POPULATION SIZE AND AGE AND GROWTH OF MOHAVE TUI CHUBS AT FORT SODA, CALIFORNIA

by

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ABSTRACT

Populations of Mohave tui chub (*Gila bicolor mohavensis*) in two habitats at Fort Soda, California were censused at six week intervals from April 28, 1981 to April 18, 1982. Annual fluctuation in population size and age and growth were documented in each habitat. Both habitats were transsected for physical dimensions and water quality. During the study a fish kill occurred in one of the habitats in the fall, however, overall effect on the population was not discernable by the following spring.

INTRODUCTION

The Mohave tui chub, Gila bicolor mohavensis, is listed as endangered by both the state and federal governments. It is the only fish native to the Mojave River. Introgressive hybridization with the introduced Arroyo chub, Gila orcutti, has eliminated the Mohave tui chub from the river. Until recently, the habitats at Fort Soda contained the only genetically pure populations of Mohave tui chubs. In 1971 about 400 Mohave tui chubs were transplanted into seeps on the China Lake Naval Weapons Center. In 1980 another population was started in a small pond near Hinckley, California. Fort Soda is currently the only location where Mohave tui chubs exist in their native range.

Fort Soda is managed by the Bureau of Land Management (BLM). A habitat management plan (HMP) was developed for the Mohave tui chub in November, 1978. This plan identified the need to document age and growth and the annual population fluctuations of the tui chub in the habitats at Fort Soda.

DESCRIPTION OF HABITAT

Fort Soda is located 11 miles south of Baker, between the shoreline of the Soda Lake Playa and the foot of the Soda Mountains. There are two primary tui chub habitats, Lake Tuendae and Three Bats Pond (Plate 1). A spring also contains a small population of tui chubs (Plate 1). Lake Tuendae is a rectangular man-made pond with its long axis running east-west. Surface area is 0.47 hectares (1.2 acres). The water level is maintained by pumping water from Zzyzx well through a fountain located in the center of the lake. Ditchgrass, Ruppia martima, grows throughout the lake in areas less than 1 m deep. Three Bats Pond is nearly square in shape with a total surface area of 0.4 hectares (1.0 acre). Water level in the pond is maintained by the water table. Ditchgrass covers the SE half of the pond. The Spring is a unique habitat for Mohave tui chubs. Open water is limited since most of the spring is choked with cattails, Typha domingensis (Figure 13).

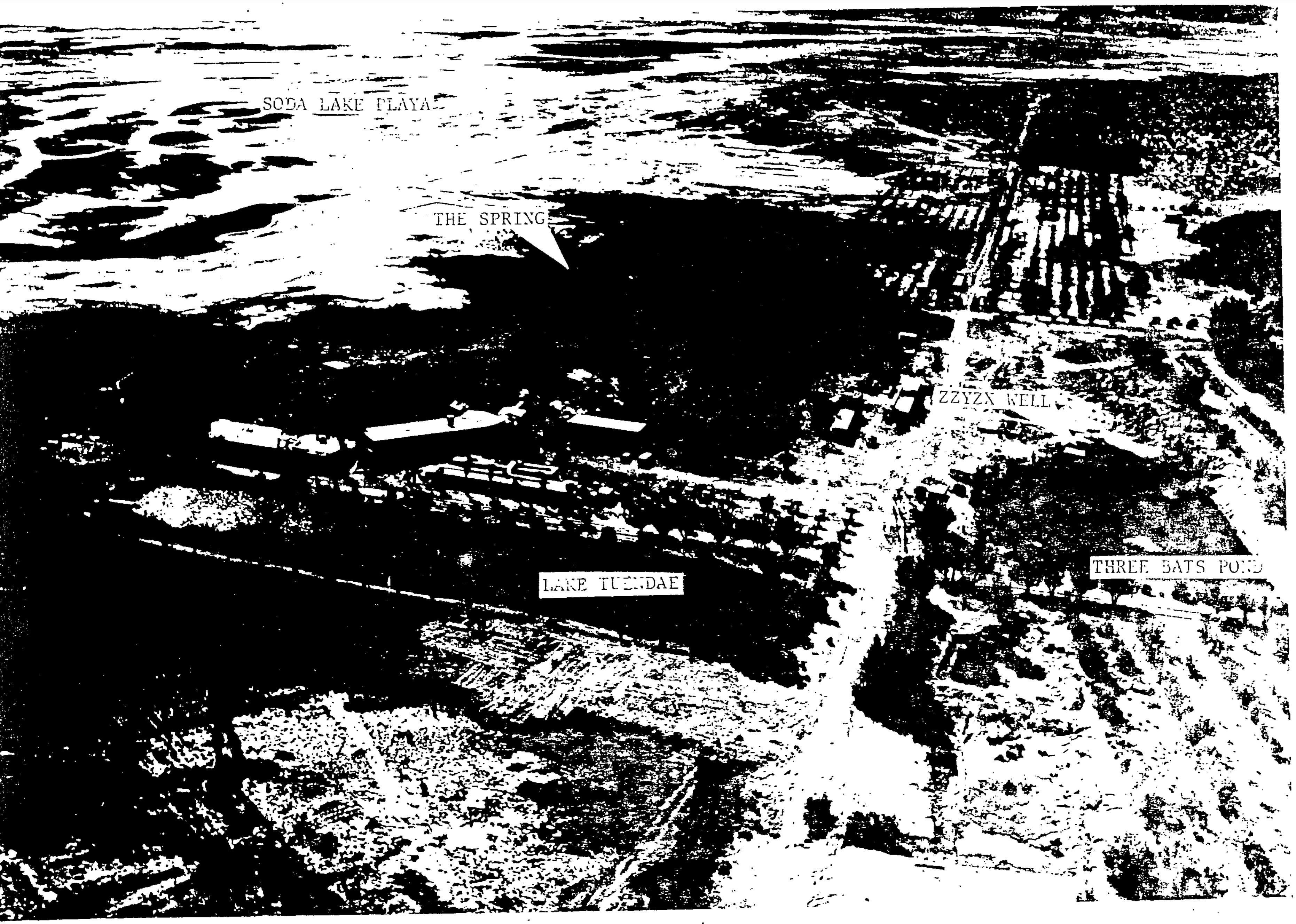


Plate 1. Fort Soda, looking south.

MATERIALS AND METHODS

Fish were captured in standard minnow traps baited with bread. Traps were set for 30 minutes to two hours. Captured fish were held in 5 gallon buckets until they were measured (mm standard length) and marked with a fin clip or a hole punch in the caudal fin. Minimum size tagged was 38 mm standard length. Fish were distributed throughout each habitat when they were released.

Traps were set again the day following marking. Captured fish were checked for marks, measured and held until all traps were collected.

Peterson estimates were made for each habitat for each sampling period. When returns of marked fish was less than or equal to seven recaptures, the Chapman correction was used. Confidence limits for each Peterson estimate were made at the 95% level.

Scales for age and growth were taken on 18 August 1981 from both the lake and pond populations. Scales were taken from the left side of the fish below the insertion of the dorsal fin and above the lateral line. Scales were viewed with a Bell and Howell SR VIII microfiche reader set at high magnification. Distance from the center of the scale to its edge and each annulus was measured directly on the screen.

Back calculations were performed using the equation for a linear relationship of scale radius to fish length.

Habitats were measured for temperature, dissolved oxygen, conductivity, salinity and pH during each sampling period. In addition Lake Tuendae and Three Bats Pond were transected on 5 meter centers for depth, temperature, dissolved oxygen, conductivity and salinity. Dissolved oxygen (D.O.) was measured with a Yellow Springs Instrument (YSI) D.O. meter. Conductivity and salinity were measured with a YSI Temperature, Salinity, Conductivity

(TCS) meter. Temperature was measured with a mercury thermometer. pH was measured with a Helige color comparator or pH sensitive paper.

Twenty-five tui chubs from each habitat were preserved during each sampling period. These fish will be held until manpower is available to analyze these samples for gut contents and fecundity.

RESULTS

The three Mohave tui chub habitats are graphically displayed in Figures 1 through 13. Annual fluctuations of water quality within these habitats is presented in Table 1. Population estimates and 95% confidence intervals of the Mohave tui chub in each habitat are presented in Table 2 and Figure 14. Age and growth of the Mohave tui chub from Lake Tuendae and Three Bats Pond is shown in Table 3 and Figure 15.

DISCUSSION

The pond is two to three times as saline as the lake (Table 1). Reasons for this difference are unclear but probably related to the retention time in each habitat. Water must be pumped into Lake Tuendae. There is no outflow channel and water leaves the lake through seepage and evaporation. The water surface level of Three Bats Pond is maintained by the ground water. There is no outlet channel and water leaves the pond only through evaporation. Seepage must be nearly negligible, resulting in the concentration of the dissolved salts within Three Bats Pond.

