Job Report

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Project Name: Pollution Abatement in Region V

Period Covered: November 1, 1960 to September 30, 1961 Job No. F-2

Detection and Measurement of Pollution and Its Effects on Marine Organisms in Chiltipin Creek and Copano Bay

Abstract: Chiltipin Creek, previously classed as a route for disposal of industrial wastes, has no commercial or recreational value from a fisheries viewpoint. However, it empties into a body of water that is valuable to both the commercial and sports fishery. The creek carried a load of oil which can produce profound changes in a marine environment. Water soluble extracts from the oily waste exert a direct toxic action upon some lower invertebrates, causing an upset in the natural food cycle. This extract inhibits feeding activities of oysters, resulting in death as well as causing an oily taste, and tends to force game fish and shrimp from the area. Settled oil covers bay bottoms, destroying fertile areas necessary for nursery grounds.

With the continuation of oily wastes carried by Chiltipin Creek, the Copano Bay area would be virtually destroyed. However, through cooperation from the Railroad Commission in issuing pipeline and production severances to those companies in violation, the conditions of Chiltipin Creek have improved considerably over the previous year.

Objective: To determine the damage to the marine environment of Copano Bay by bleedwater infiltration from Chiltipin Creek so as to control pollution and obtain a better water quality.

Procedure: Six stations were established in Chiltipin Creek (Figure 1) according to accessibility and contributions of waste from the various fields. These stations were sampled semi-monthly for oil and brine concentration. Analyses were compiled monthly to measure any chemical changes from the previous year.

Four stations were set up in Copano Bay (Figure 2). Bottom samples were collected monthly (when weather permitted) with a grab sampler, agitated, digested, and filtered to determine oil concentration and to evaluate possible damage to the bay bottom by oil pollution.

Toxicological studies were performed in the laboratory on a marine index, pinfish, to determine a median tolerance limit (TLm), the concentration in which 50 per cent of the species can survive for a 48-hour period. From 1 to 50 gram increments of bay bottom were added to 10-liter containers of bay water to determine what effects the water soluble extract from the oil-soaked mud had on aquatic forms.

Samples of crude oil were agitated for one hour to extract toxic components which would normally be separated by wind and wave action. The liquor was separated from the crude oil, placed in 10-liter containers and observed for 48 hours.

