THE EFFECTS OF 1973 SPRING FLOODWATERS ON OYSTER POPULATIONS IN LOUISIANA

by
RONALD J. DUGAS
and
WILLIAM S. PERRET
Louisiana Wildlife and Fisheries Commission
400 Royal Street
New Orleans, Louisiana 70130

ABSTRACT

A total of 122,700 acres of leased oyster bottoms were adversely affected by the floodwaters of 1973; this represented 68 percent of the leased oyster grounds in Louisiana. Additionally, much of the public natural "Oyster Seed Grounds" were subjected to unusually low salinities, siltation, and vegetation overburden; this resulted in loss of a portion of the 1973 seed oyster crop.

INTRODUCTION

Louisiana is fortunate to have a vast and extensive estuarine and marsh complex. This system was estimated to contain 3,378,924 surface water acres (Barrett, 1970), and 3,910,664 acres of marshland (Chabreck, Joanen, and Palmisano, 1968). The marsh acreage is divided into four major types: saline—862,973 acres, brackish—1,203,790 acres, intermediate—650,576 acres and fresh—1,193,325 acres. The volume of freshwater discharged by the many rivers and streams flowing through this complex is tremendous. Perret, *et al.* (1971) reported the total average annual freshwater discharge into Louisiana's coastal areas from the Pearl, Amite, Tangipahoa, Mississippi, Atchafalaya, Calcasieu, and Sabine Rivers, and Bayous Lafourche and Teche was 678,736 cubic feet per second (cfs). Discharges from the Mississippi and Atchafalaya Rivers accounted for over 90 percent of this total average annual discharge. During recent years (1973, 1974, 1975), discharge from these rivers has become greater. Such was the case in the spring of 1973 when discharges as high as 1,498,000 cfs for the Mississippi and 781,000 cfs for the Atchafalaya River were recorded (U. S. Army Corps of Engineers, 1974). These rivers were so high during this period that two relief floodways had to be opened to protect river's levees. The Bonnet Carre Spillway was opened on April 8, 1973, and was closed on June 21, 1973. For a period of 75 days, discharges as high as 195,000 cfs entered Lake Pontchartrain, Lake Borgne, and the surrounding estuarine zone (U. S. Army Corps of Engineers, 1974). Additionally, water breached levees at numerous points on the east side of the Mississippi River below Pointe-A-La-Hache, Louisiana. The volume of this discharge was not known, but these floodwaters saturated the extremely important estuarine systems of southeast Louisiana.

On April 17, 1973, the Morganza Spillway (part of the Atchafalaya Floodway system) was opened; this spillway was closed on June 15. For a period of 60 days, discharges as high as 194,000 cfs entered the estuaries from Caillou Lake to Vermilion Bay (U. S. Army Corps of Engineers, 1974).

These tremendous volumes of freshwater along with warm water temperatures had a temporarily disastrous effect on both private and natural oyster grounds located within the influence of the discharges. Oyster mortalities from floodwaters had been reported in Alabama (May, 1972), Mississippi and Louisiana (Butler, 1949a, 1952; Butler and Engle, 1950; Owen and Walters, 1950; Gunter, 1953), and Andrews, Haven and Quayle (1959).

Much of the public natural "Oyster Seed Grounds" (Perret, *et al.*, 1971) were subjected to unusually low salinities, silt, and vegetative overburden; this resulted in the loss of a portion of the 1973 seed crop. Oysters produced on seed grounds are for the use and benefit of the oyster fishermen, and are available for harvest on a seasonal basis.

The bulk of Louisiana's prime oyster producing acreage was adversely affected by these spring floodwaters in 1973 (Figure 1). This posed a serious threat to the oyster industry; Louisiana's production has averaged 10,055,000 pounds annually for the period 1968-1972 (Fishery Statistics, U. S., 1968, 1969, 1970, 1971, 1972). The ill effects of the floodwaters were two fold; i.e., the actual mortalities incurred by intrusion of the freshwaters into normally brackish estuarine bays and marshes, plus the closures by Louisiana's state health agency of large zones to oyster fishing to insure protection of the public's health. These two factors were synergistic in some instances to the extent that the ban on fishing in certain areas imposed at an early date resulted in their loss since the fishermen were unable to harvest or even relocate their oysters.

Figure 1. Map of Louisiana showing locations of Bonnet Carre and Atchafalaya Floodway and areas where oyster mortalities occurred.