The spring habitat stayed relatively constant in its water quality attributes throughout the year. The small population of Mohave tui chubs in the spring were difficult to sample. Often no fish or only a few fish could be captured. Therefore the population estimates for this habitat are very weak. Tui chubs captured in the spring during the August sampling period were emaciated, displaying oversized heads and gaunt bodies. The fish in this habitat, however, appeared normal by the December sampling period. The spring may not provide enough food during certain times of the year to adequately met the needs of the tui chub population. Low dissolved oxygen levels may also stress these fish.

Population size in the lake and pond display a similar annual cycle (Figure 14). The pond population begins its spring population increase later than the lake population. Pond and lake populations died back in the fall and by April 1982 had approximated their April 1981 levels.

Beginning on November 11, 1981, a fish kill began in the pond that lasted about 10 days. Ammonia was suspected but was never confirmed. The fish kill was preceded by a die-back of the ditchgrass beds in the pond. This same phenomenon did not occur in the lake.

A total kill in the pond was suspected based upon the number of fish seen and the length of time the water was toxic.

During the December sampling period five seine hauls were made with a 20' minnow seine in the pond. No living organisms were captured. The net was full of a slurry of decaying vegetation. No activity was observed in the pond. Minnow traps caught nothing. By February, however, fish were again caught in the pond. There was no obvious die-off in the lake, however, 1982 spring population levels indicate both habitats experienced die-offs of similar magnitude.

The fish in the pond could have survived the fill kill if there were springs flowing into the pond that could offer a refuge from the toxic pond water. Evidence of two to three springs on the south side of the pond is displayed on Figures 9, 10, 11 and 12. These are areas of lower dissolved oxygen, temperature, conductivity and salinity.

Fish in the pond grow more quickly than do those in the lake (Table 3 and Figure 15). However, more larger fish were captured from the lake than from the pond. This may indicate that fish in the lake live longer. Large fish (≥120 mm) were difficult to capture in standard minnow traps in both habitats. Water clarity in the lake is much better than in the pond and allowed observation of several large fish (≥200 mm) in the lake. No fish this size were detectable in the pond. Some speculation as to the importance of depth to larger fish has been made in the HMP. The pond has only one small area >1 meter in depth.

Mohave tui chubs probably spawn from March to October. Recruitment appears to be continuous based upon size-frequency distributions. Mohave tui chubs held at U. C. Davis continued to spawn between temperatures of 18° to 26°C. Fry were seen from April to October in the shallow waters of the lake. Spawning may have been unsuccessful in the pond in the spring of 1982. No fish smaller than 54 mm were captured in the traps and no fry were observed. By the April 1982 sampling period the pond was still devoid of ditchgrass. This may be an important structure for the deposition of eggs. Fish in both the pond and the lake were ripe.

SUMMARY

Populations in the lake and the pond increase two to three times during the spring and summer months. Both populations decrease during the fall and winter. Water quality in both habitats decline during the summer but apparently do not present any problems to the tui chubs. The die-off in the pond during November 1981 is the first documented die-off of tui chubs at Fort Soda. The cause for the die-off is still unverified.

Table 1. Annual fluctuations of temperature, dissolved oxygen, conductivity, salinity and pH in the three Mohave tui chub habitats at Fort Soda.

Parameter	Habitat	Sampling period							
		4/81	6/81	8/81	10/81	11/81	12/81	2/82	4/82
Water temperature °C	Lake	24	26	30	17		11	17	20
	Pond	24	27	31	-	17	11	17	19
	Spring	23	26	26	22		19	20	-
Dissolved oxygen	Lake	6.3	5.8	8.2	5.0		6.5	6.6	9.4
	Pond	-	6.9	7.3	-	9.4	4.2	5.9	9.2
	Spring	-	0.9	-	2.1		1.4	2.4	-
Conductivity	Lake	5,500	5,050	6,000	3,700		3,050	3,575	4,050
	Pond	-	12,000	14,500	-	14,000	8,000	8,000	8,000
	Spring	-	3,050	3,100	2,900		2,300	2,800	-
Salinity	Lake	2.8	3.0	3.0	2.2		2.2	2.5	2.5
	Pond	-	6.5	8.0	-	7.0	6.0	5.5	5.0
	Spring	-	1.5	1.5	1.6		1.6	1.7	-
pH	Lake	-	1.0	-	9.2		8.3	8.3	-
	Pond	-	9.0	9.5	-	8.9	8.3	8.3	9.0
	Spring	-	7.5	7.0	7.0		7.5	7.4	-

Table 2. Population estimates of Mohave tui chub at Fort Soda, California.

Sample	Lake Tuendae Population estimate	Lake Tuendae 95% confidence limits	Three Bats Pond Population estimate	Three Bats Pond 95% confidence limits
April 1981	2782	1862-5093	2011	1344-3944
June 1981	4130	3424-5203	1881	1417-2797
August 1981	5678	4303-8327	4088	3315-5328
October 1981	5588	4314-7929	4458	2873-9941
December 1981	2272	1855-2931	-	---
February 1981	1450	1251-1725	2177	1789-2778
April 1982	2203	1978-2487	2648	2192-3341

The Spring

	Population estimate	95% confidence limits
April 1981	58	42-102
June 1981	37	-
August	17	-
October 1981	-	-
December 1981	7	-
February 1982	17	-
April 1982	14	-

Table 3. Backcalculated standard length and standard length at capture of Mohave tui chubs from Lake Tuendae and Three Bats Pond, Fort Soda, California. Samples taken August 18, 1981.

Lake Tuendae

Age	Backcalculated length 1	2	Mean length at capture	N
0+	-	-	48.77	22
1+	57.20	-	68.35	20
2+	52.43	71.14	80.29	7
Average	55.96	71.14		

Three Bats Pond

Age	Backcalculated length 1	2	Mean length at capture	N
0+	-	-	58.53	15
1+	57.90	-	73.43	21
2+	58.42	86.40	91.10	10
Average	58.07	86.40		

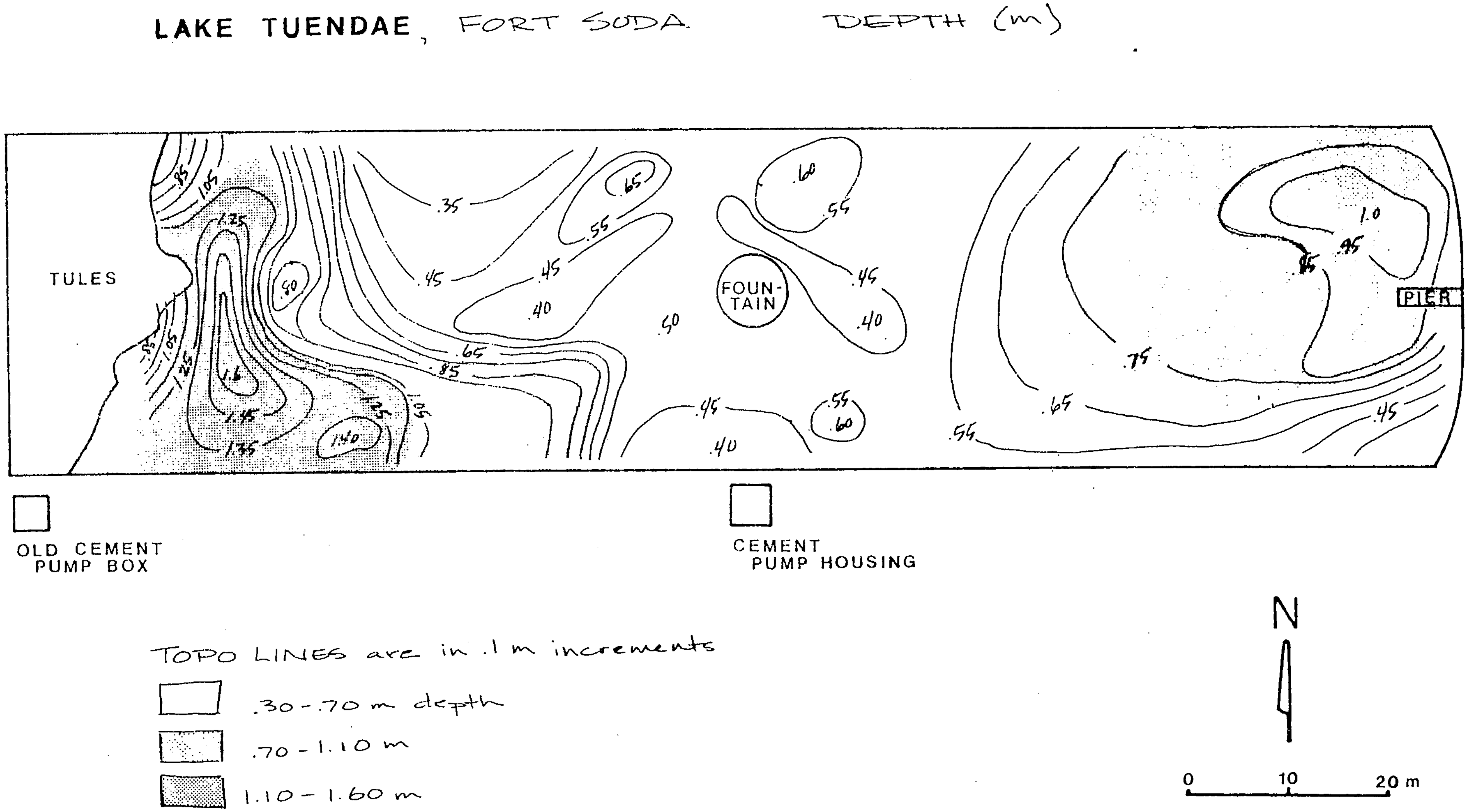


Figure 1. Depth contours in Lake Tuendae, June 30, 1981.

