

Water Quality Monitoring and Data Collection in the Mississippi Sound

MICHAEL S. RUNNER¹ and TRACI FLOYD²

¹U.S. Geological Survey

308 South Airport Blvd.

Pearl, Mississippi 39208-6649 USA

²Mississippi Department of Marine Resources

1141 Bayview Ave,

Biloxi, Mississippi 39530 USA

ABSTRACT

The United States Geological Survey and the Mississippi Department of Marine Resources are collecting data on the quality of the water in the Mississippi Sound of the Gulf of Mexico, and streamflow data for its tributaries. The U.S. Geological Survey is collecting continuous water-level data, continuous and discrete water-temperature data, continuous and discrete specific-conductance data, as well as chloride and salinity samples at two locations in the Mississippi Sound and three Corps of Engineers tidal gages. Continuous-discharge data are also being collected at two additional stations on tributaries. The Mississippi Department of Marine Resources collects water samples at 169 locations in the Gulf of Mexico. Between 1800 and 2000 samples are collected annually which are analyzed for turbidity and fecal coliform bacteria. The continuous data are made available real-time through the internet and are being used in conjunction with streamflow data, weather data, and sampling data for the monitoring and management of the oyster reefs, the shrimp fishery and other marine species and their habitats.

KEY WORDS: Water quality, data collection

INTRODUCTION

The Mississippi Department of Marine Resources (MDMR) and the U.S. Geological Survey (USGS) are collecting data on the quality of water in the Mississippi Sound of the Gulf of Mexico in support of the MDMR missions to protect the public health from diseases associated with the consumption of raw shellfish and to assist in the management of shellfish and their habitats as renewable resources. Data are being collected in the Mississippi Sound of the Gulf of Mexico as well as in its estuaries.

PURPOSE AND SCOPE

This report describes data-collection efforts of the MDMR and USGS in the Mississippi Sound. Included in the report are:

- i) Type of data collected,

- ii) Methods of data collection,
- iii) Description of data-collection sites, and
- iv) Preliminary results of data collected for instrument verification.

Data are being collected on the quality of water in the Mississippi Sound and its estuaries. The Mississippi Sound is the part of the Gulf of Mexico that lies between the Mississippi Coast and the barrier islands, and extends from the mouth of the Pearl River to the Mississippi-Alabama State boundary. Data collection consists of the compilation of discrete water samples for laboratory analysis and the operation of in situ hydrological parameter monitors for the recording of continuous data. The MDMR collects discrete water samples at 169 locations. The MDMR-USGS operates continuous water-quality monitors and collects water samples at seven locations in the coastal region. The USGS also operates continuous hydrological monitors and velocity sensors at two additional locations.

DATA COLLECTION

Water-quality monitoring and data collection by the MDMR and the USGS are described in the following two sections.

Mississippi Department of Marine Resources Data Collection

The primary purpose of the MDMR sampling program is to protect the public health from diseases associated with the consumption of raw shellfish as stated in guidelines set forth by the National Shellfish Sanitation Program (NSSP). The NSSP was developed in 1925 in response to requests from State and local public health officials for assistance in controlling disease associated with the consumption of raw shellfish. Their requests came after widespread outbreaks of typhoid fever in Chicago, New York, and Washington, D.C., in 1924 that were traced to contaminated oysters (U.S. Department of Health and Human Services 1997). The National Food and Drug Administration has the oversight of the shellfish industry at the Federal level; however, the development and enforcement of regulations is the responsibility of the individual States. The Mississippi Department of Marine Resources is the agency responsible for regulation of the harvest and handling of shellfish in Mississippi.

The Mississippi Sound has been divided by the MDMR into eight harvest areas extending from the mouth of the Pearl River across the Mississippi Sound to the Mississippi-Alabama State boundary (Figure 1). The MDMR has established 169 water-sampling stations in the Mississippi Sound, with individual harvest areas containing between 10 and 40 sampling stations.

Sample collection by the MDMR begins after an oyster reef area is closed to harvest. Area closure is primarily based on two factors:

- i) the stage of the Pearl River at Pearl River, La., and
- ii) 24-hour rainfall amounts at nearby weather stations.

Flow from the Pearl River is critical to the quality of water in Mississippi Sound because water entering the Mississippi Sound flows east along the coastline between the shore and the barrier islands. This flow pattern brings the water over most of the oyster reefs in the western part of Mississippi Sound. Flows that are significantly above base flow carry increased amounts of bacteria and other pollutants. As water from the river flows across oyster reefs, pollutants in the water are taken up by filter feeders such as oysters. Human consumption of the contaminated shellfish can cause severe illness. The base-flow stage of the Pearl River at Pearl River, LA., is approximately five feet. When the river stage reaches 10 feet, the MDMR starts closing areas to the harvesting of shellfish. If the river reaches a stage of 12.5 feet, additional areas are closed.