The objectives of this study were to delineate the areas affected by floodwaters, to determine mortality percentages, and ιο give possible explanations for their occurrence.

MATERIAL AND METHODS

The Louisiana Wildlife and Fisheries Commission was requested by the industry to document and determine the extent and area of freshwater influence and oyster mortality on private grounds. To accomplish this the entire productive oyster grounds were gridded off in three mile square grids. One or more oyster leases were randomly selected in each grid and generally two oyster dredge samples were taken on each lease. In all, a total of 238 oyster leases were examined during June, July, and August, 1973. Areas on the state seed grounds were selected from known productive oyster reefs. Those grids which were not known to produce oysters were also checked to determine productivity and mortality. Boxes (hinged valves) and recent dead valves were recorded. In most cases, mortality was recent enough that counts were fairly accurate. In all areas, some oyster tissue was still within the hinged valves. In some instances living oysters appeared to be in a moribund state and may have died within a few days, therefore, increasing the recorded percent mortality of the area. These were recorded as live oysters. The State controlled "Seed Grounds" were very closely monitored after it first became apparent that they were going to receive a tremendous amount of freshwater.

Salinity measurements were made in the field at all oyster sampling stations by use of a portable salinometer. On several stations along the Louisiana coast, the Commission in conjunction with the U. S. Army Corps of Engineers, has installed constant salinity and temperature monitoring systems which record salinity and temperature information on an hourly basis. That portion of estuarine grounds east of the Mississippi River managed by the Commission for seed oyster production, has three such constant monitoring stations established in the vicinity of oyster reefs. These had been established primarily to monitor freshwater introduction on these seed grounds by control structures incorporated into the Mississippi River levee system.

RESULTS

The very productive Lake Borgne complex (Figure 1) was hard hit by freshwater discharges from the Bonnet Carre Spillway, the Pearl River, and heavy localized rainfall. This resulted in mortalities of 50 percent (%) and over throughout this complex. Mortalities exceeded 90% in a portion of this system. The mortality here was not serious immediately after the Spillway was opened on April 8, but increased alarmingly as depressed salinities continued into periods of elevated water temperatures in May and June, 1973.

The American Bay-California Bay complex was dealt a severe, though localized, blow due to the influx of Mississippi River water by overtopping of low natural levees, and crevasses in the Bohemia vicinity, plus heavy localized rainfall. Mortalities in this area were directly related to distance from the point of freshwater discharge. Mortalities in excess of 90% were commonplace in American Bay, Bay Long, and upper California Bay (Figure 1).

The Lake Washington-Sandy Point complex suffered rather extensively, both from river discharge and heavy localized rainfall, with over one-half of the area experiencing mortalities in excess of 25 percent, but not quite as severely as the above-mentioned vicinities. Lower Bay Adams, upper Bastian Bay, Scofield Bay, Bay Pomme d'Or, Skipjack Bay, and Cyprien Bay were most affected (Figure 1).

The Little Lake-Upper Barataria Bay complex also suffered extensive damage, but primarily from heavy localized rainfall. Little Lake bore the brunt of the damage, mortalities of 75 percent and above being quite common there (Figure 1).

The Bay Junop-Caillou Lake complex received severe damage in the upper reaches of the region, namely lower Four League Bay, upper Bay Junop, Lake Mechant, Mud Lake, and environs with mortalities of over 90 percent very common. Damage in the seaward regions was extensive but less severe, as the influence of the flooding Atchafalaya River and Floodway was not as great in this zone.

The Vermilion Bay complex, although possessing limited oyster producing acreage (2,179 acres), suffered very severe damage, from freshwater influx through the Atchafalaya River and Floodway, with all mortalities in excess of 95 percent.

An expanded projection revealed that 122,700 leased acres were adversely affected by the floodwaters of 1973; this was 68 percent of the 180,000 acres of oyster grounds under lease in Louisiana. Of this 122,700 acres, 88,715 acres (72 percent) had in excess of 25 percent mortality. This acreage represented 49 percent of Louisiana's total leased acreage.