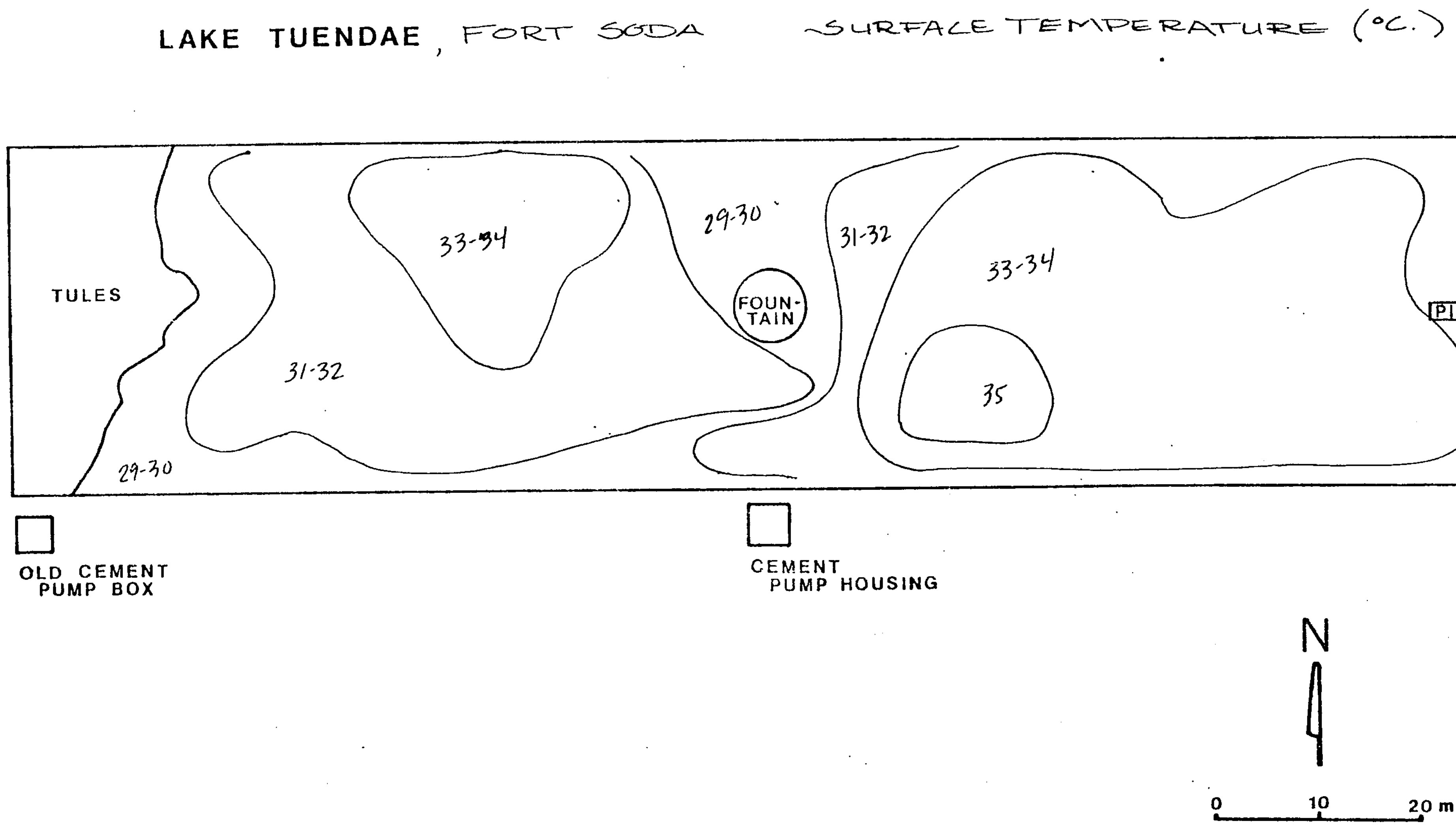


Figure 2. Surface temperatures in Lake Tuendae June 30, 1981 taken 1500-2000 hours.

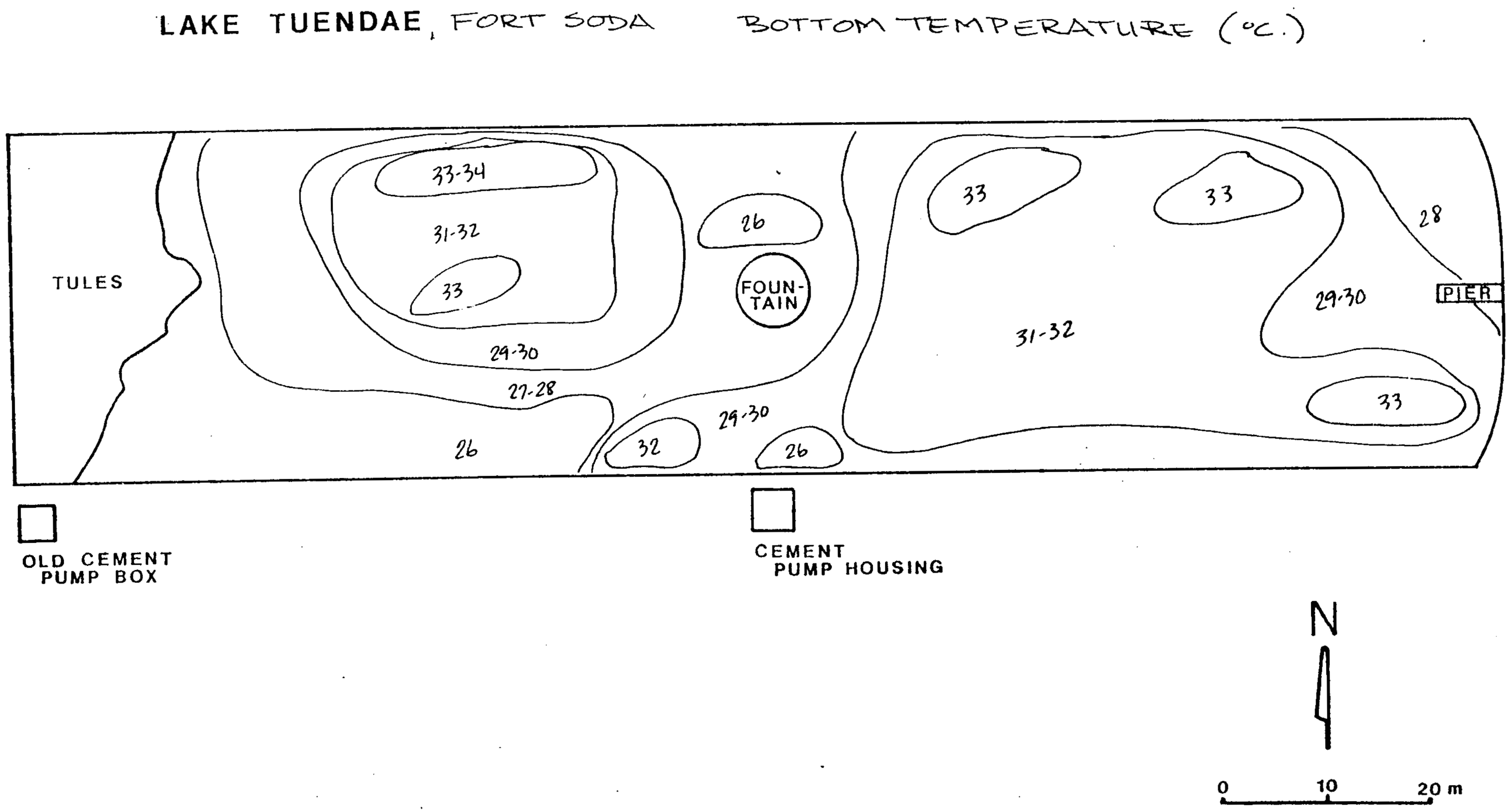


Figure 3. Bottom temperatures in Lake Tuendae June 30, 1981 taken 1500-2000 hours.