Rainfall is a closure factor due to pollutants that are contained in storm-water runoff from urban areas. A recorded rainfall of 1 inch within 24 hours will cause the closure of some harvest areas, primarily those near to the shore. A 24-hour rainfall of 2 inches or more causes the closure of additional areas.

After an area has been closed to harvest by the MDMR, representatives of that agency will collect water and shellfish tissue samples to be analyzed for fecal-coliform bacteria. The area remains closed to harvest until both the water and tissue samples reach acceptable concentration levels for fecal-coliform bacteria. The MDMR collects between 1,800 and 2,000 samples annually in this sampling program.

In addition to protecting the public health, the MDMR is responsible for the management of oyster reefs and other marine life and their habitat as renewable resources. The shellfish industry has a significant impact on the economy of Mississippi, especially for the Mississippi Gulf Coast region. The average annual oyster harvest for the past 10 years (1989-99) was 1.5 million pounds of meat. The oyster harvest in 1997 was 3.5 million pounds and had a dockside value of 5.3 million dollars. The industry employs thousands of people in the coast region including harvesters, processors, and shippers, and wholesalers. Approximately 200 commercial and 35 recreational oyster permits as well as hundreds of dealer and processor licenses, are sold annually.

Water temperature, specific conductance, and salinity are important hydrological parameters providing a tool for the management of marine organisms and their associated habitats. First, these parameters serve as indicators of the presence of freshwater from streams flowing into the gulf, as the freshwater will cause a significant decrease in the specific conductance. Second, temperature and salinity are critical to the propagation of oysters and maintaining productive reefs. In addition, these two parameters affect the distribution, growth and survival of all marine organisms in the Mississippi Sound. As part of its mission to manage the oyster reefs, the MDMR has a program in which it seeds the spat (oyster babies) on the reefs to stimulate oyster growth. There are optimum ranges in temperature and salinity for maximum oyster growth, and detecting long-term trends in temperature and salinity will help the MDMR plan and predict oyster growth and harvest as well as indicate if additional areas are also suitable for seeding.