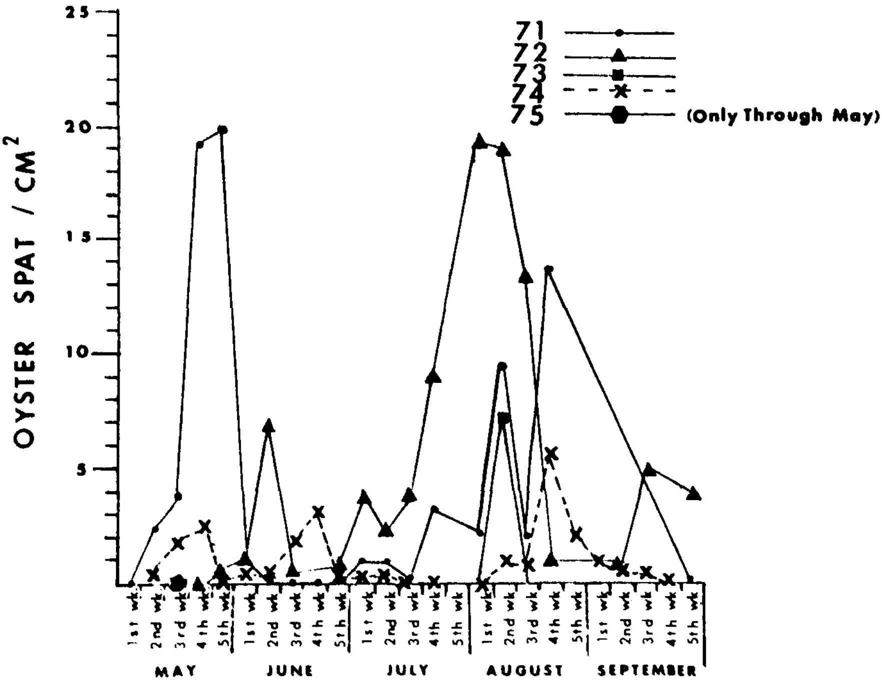

Figure 2. Number of oyster spat taken on collecting devices.

The state "Seed Grounds" were monitored on a weekly basis from April 4, 1973, through June 21, 1973. The mortality on the state grounds began in May with the peak observed in late May and early June, 1973. Additionally, the state "Seed Grounds" received low spat catches when compared to previous years (Figure 2). This agrees with Butler's (1949b) findings that freshwater does supress spawning and in fact changes the sex of the female oyster. Davis and Ansell (1962) observed that if spawning does occur, 90 to 95 percent larval mortalities result in salinities of 5 ppt and lower. Tabony (1972) did not find spat fall in salinities less than 11 ppt on the "Seed Grounds."

Rainfall during March and April, 1973 was extremely heavy. The 11.54 inches that fell in March was 6.40 inches above the overall average, and 6.14 inches above the average rainfall for that period (Climatological Data 1973, U. S. Department of Commerce, Vol. 78, Nos. 3 and 4).

Penetration of Mississippi River water through levee breaks coupled with the above average rainfall produced low salinities. May salinities were extremely suppressed when compared to 1972 (Figure 3). Of particular interest is the 5 parts per thousand (ppt) isohaline line during May, 1973. Loosanoff (1952) reported this as the critical salinity level to oyster survival.

The highest mortality (above 90 percent), which virtually destroyed all the beds in the American and Long Bay area, was experienced near the end of May and the first of June. This is about the same time that excessive mortalities were experienced in other sections of the state. Discussion with local fishermen who were checking their beds indicated that the oysters were doing well until the end of May. In June, recent mortality, as evidenced by the hinged, clean valves with tissue remaining in many hinged sets, was detected in nearly all samples.

The constant monitoring on the "State Seed Grounds" revealed that the situation was similar to that reported by Andrew, Haven, and Quayle (1959) for Chesapeake Bay. They indicate that oysters are able to "condition" themselves to freshwater as evidenced by a reduction in heart beat and other activities primarily during midwinter when water temperatures are suitable. This critical salinity level is 5 ppt when the temperature is about 23 Centigrade (C). Loosanoff (1952) reported that 5 ppt is

Figure 3. Comparison of the May, 1973 with the May, 1972 isohalines, east of the Mississippi River.

the lowest salinity at which oysters will open and pump water. During the winter periods, oysters are in a state of low metabolic activity and do not become really active until temperatures are 23 C. Once this "conditioned" or inactive state is broken by an increase in salinities to and above the critical level (5 ppt) during periods of higher water temperature (above 23 C) oysters when again subjected to low salinity waters (below 5 ppt) are not able to retreat to the former level of inactivity. Thus, the inactive state is dependent upon low temperatures to initiate this condition and, once established, any temporary increase in salinity during periods of high temperature will break the dormancy.