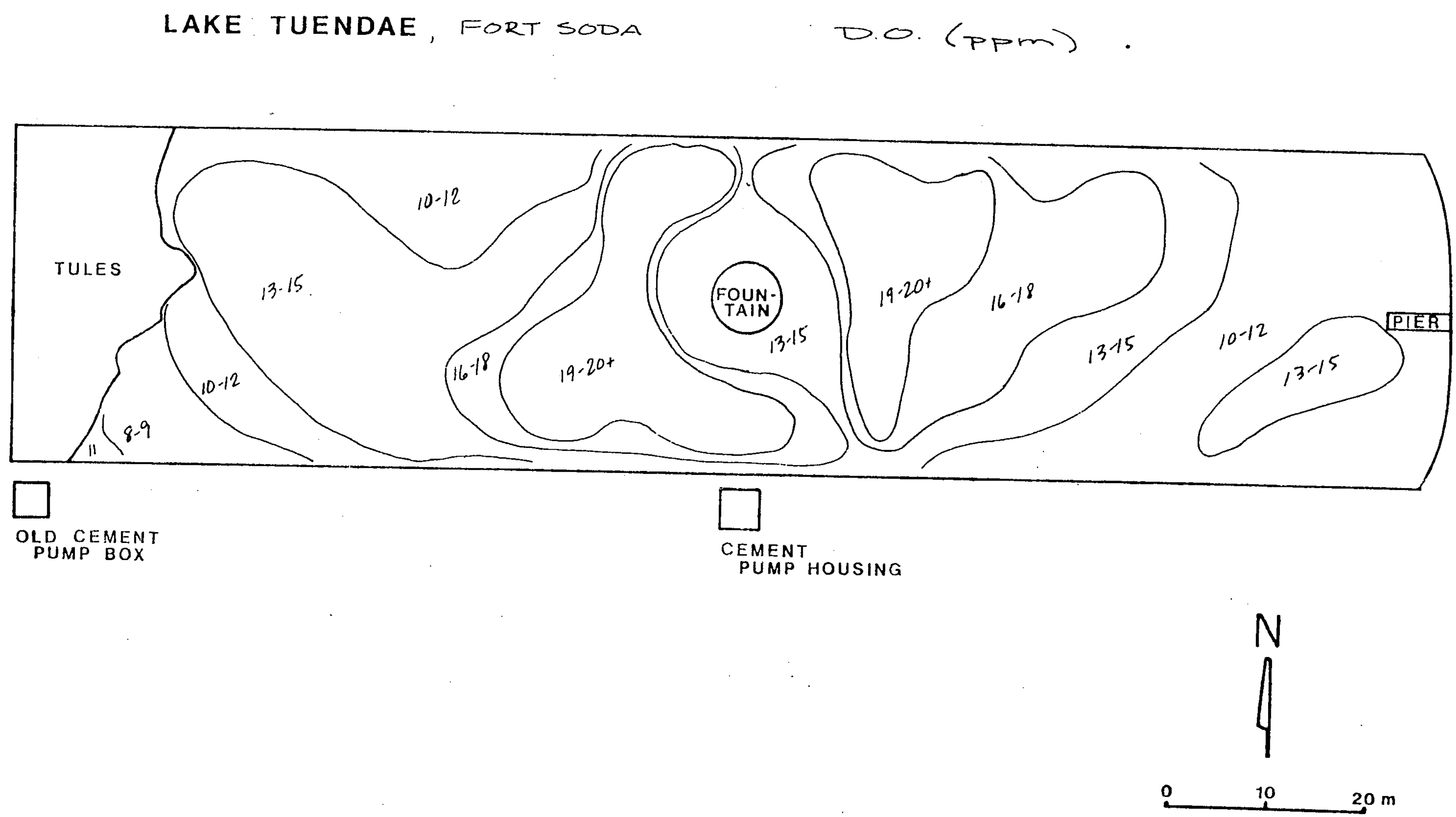


Figure 4. Surface dissolved oxygen levels in Lake Tuendae June 30, 1981 taken 1500-2000 hours.

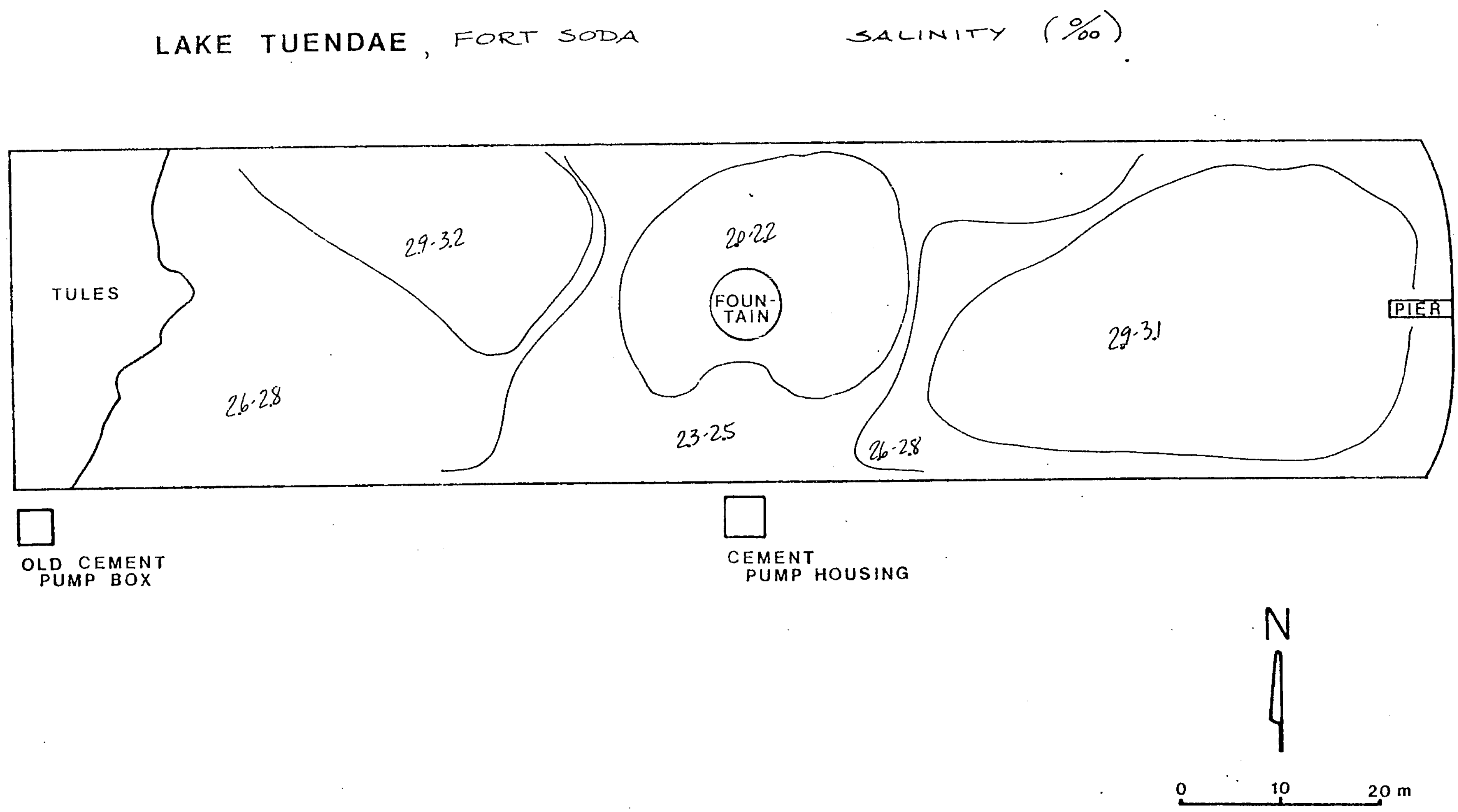


Figure 5. Surface salinity in Lake Tuendae, June 30, 1981 taken 1500-2000 hours.