Data were obtained from Railroad Commission personnel on location of fields,

Figure 1
Sampling Stations

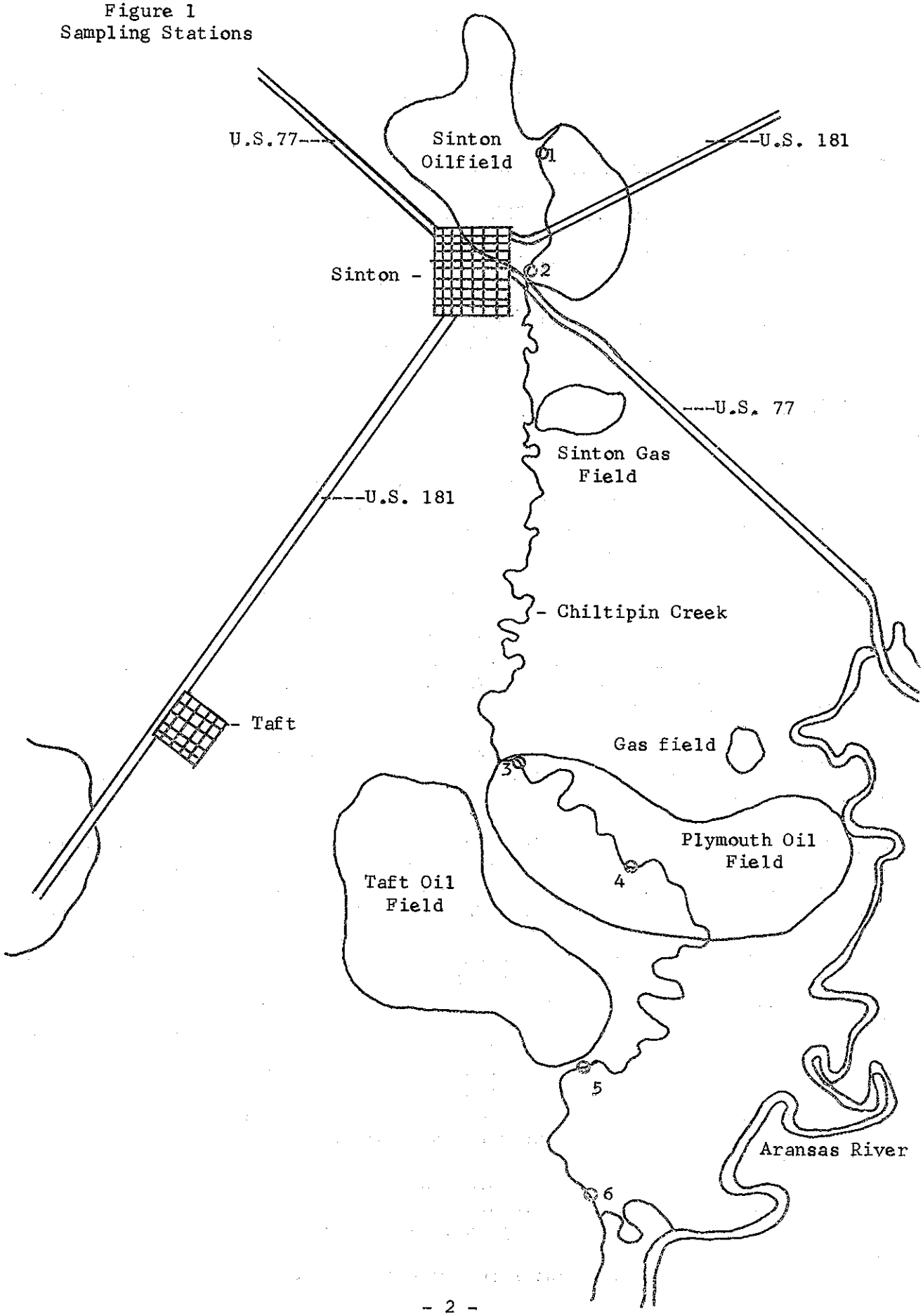

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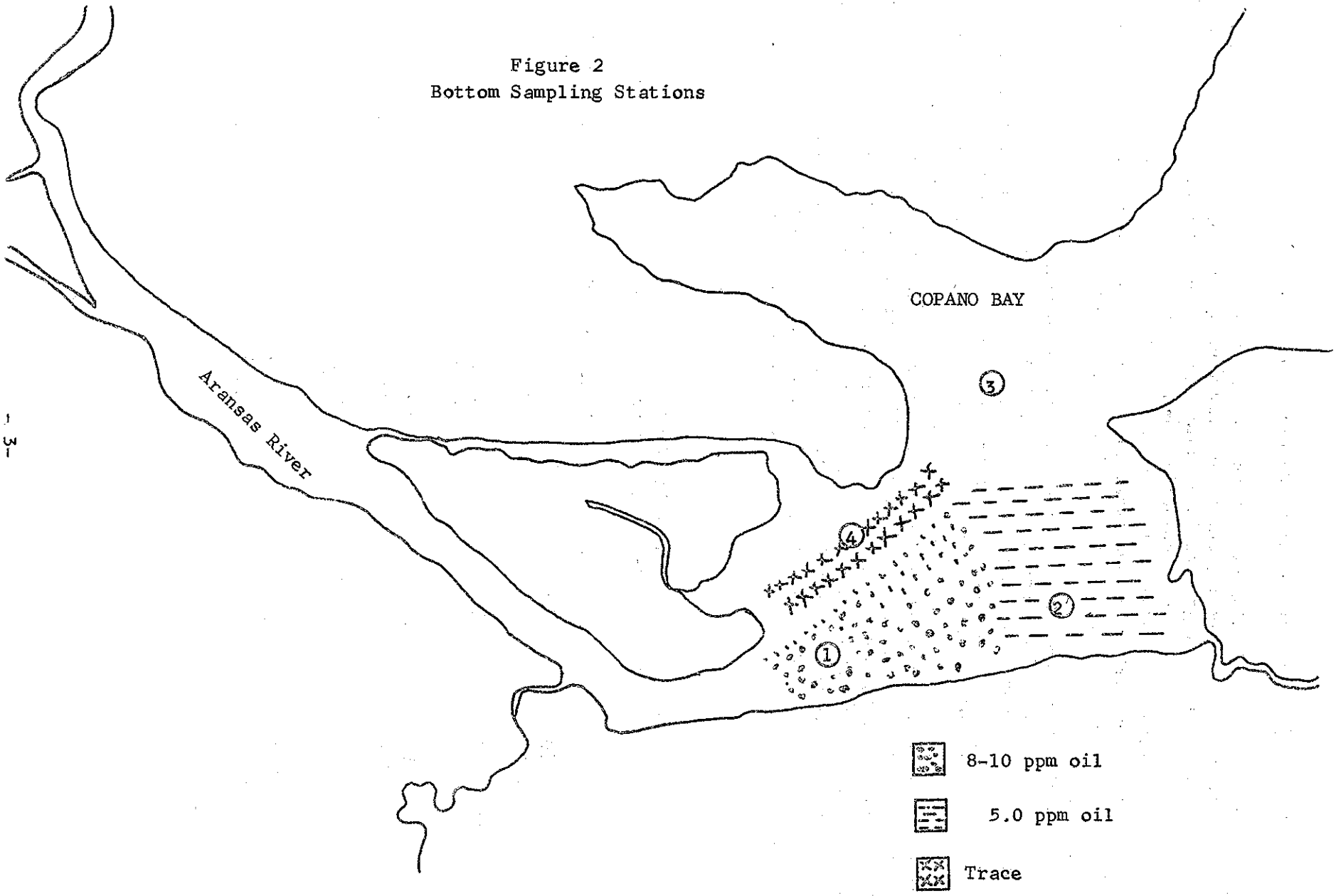
Figure 2
Bottom Sampling Stations



