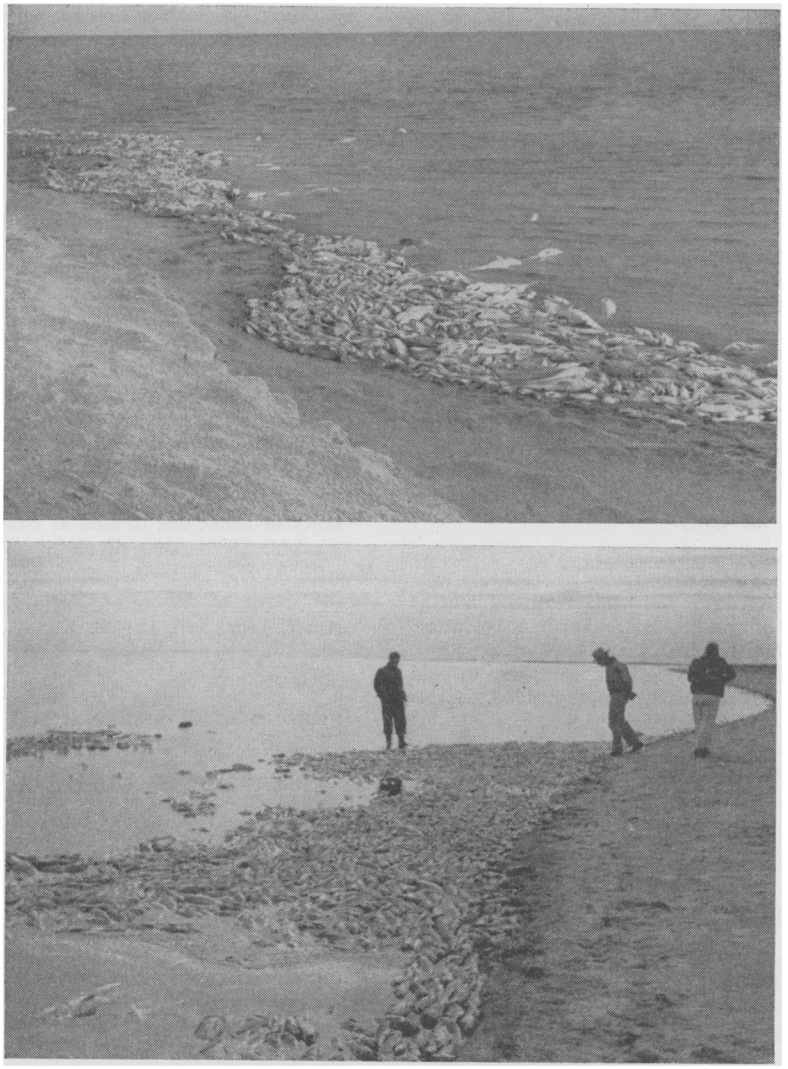

FIG. 1. Fishes killed in the Laguna Madre of Texas by the cold wave of January 28–February 3, 1951. (Photographs by courtesy of the Game, Fish and Oyster Commission.)

because the fish had largely left the bays. In any case, it seems to be clear that the amount of damage to marine life on the Texas Coast is dependent upon the rapid onset of northers as well as the degree of low temperature attained. Whether or not the damaging northers have been preceded by other cold waves is also a factor influencing the amount of mortality.

The marine life of the Texas Coast and the west coast of Florida seem to be particularly subject to destruction by hard cold spells. Gunter (1947) considered this matter in connection with catastrophic mass mortalities in the sea and the increased chance for fossilization. Nevertheless, the Recent deposits along the Gulf yield very few fossils, although the northers and other agents producing catastrophic mortalities of fishes must have been operative in this environment for 25,000 years or more.

The physiographic features of the Texas Coast and the quick onset of the northers explain to some extent the prevalence of fish kills in this region. The presence of large numbers of fishes with tropical affinities also plays a part as Storey (1937) has postulated for Florida waters. Her paper showed conclusively that mortality was most extensive among those fishes with tropical distribution.

SUMMARY

The shallowness of Texas bay waters, their practically landlocked condition and the rapidity with which cold northers strike the coast are factors making the marine life of this area particularly subject to mortality from cold waves every few years. Since 1940 slight mortality was caused by cold waves in 1941 and 1949. Considerable damage was caused in 1947. The 1940 and 1951 episodes were catastrophic. Probably the 1940 instance was the most severe although the 1951 freeze was the hardest. Estimates made by biologists of the Game, Fish and Oyster Commission of the amount of fish killed in 1951 range from 60 million to 90 million pounds. It seems that if the damaging cold waves are preceded by other freezes, their destructive effect is lessened. Some animals escape to deeper water if the onset of the cold wave is slow and the rapidity with which the northers strike is a factor influencing the amount of mortality.

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ECOLOGICAL LIFE HISTORY OUTLINES FOR FUNGI [1, 2]

INTRODUCTION

This is another in the series of outlines and bibliographies of ecological life history studies of both plants and animals which are currently appearing in ECOLOGY, under the sponsorship of the Committee on Ecological Life Histories.

The study of mycology and its related subjects including plant pathology, human pathology, and the various fields of industrial microbiology devoted to the study of various aspects of fungus physiology, has resulted in a high degree of development in ecological life history studies in this particular area. As in parasitology this group is far ahead of any other group of organisms in life history studies because of the facility of culture of saprobic species, and because of the great economic importance of saprobic, perthogenic and pathogenic species. Ecological life history study methods have been in use in the above mentioned fields for a long time to solve practical problems of disease control in crop plants including forest trees, in domestic animals and man, as well as practical problems in the manufacture of industrial alcohol, antibiotics, various chemical compounds, and the prevention of decay in various organic materials including natural and synthetic fibers and other products. This group of organisms has thus been in a most favorable position to compete for attention and funds for research on and development of our knowledge of their ecological life histories. The result of this interest is a vast literature on methods of study and life history monographs which are rarely complete but are usually devoted to one or more phases of the life history of the organism, especially those associated with the practical problem at hand. Within the fungi there is a great diversity of ecological relations, basic physiology,

[1] This investigation was supported in part by funds provided for biological and medical research by the State of Washington Initiative Measure No. 171.

[2] Scientific Paper No. 1031, Washington Agricultural Experiment Stations, Institute of Agricultural Sciences, The State College of Washington, Pullman.