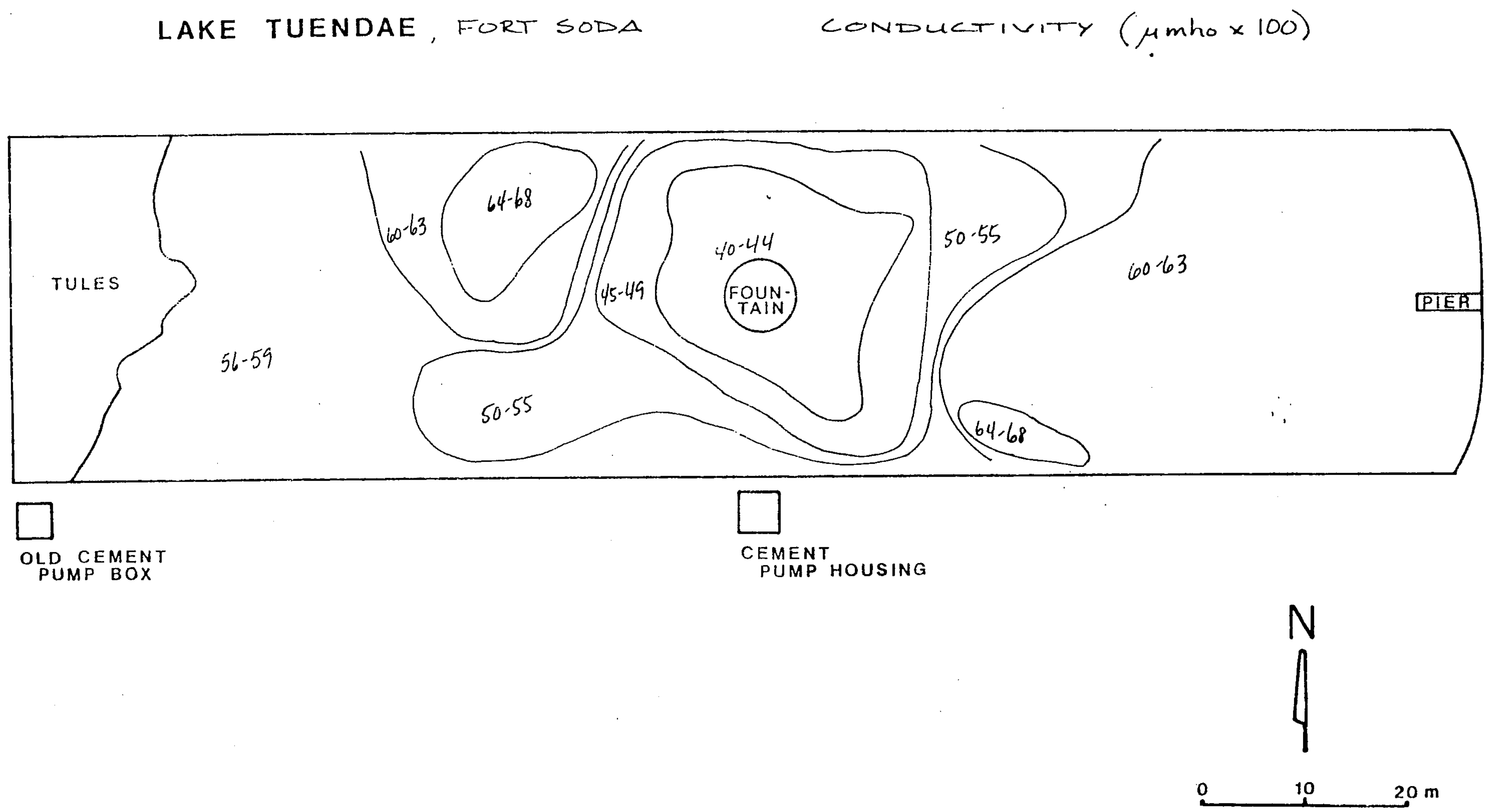


Figure 6. Surface conductivity in Lake Tuendae June 30, 1981 taken 1500-2000 hours.

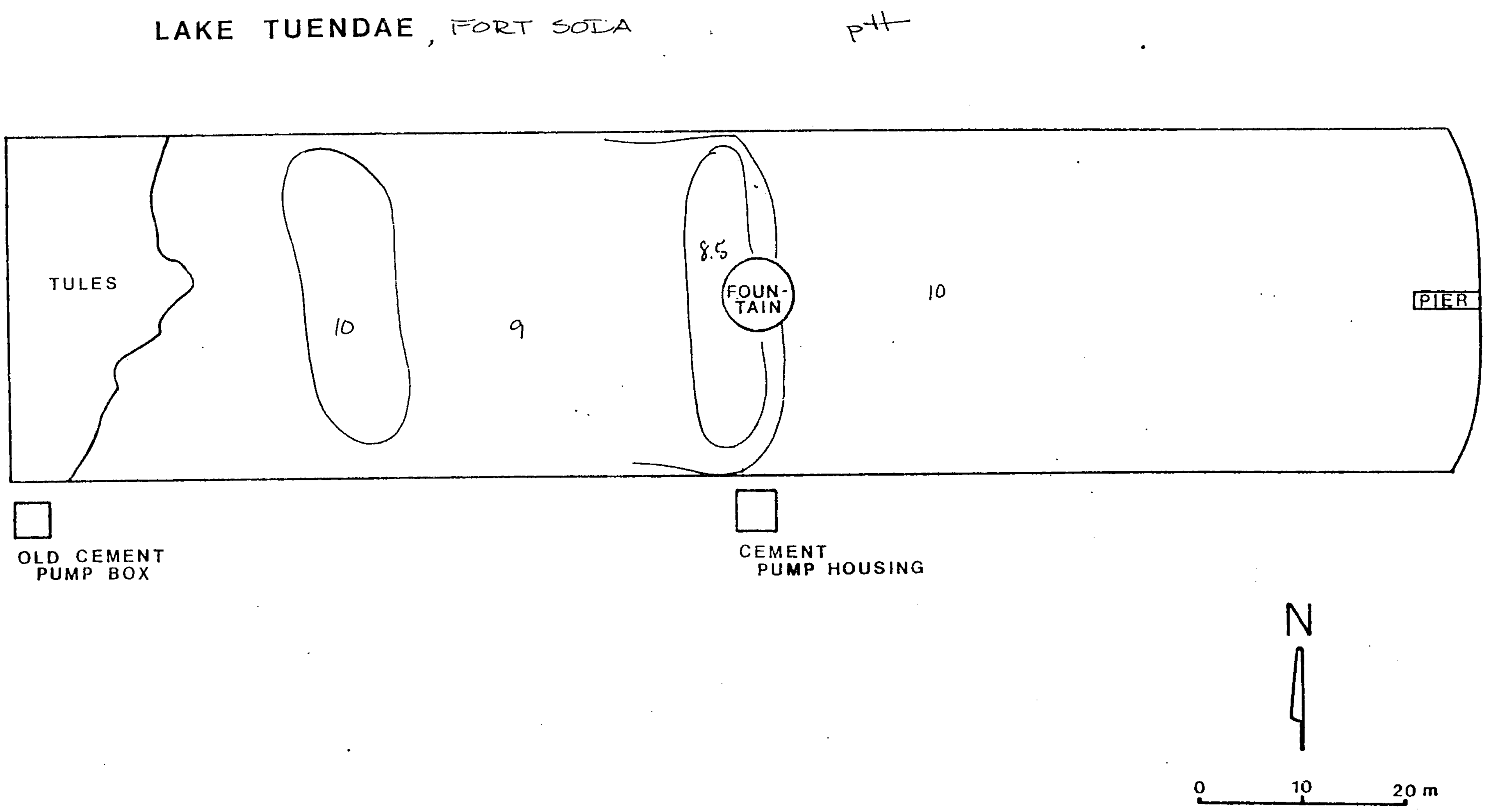
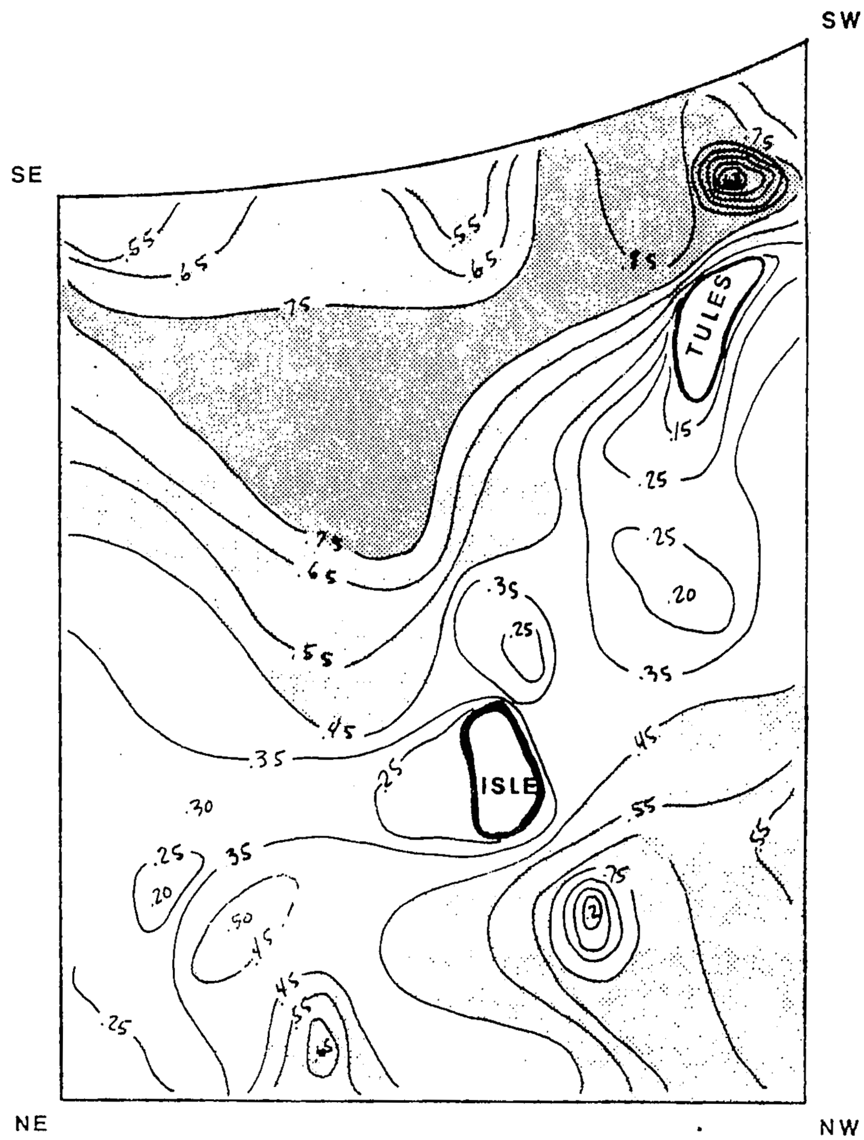