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numbers of wells, and salt water production (Table 1).

Findings: Waste disposal for the project year averaged 16.4 cubic feet per second per day (Table 2), and creek flow (average for April, May and June, Health Department readings) was 15.5 cubic feet per second per day. The monthly average salinity of the creek coincides with rainfall. The creek reached the average salinity of bleedwater from the wells (65.0 parts per thousand) during low rainfall, May 1961, and decreased in salinity during heavy rainfall, June 1961, indicating the creek to be useful only as a drainage ditch for oil field waste and runoff.

Table 2 is a comparison of 1960 and 1961 project data. There was a decrease of oil concentration each month, indicating some improvement in handling the waste. This decrease was possibly due to cooperation of the Railroad Commission in issuing pipeline and production severances to those companies allowing excess oil to get into the creek. A pipeline severance prohibits the sale of oil from the tanks but does not stop production. On several occasions some habitual violators were issued a production severance and taken off schedule, thus shutting in the well and allowing no production. These severances were not released until the violation was remedied and accepted by the Texas Game and Fish Commission. Several of the violators dug larger, additional pits, added chemical treaters and did work that was necessary to bring the oil content down. One company constructed a separator-dam across a tributary to the creek which contributed 50 per cent of the waste from Taft field, reducing the oil content of the creek considerably.

Table 1
Average Salt Water Production from Fields
Over a 24-hour Period for Two Years

Date	Field	Bbls. Salt Water	No. of Wells
Aug. 1960	Sinton	51,011	60
1961		48,411	59
Aug. 1960	Taft	105,075	125
1961		99,278	161
Aug. 1960	Plymouth	44,888	147
1961		40,491	110
Aug. 1960	Midway	72,773	32
1961		64,888	29
Aug. 1960	Mudflats	72	3
1961		50	2
Total		253,118 (16.4cfs)	728

Table 2
Composite Analytical Data Summary for Two Year Period

Date	Oil (ppm)	Salinity (o/oo)	Rainfall (in.)
Sept. 59	19.0	62.8	.25
60	9.5	37.8	2.45
Oct. 59	25.0	15.3	6.30
60	7.5	9.5	13.98
Nov. 59	30.0	56.3	1.45
60	21.9	41.2	3.66
Dec. 59	54.0	52.5	2.25
60	24.2	37.6	7.85
Jan. 60	78.6	58.1	1.30
61	29.4	56.5	2.17
Feb. 60	91.5	56.1	-----
61	54.3	44.5	4.11
Mar. 60	78.3	43.1	1.90
61	42.5	59.0	.14
Apr. 60	36.0	31.8	1.80
61	43.4	42.5	1.81
May 60	61.0	65.6	-----
61	38.0	63.4	.02
June 60	842.0	66.3	-----
61	22.0	20.1	7.23
July 60	52.3	59.5	.35
61	20.0	28.5	3.72
Aug. 60	89.5	19.6	6.17
61	19.5	24.6	2.08

