JOB REPORT

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Project Name: Ecological Survey of the Lower Galveston Bay Area.

Period Covered: September 1, 1958 - Aug. 1, 1959. Job No. F-3

Ecological Studies Related to Pollution

Objectives: Study of areas of physical pollutants and the related fauna to determine effects of pollutants on populations in the area.

Procedure: Stations were visited in the Texas City Channel, and Offatts Bayou areas and data gathered on the physical properties of the water as far as possible and on the populations of fishes and other marine life in the area. Comparisons will be made with other nonpolluted areas.

Offatts Bayou was visited on several dates in spring and early summer, 1958. Extensive pH, H_2S, and DO data was taken on March 10 and 13. Dissolved oxygen was determined by the Winkler method, and several samples run by the Rideal-Stewart method were compared. Sulfides were determined by the methylene blue colorimetric method. Hydrogen ion concentration was determined insitu with a Beckman model N pH meter. Salinities were determined by silver nitrate titration of halides converted to total salts. Sediment samples were taken with an Ekman Dredge, and all water samples with a Kemmerer water sampler. W.C. Renfro and C.W. Washburn helped collect the diurnal data.

Results: Texas City Channel

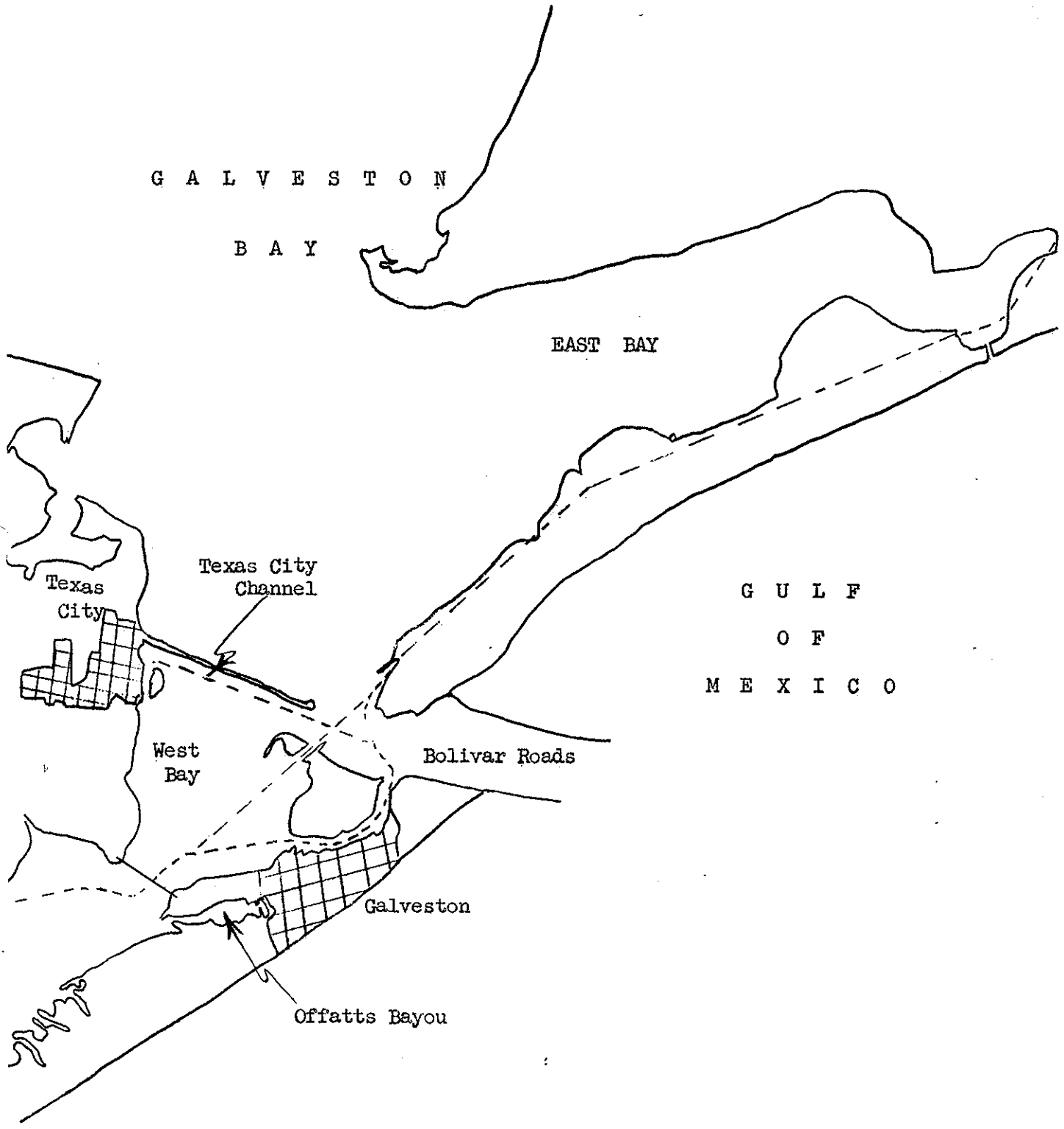
The Texas City Channel is the only area other than Offatts Bayou in Area M-3 that can be considered as polluted. Pollution is not considered serious in the Texas City Channel, but a small slip into the Union Carbide plant is heavily polluted, the bottom sediment containing a large amount of oil and other pollutants.