Figure 7. pH in Lake Tuendae June 30, 1981 taken 1500-2000 hours.

POND, FT. SODA DEPTH (m)



.10 - .45 m

.45 - .75

.75 - 1.30

TOPO LINES in .1 m increments

0 10 20m

Figure 8. Depth contours in Three Bats Pond August 18, 1981.

POND, FT. SODA

TEMP (°C.)

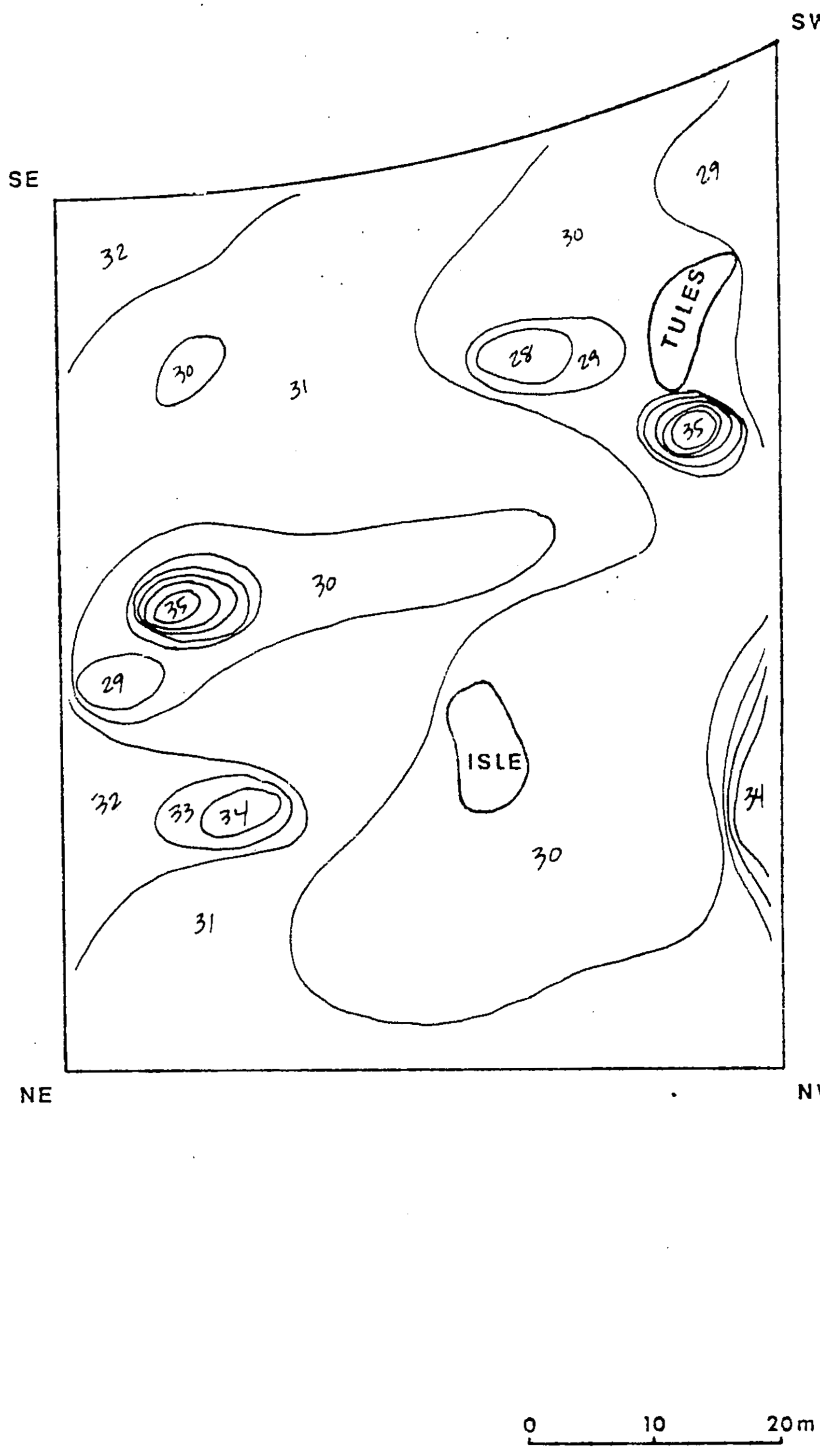


Figure 9. Surface temperature levels in Three Bats Pond August 18, 1981 taken 1400-1800 hours.

POND, FT. SODA D.O. (ppm)