Copano Bay Investigation: Oil affects marine life in several ways - by interfering with gaseous exchange; by coating the bodies of fish; by direct toxic action of substances soluble in water; by repelling aquatic forms, forcing them to leave the polluted area; and by interfering with the natural food cycle. The oil spreads until it forms a monomolecular film invisible to the eye, clings to suspended clay particles in the water, and settles, covering bay bottoms with oil. This disappearance of visible oil from the water surface does not necessary mean that the pollutant has been eliminated. Its effects still persist, virtually covering the bay bottoms.

Toxicity studies on samples of bay bottoms produced no deaths in a 48-hour period, but agitation from the air stone produced oil slicks releasing a toxic extract which caused the fish to react vigorously for the first hour. They then became very sluggish for the remainder of the tests.

The tests using liquor obtained from agitating crude oil with bay water at 1-hour intervals indicated some direct toxic effects. There was one death in a 48-hour period in the 500 milliliter liquor to 9.5 liter bay water dilution. This mixture would be more concentrated than would occur naturally, and aquatic forms would tend to leave the area before succumbing to the toxic extract. However, bottom organisms would be affected by the conditions and could not escape the polluted area, thus causing an upset environment by breaking the natural food chain.

Chipman and Galtsoff 1/ performed similar tests on bottom organisms and found that crude oil was toxic to hydrozoans, barnicles, oysters, and embryos of toadfish whether the oil was present as oil slicks or agitated.

Galtsoff 2/ found that microscopic organisms providing necessary food for larger animals playing an important role in the food cycle are affected by the presence of oil. He also determined that oil in water tends to interrupt the feeding habits of oysters, thus causing underfeeding and starvation as well as affecting the taste.

Discussion: Pollution of the creek attributable to oil field waste results in a biologically dead stream obtaining a flow from runoff and waste disposal. Some natural purification occurs by dilution with bay water prior to disposal into Copano Bay. The salinity of the creek is reduced to that of bay water, but the oil content accumulates and then disperses into a monomolecular layer over the bay, clings to clay particles, and settles to the bottom. The bulk of the pollution load settles in an area approximately 100 yards into the bay from the mouth of Chiltipin Creek. This damaging effect is great to our bay bottoms; and as quoted by Nelson 3/, "oil is gallon for gallon as thrown out, the most destructive to aquatic life of all foreign substances entering our coastal waters."

Conclusions: 1. Chiltipin Creek may be considered as a natural drainage system for runoff and oil field waste, thus having no local biological importance.

2. The creek flows into a bay that is biologically important to the

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1/ Walter A. Chipman and Paul S. Galtsoff, Special Scientific Report No. 1, U.S. Fish and Wildlife Service.

2/ Paul S. Galtsoff, U.S. Bureau of Fisheries, "Oil Pollution in Coastal Waters", Proceedings of the North American Wildlife Conference, 1936.

3/ Thurlow C. Nelson, quoted by F. W. Lane; Bauer, A.D.; Fisher; H.F., and Harding, P.N., 1925, "Effect of oil pollution on marine and wildlife." Appendis V to the Report of the U.S. Commissioner of Fisheries for 1925. Bureau of Fisheries Document; pp. 171-181.

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commercial and sports fishery.

3. There is some direct toxicity occurring from soluble extracts of the waste released into the area. The majority of the pollution causes destruction indirectly by covering bay bottoms and causing an upset environment, thus destroying a productive area.

4. Railroad Commission personnel have helped reduce the pollution load by issuing severance notices to those violators allowing excess oil to escape into Chiltipin Creek.

5. Major operators in the area have expressed concern about the creek's condition and have installed additional separators and chemical treaters to reduce the oil content of the effluent.

6. Using data obtained from the last two project years, a comparative value of the creek's condition could be summed up as showing some improvement over the previous year.

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