This is apparently the situation that led to the heavy mortalities suffered in the American Bay and Long Bay areas near the state "Oyster Seed Grounds." Similar situations could have stimulated excessive mortalities in other areas heavily affected. Bottom salinity ranges first went below 5 ppt on April 4, 1973, with minimum daily salinity readings remaining below 5 ppt 11 days prior to this date (Figure 4). Salinities remained below 5 ppt for a period of 47 consecutive days when the maximum daily reading barely exceeded the critical level. Then, during the next eight consecutive days, the average daily value remained above 5 ppt even reaching 18.5 on May 25, 1973. This was during a period when water temperatures were in excess of 23 C; beginning on May 21, 1973, the daily low did not fall below 25 C for the remainder of the summer. On June 1, 1973, the average daily salinity dropped below 5 ppt, and on June 6 and 7th, there was a two-day period when the daily high did not exceed 5 ppt. From that period on, it fluctuated around 5 ppt for the remainder of the month.

Increased salinities on May 22, 1973, for which we have no hydrological answer at this time, and the decrease to the former low salinities on June 1, 1973, correlates with findings of Andrews, *et al.*, (1959). This was the period of break (May 22 to June 1, 1973) in a 47-day dormancy. After this time period, salinities again decreased below the critical level, water temperatures remained above 23 C, oysters did not return to the dormant state, and excessive mortalities occurred.

In conclusion, though the 1973 floodwaters were responsible for excessive oyster mortalities along a major portion of Louisiana's coast, this effect was only a temporary setback and the long range benefits should be of considerable value. The controlled introduction of freshwater into estuarine systems is an important management tool, which will aid in the control of oyster predators and pathogens, enhance nutrient introduction, and retard salinity encroachment. On the basis of field checks from the "Oyster Seed Grounds," and from interviews with experienced commercial oyster

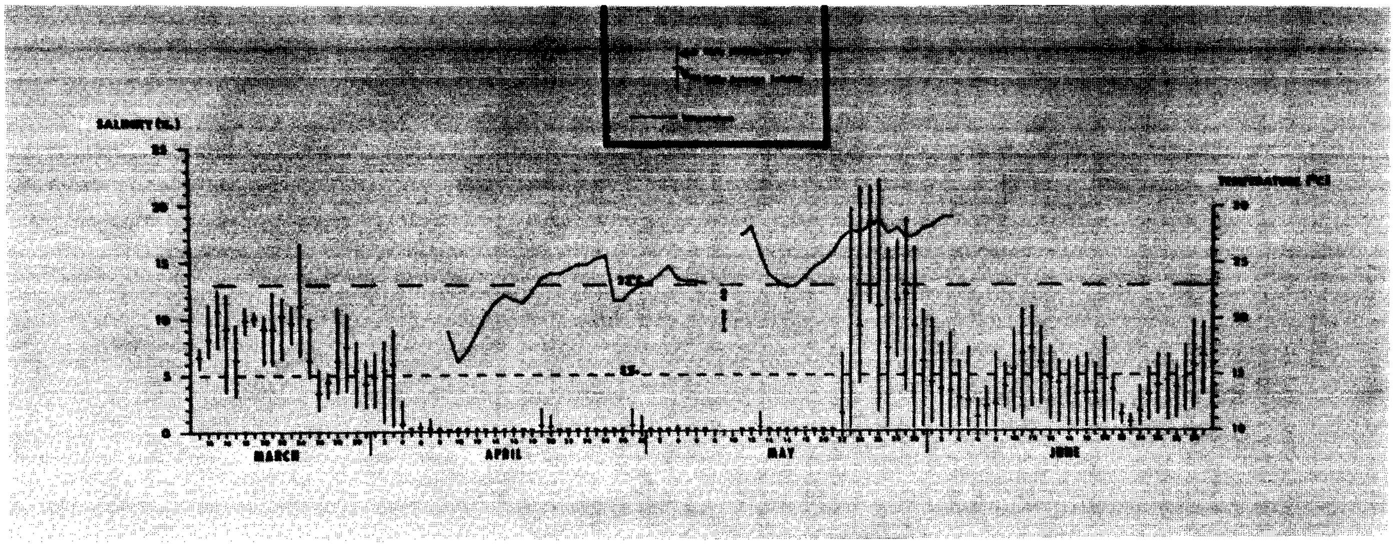

Figure 4. Daily mean bottom salinity (ppt) and range and daily mean temperature (C) at American Bay.

fishermen, indications are that oyster densities are up substantially since the 1973 flood. This trend is expected to continue for several additional years.

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