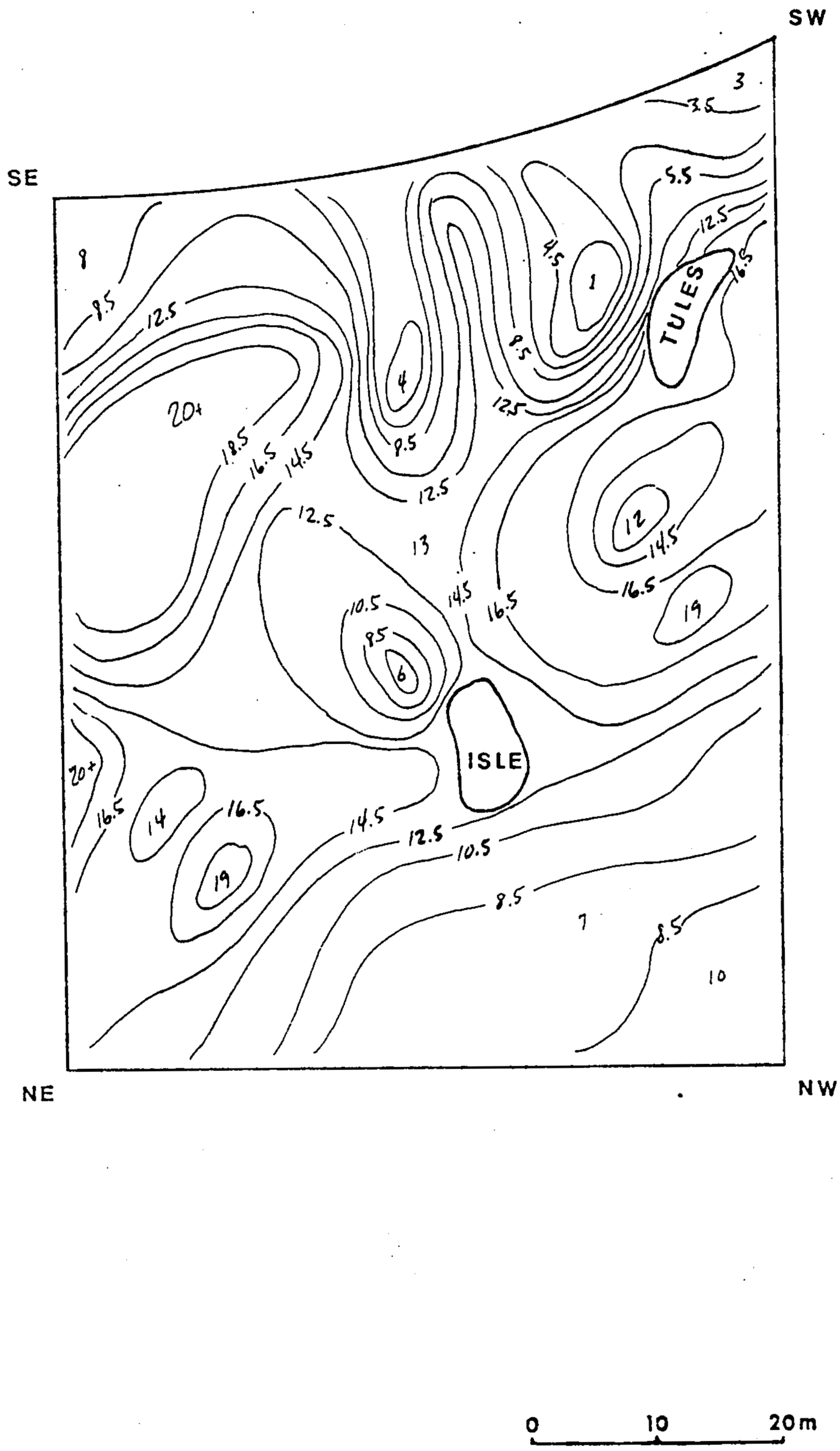


Figure 10. Surface dissolved oxygen levels in Three Bats Pond August 18, 1981 taken 1400-1800 hours.

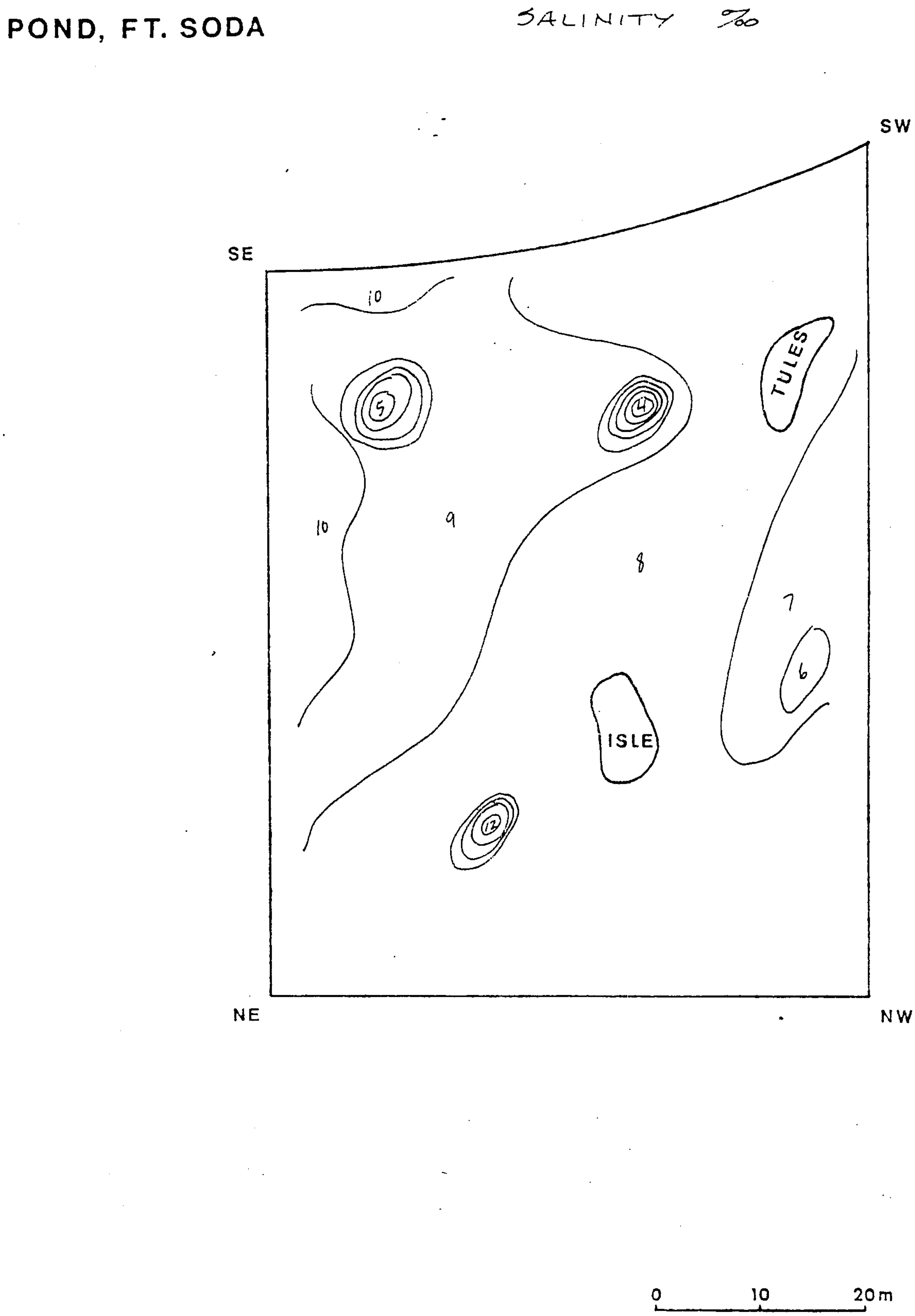


Figure 11. Surface salinity in Three Bats Pond August 18, 1981 taken 1400-1800 hours.