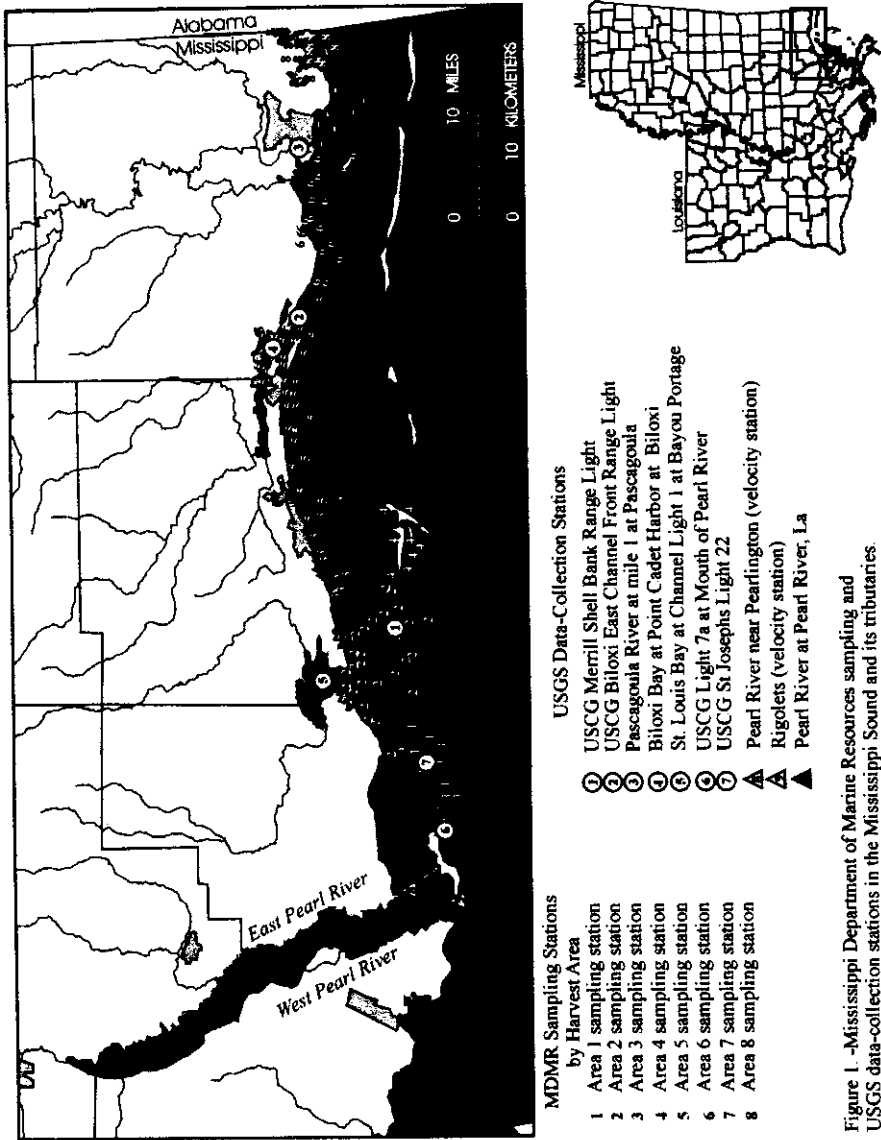


Figure 1. -Mississippi Department of Marine Resources sampling and USGS data-collection stations in the Mississippi Sound and its tributaries.

Figure 1. Mississippi department of Marine Resources sampling and USGS data collection stations in the Mississippi Sound.

U.S. Geological Survey Data Collection

Through a cooperative agreement which supports the MDMR mission of resource management, the MDMR and USGS have established seven data-collection stations where temperature, specific conductance, and salinity data are collected in Mississippi Sound and its estuaries, and two stations where velocity data are collected. The instrumentation at the continuous-data collection stations consists of a stage sensor, water-quality probe, velocity sensor where required, data-collection platform, satellite-transmission equipment, 12-volt battery, and solar panel. At each station, water level (stage), temperature, and specific conductance are measured and recorded hourly. Salinity is computed *in situ* by the probe using temperature and specific conductance data and is recorded hourly. Velocity data are collected and recorded hourly. The recorded data are transmitted via satellite to the USGS office in Pearl, Mississippi. Data are then made available to the MDMR via the Internet. An example of the data made available to the cooperator is shown in Figure 2. The velocity stations were not established as a part of the MDMR-USGS data-collection program but the data are used to help show the effects of the Pearl River on the water quality of Mississippi Sound.

Water samples are also collected by the USGS and analyzed for specific conductance, salinity, and dissolved chloride at the USGS laboratory in Ocala, Florida. Since the specific conductance measured by the probes may be affected by dissolved constituents other than chloride, the salinity values computed by the probes may vary from those obtained from the laboratory. A comparison of the computed salinity and laboratory salinity is shown in Figure 3. Water-quality data and samples collected by the USGS are collected according to the methods described by Wilde, and others, (1998).

The selection of locations for the continuous water-quality data-collection stations was dependent on the availability of a suitable structure in or near a shellfish harvest area. The first station established was on the U.S. Coast Guard (USCG) Merrill Shell Bank Front Range Light approximately five miles south of Pass Christian, Miss. (Figure 1). This monitoring station is located in one of the most productive oyster harvest areas in the Mississippi Sound. The second monitoring station was established on the USCG Biloxi East Channel Front Range Light, approximately two miles southeast of Biloxi Bay. The next three monitoring stations were established at U.S. Army Corps of Engineers tidal gages on the Pascagoula River mile 1 at Pascagoula, Back Bay of Biloxi at Ocean Springs, and St. Louis Bay at Channel Light 1 in Bayou Portage. These three stations are operated in cooperation with the Corps of Engineers to take advantage of existing data-collection efforts. Although these stations are located in estuaries, they are located where the water level and water quality are affected by the Mississippi Sound. These stations are located in areas sampled by the MDMR and were established to help determine the influence of the tributaries on the water quality of the sound. The final two water-quality monitoring stations established were at the mouth of the Pearl River and at St. Josephs Pass. These were established to give better spatial definition of the effects of the Pearl River on the water-quality in

Mississippi Sound.

The stations where velocity data are collected along with water-quality data are at USCG light 22A in the Pearl River near Pearlington and at the railroad bridge in the Rigolets. These stations were established to determine the flow characteristics of their respective waterways. The data collected will also be used in conjunction with the data collected by the MSMR and USGS.