No apparent faunal difference was noted in the Texas City Channel, but local residents claim that fish taken in the vicinity are often "oily". The Union Carbide Slip, however, from time to time, contains no life in parts of the channel and the whole channel always has at least a reduced fauna from 1/4 to 1/3 that which could be expected in a similar non-polluted habitat. Only a few species were ever taken from the channel.

Several mortalities of small fishes (Brevoortia and Anchoa) occurred in the channel during the study period but no cause could be determined.

The Texas City Channel is deep (35 ft) and is under the influence of tides through Bolivar Roads; so pollutants are probably dissapated rapidly.

GALVESTON - TEXAS CITY AREA



The Oxygen Minimum Layer in Offatts Bayou

Offatts Bayou, a small, blind body of water on Galveston Island, has gained attention from its periodic fish mortality, the cause of which is uncertain (Gunter, 1942, 1951; Connell and Cross, 1950; Hedgpeth, 1951). Several factors other than recurring mass mortality make Offatts Bayou distinctive, yet it has been the subject of little study.

Offatts Bayou has several characteristics which indicate that it may be a relict inlet, having reached the final stage of migration some time ago, that Bolivar Roads would be experiencing were it not for the Corps of Engineers. An 1851 map shows Offatts Bayou connected by a series of sloughs to the Gulf of Mexico. The Deer Islands near the bay mouth may well be the remnants of the inlet's tidal delta. Pelican Island might tend to be broken up in a similar manner from tidal currents if Bolivar Roads was allowed to migrate to trend east-west. Offatts Bayou has depths up to 8.5 meters. Such depths are more characteristic of inlets than marshes or bays, although Hopkins (1931) claims that the bayou was once shallow and has been dredged.

Much of the bottom of Offatts Bayou is an anaerobic, reduced mud, seemingly highly organic. Connell and Cross (1950) have discussed pollution of the bayou. The wastes they listed going into the bayou have been stopped, but there is still sporadic dumping of refuse. No one has previously studied the bottom of Offatts Bayou, but local residents are of the opinion that the reduced condition of the bottom came about as the result of organic pollution. A similar condition was brought about in Cedar Bayou, which receives on pollution, after the Gulf mouth of the inlet closed (Simmons and Hoese, 1959). The sediment in Cedar Bayou, although anaerobic, did support a few mollusks (mainly Mulinia lateralis), whereas that of Offatts Bayou apparently normally supports no aerobic life. Up to 1.3 ppm H_2S was recorded as high as 1 meter above the bottom in 7 meters of water and up to 2.2 ppm from water in the upper portion of the sediment. Gunter (1942), from the blackening of lead, assumed that H_2S was a factor contributing to the recurring mortality.

Often the water a meter above the bottom contained at least a trace of H_2S, along with dissolved oxygen 1 ppm. or less and a pH of 6.5 to 6.9. Oppenheimer and Kornicker (1958) recently presented experimental evidence that the pH of recent sediments is directly related to bacterially produced H_2S and CO_2. They found that H_2S saturated sediment has a pH of 6.8. Presumably the bottom of Offatts Bayou is rich in sulfate reducing bacteria, similar to the bottom of Cedar Bayou.

Diurnal curve data (1300 10 March - 1400 11 March) showed surface waters to be supersaturated at all times except from 1900 through 2100 10 March. This coincided with a high southeast wind which would tend to push water out of Offatts Bayou into West Bay. Shortly after the wind died the surface waters returned to supersaturated where they remained during westerly winds of 11 March. During the southeast wind dissolved

oxygen one meter above the bottom dropped suddenly from 3.0 to 1.2 ppm, and finally to 0. After the wind died they rose rapidly to over 5 ppm. Apparently this wind had moved surface waters out of Offatts Bayou allowing the anaerobic bottom waters to rise. When the wind died, these waters returned, and dissolved oxygen and pH returned to normal. If this is the case, then Offatts Bayou waters were relatively stable for surface DO, other than during the southeast wind, varied only 3.6 ppm. (7.4 - 11.0 ppm). Bottom DO varied 6 ppm., and was not saturated until noon of 11 March. If winds largely control the rising and falling of the boundary O_2/H_2S layer, then increased bacterial activity during easterly winds in the warmer months could eventually push the boundary layer to the surface and over much of the bayou. The mortalities begin at the eastern end of the Bayou and spread westward (Gunter, 1942, Connell and Cross, 1950) adding support to this hypothesis.

Such a cause of mortality has been shown by Copenhagen (1953) in Walvis Bay, South Africa, a much larger area than Offatts Bayou.

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