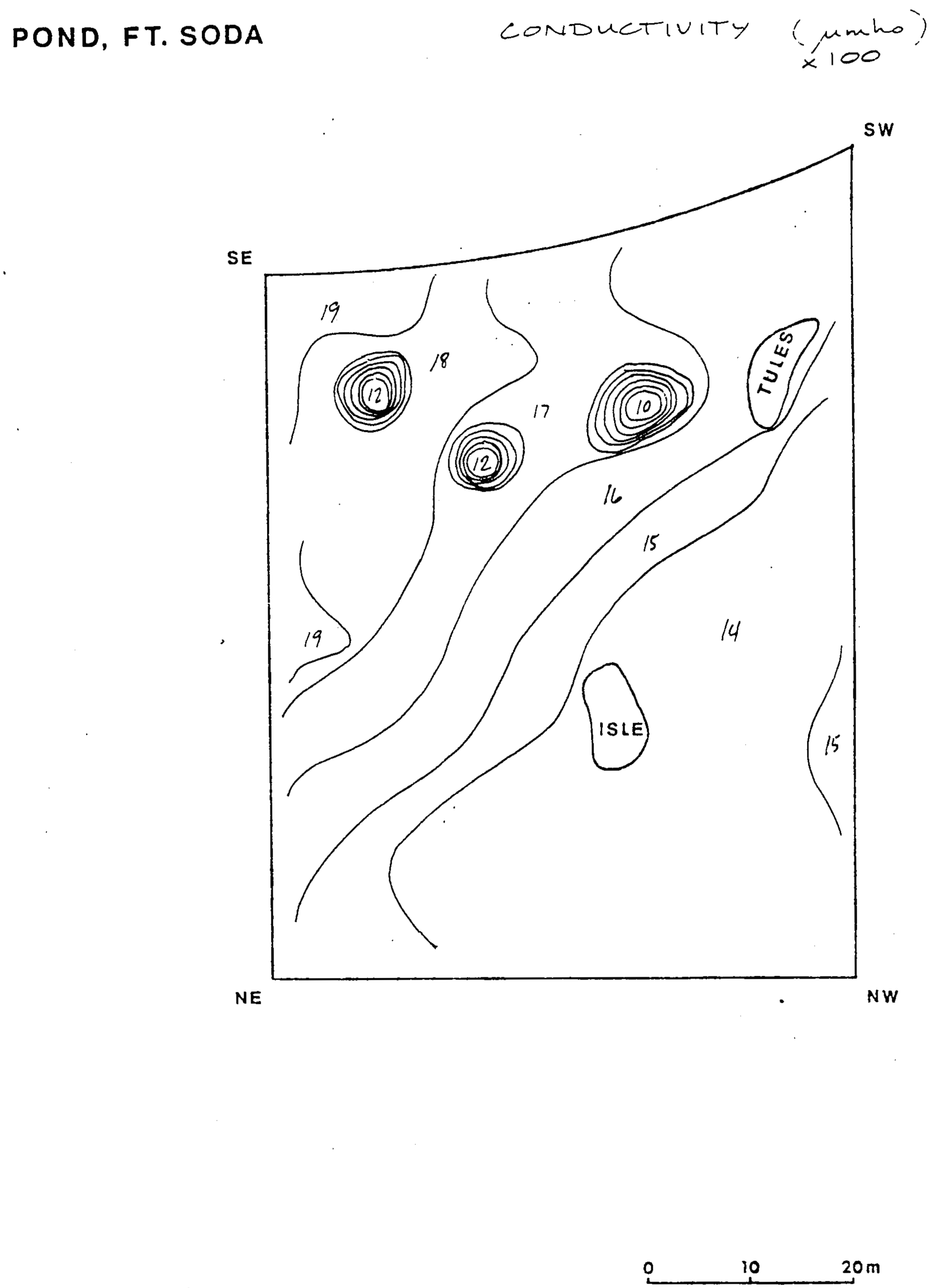
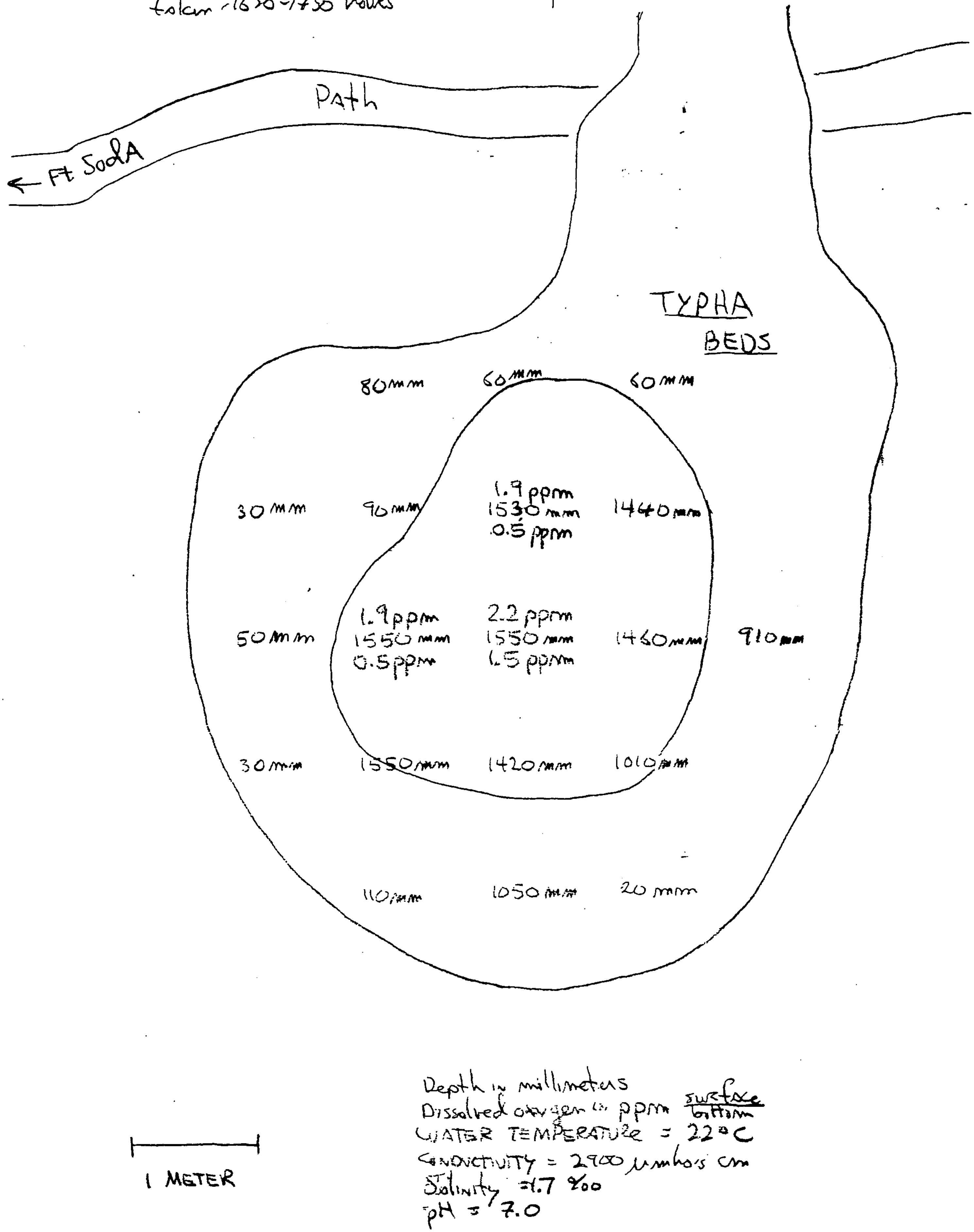


Figure 12. Surface conductivity in Three Bats Pond August 18, 1981 taken 1400-1800 hours.

Figure 13: the Spring habitat October 17 1981 Samples taken 1630-1730 hours



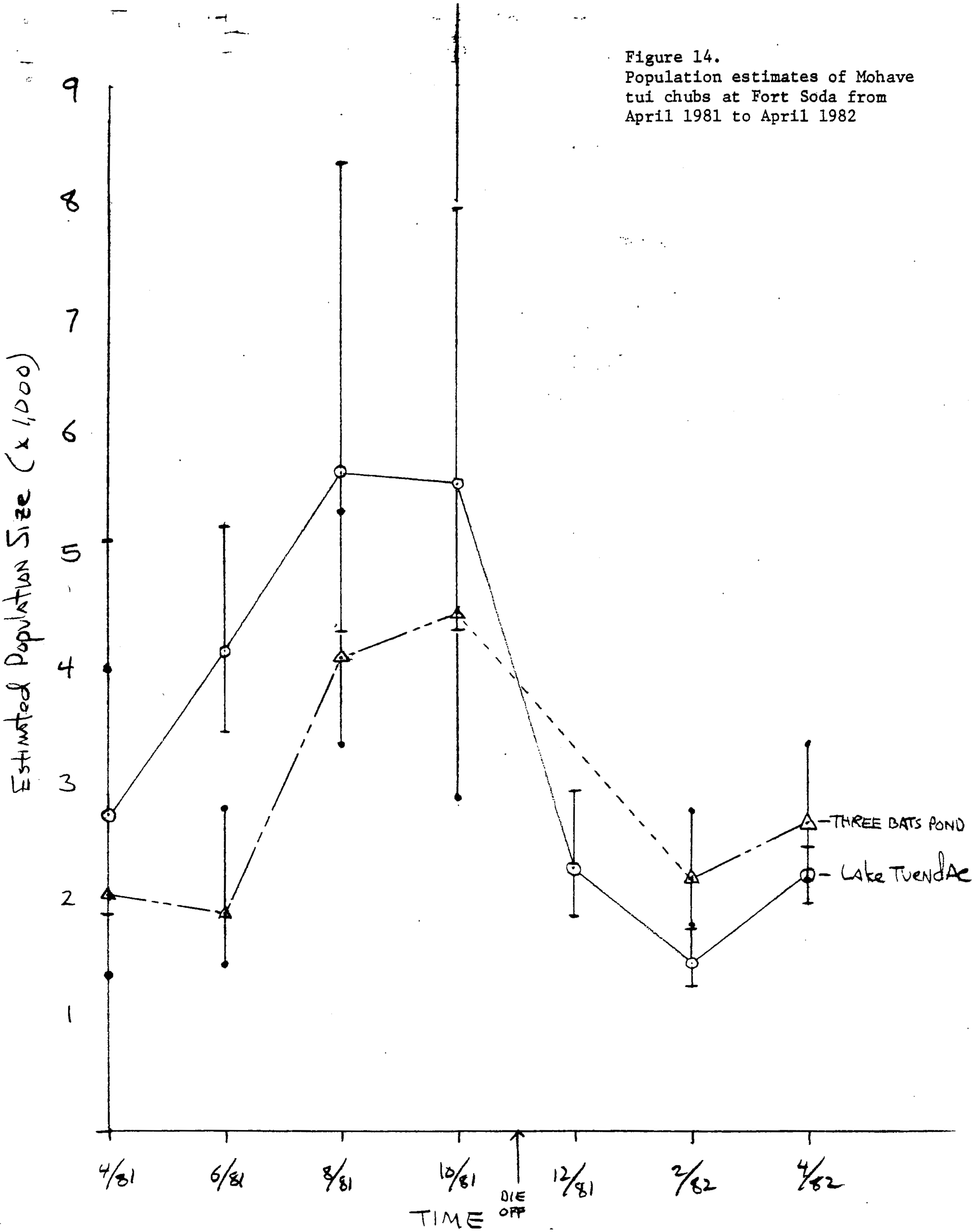


Figure 14.
Population estimates of Mohave tui chubs at Fort Soda from April 1981 to April 1982

Figure 15

Age and Growth of Mohave tui chubs at Fort Soda