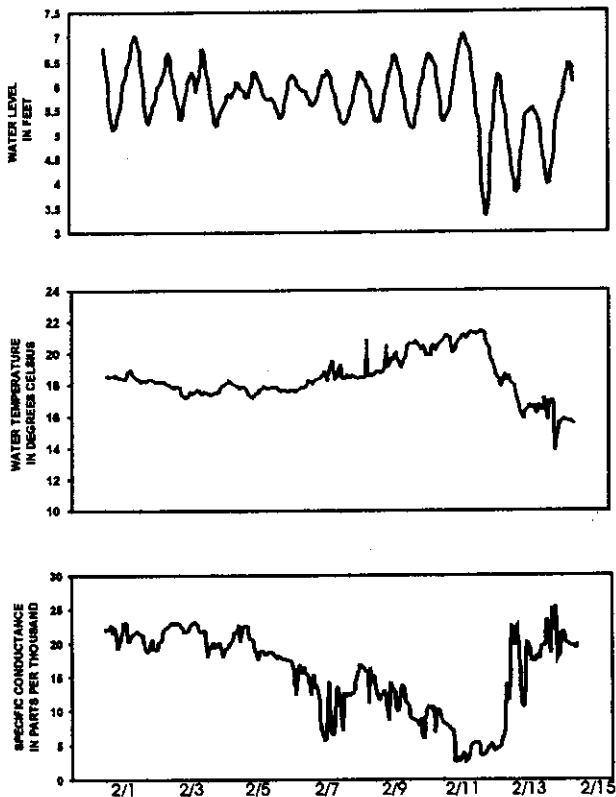


Figure 2. Water level, temperature, and salinity for Biloxi East Front Range Light for the period February 1 through February 15, 1999.

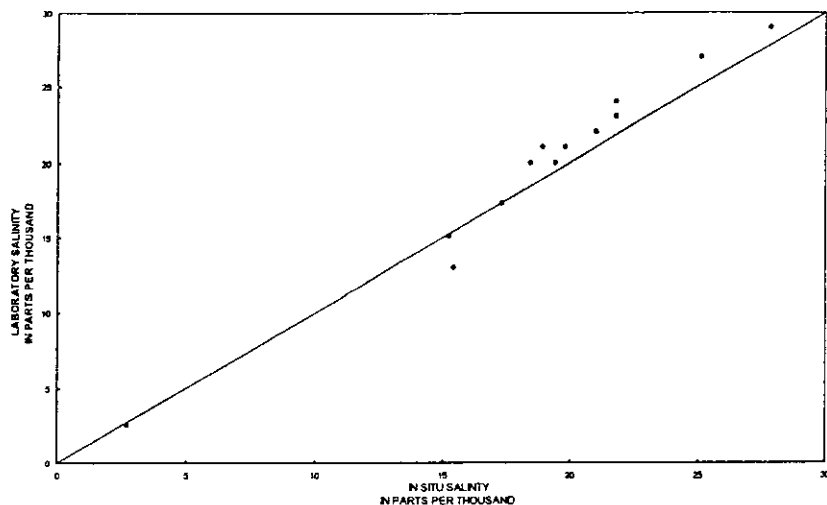


Figure 3. Comparison of in situ salinity to laboratory salinity for Mississippi Sound monitoring stations.

RESULTS

Preliminary analysis of the data obtained from the MDMR-USGS monitoring and sampling program have shown that the salinity values computed *in situ* by the probe using the temperature and specific conductance data correlate well with the data obtained from the laboratory analysis for the normal ranges of salinity. However, limited data for periods of low salinity do not allow accurate definition of the relation when the salinity decreases due to freshwater influence.

An insufficient amount of data exists at this time to develop correlations between flows of the Pearl River and other tributaries and spatial variations in the water quality across the Mississippi Sound.

DISCUSSION

The U.S. Geological Survey, in cooperation with the Mississippi Department of Marine Resources, Office of Fisheries, is collecting data on the quality of water in the Mississippi Sound of the Gulf of Mexico and its tributaries. The Mississippi Department of Marine Resources collects water samples at 169 locations in the Gulf of Mexico. Between 1,800 and 2,000 samples are collected annually and are analyzed for fecal-coliform bacteria. The U.S. Geological Survey is collecting continuous water level, water-temperature, specific-conductance, and salinity data, as well as supplemental chloride and salinity samples at seven locations in or near the Mississippi Sound. The continuous data are made available through the Internet and are being used in conjunction with stream flow, weather, and supplemental-sampling data for the monitoring and management of the oyster reefs and other marine species and their habitats.

LITERATURE CITED

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