CARIBBEAN RESEARCH INSTITUTE

SURVEY OF THE ECOLOGY AND WATER QUALITY OF LINDBERG BAY, ST. THOMAS

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January, 1970

GOVERNMENT OF THE VIRGIN ISLANDS

DEPARTMENT OF HEALTH, DIVISION OF ENVIRONMENTAL HEALTH

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COLLEGE OF THE VIRGIN ISLANDS

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TABLE OF CONTENTS

I. INTRODUCTION

Over the past five years, staged installations of water desalination and electric power generation equipment for the island of St. Thomas have been constructed at the Virgin Islands Water and Power Authority site on the peninsula between Krum Bay and Lindberg Bay, just north of Grambokola Hill, which lies on the southern tip. Process and cooling water intake is from Krum Bay, and heated brine/cooling water effluent is discharged through a tunnel into Lindberg Bay. The bay covers an area of approximately 6 million square feet, with an average width on the east-west axis of about 2,000 feet, and a north-south length out to the 5 fathom isobath of about 3,000 feet.

The plant now operates at an electrical load factor of about 75% and, in addition, supplies the island potable water demand of 2 million gallons per day. Installed seawater desalination capacity is 3.75 MGD. Growth projections for the resident and tourist populations forecast the need for facility expansion to be completed in 3 to 4 years and installation on the same site is planned for an additional 15-20 megawatts of electrical generating capacity and 2 million gallons per day of potable water desalting equipment.

Some resident complaints, stemming from the effects of a series of operational failures at the plant and the projected permanent damage to the nearly enclosed Lindberg Bay, a popular recreation area, began as early as the spring of 1967. At that time, the concern was over heavy smoke and particle emissions from the stacks, noise, and oil spills. As constructions progressed and the capacities were increased, the complaints began to show concern over the effects of the plant discharges into Lindberg Bay as well as the continuing hydrocarbon films from spills and leechings. Throughout the past year there have been complaints of scum and undesirable algal growths and a general deterioration of water quality and clarity.

On December 30, 1969 instrument and visual surveys of Lindberg Bay, particularly the area around the power plant discharge, were made in an attempt to describe the nature and extent of the plant effluent plume, and its effects, if any, on the local biota. Other inspections made last year by the Institute staff indicated a generally poor benthic fauna in the area of the discharge and, at times, abnormally high temperatures in the vicinity of the plant discharge.

II. PHYSICAL SURVEYS

In November-December, 1968, marine biologists of the Caribbean Research Institute of the College of the Virgin Islands made exploratory dives into the waters of Lindberg Bay. On the first two occasions, the effluent discharge temperature could not be measured by the divers as the temperature was above that which could be tolerated. It is estimated to have been in excess of 60 degrees C. Corals and other invertebrates in the nearshore area were killed to a distance of 200 yards from the discharge point, with a gradual decrease in destruction of the sub-littoral flora and sessile fauna as the water depth increased. On the third reconnaissance, (Dec. 12, 1968), the water temperature contour was measured, (Fig. 1), with one measurement taken 25 feet from the mouth of the tunnel where the temperature was 32.5 degrees C. Water temperature decreased toward the south and the lowest temperature measured in the bay was 28.7 degrees C. approximately 300 yards south of the outfall.

On December 30, 1969, temperature/salinity measurements were made in the surface water approximately every 200 feet along 3 compass bearings radiating from a focus at the outfall (Figs. 2, 3). The highest temperature measured was 28.7 degrees C., at about 100 feet straight out from the outfall. The lowest temperature and salinity measured were 27.1 degrees C., and 36.2 $‰_o$, about 700 feet away from the outfall tunnel on a line running NW (approximately 135 degrees). The highest salinity measured was 36.8 $‰_o$ at about 500 feet SW of the outfall. These measurements indicate a slight temperature gradient (less than 2 degrees C. in 700 feet) increasing toward the outfall from the north. A very slight increase of salinity (maximum 0.6 $‰_o$ actually measured) was also noted as measurements progressed toward the tunnel. The distribution of these data indicate that the effluent from the tunnel at the time of this survey was only slightly warmer and more saline than the receiving water of Lindberg Bay. These differences would not be expected to pose problems of shock to most marine life. The maximum temperatures and salinities recorded are well within the normal ranges for the environment and certainly within the limits of tolerance of the local biota.

The data distribution also indicates that the effluent was, at the time, dispersing south/southwest along the east shore of the Bay.

The visibility is very poor throughout the Bay. Measurements of depth and visibility made from the boat are shown on Fig. 3. Of the spots so checked, the bottom could be seen only where noted. Following heavy rains we have noticed dense sediment plumes in the nearshore water of the Bay, with a focus in the northeast corner where a ditch brings runoff from most of the area between the eastern end of the airfield and the hills to the north and east.

III. ECOLOGICAL OBSERVATIONS

During the survey on December 12, 1968 it was noted that corals and other invertebrates in shallow water were dead up to 200 yards from the outfall. Beyond this and to a depth of about 8 feet algae and Millepora corals survived. In water deeper than 8 feet no damage to the biota was apparent.

On December 30, 1969 snorkeling excursions were conducted in the area roughly from 400 feet north and 1,000 feet south of the tunnel and out about 300 feet from the shore, and also around the large offshore rocks and cove south of the Caribbean Beach Hotel. On the eastern side of the Bay, the water is extremely turbid due to a heavy load of suspended material which includes a large proportion of small microscopic particles. In the area just northwest of the power plant outfall visibility is less than 4 feet. This increases slightly as one moves south, but in the whole area probed, the bottom could be seen only near the surf zone. The bottom as far out as 50 feet from the shore is coarse gravel, coral and rock rubble with several large boulders, and dead coral heads. Further out, this grades into sand with patches of dead Porites coral, the whole now overlaid by a film of silt, and about 130 feet from shore northwest of the outfall, is the margin of a turtle grass (Thalassia) bed. Directly in front of the tunnel, surge action maintains a path of clean, coarse rocks. To the south of the tunnel there are many large boulders and coral heads which support life only near the tops. A heavy coating of silt covers the rocks, dead corals, shells, and octocorals. Here and there isolated apices of coral colonies survive. Empty mollusk shells are common, including the gaping shells of many rock oysters, attached to the large boulders. Dead sea fans and whips are common. Very few fish were seen, but a few remain, all small (beau gregories, chocolate damsels, several spp. of small groupers). The remaining organisms include small hermit crabs on the rocks and dead coral. Fire coral produces some good isolated stands, especially on the tops of higher boulders and coral heads. Several small (6" - 8") conch were found in the Thalassia bed and large numbers of their shells were piled outside of several octopus dens. The dominant sessile organism on rock and dead coral is a feathery, white-tipped colonial hydroid. No soft corals were found on the sandy bottom off the outfall, nor were there any urchins, typical inshore fish or evidence of burrowing worms or crustaceans. A few tube worms were seen (Sabellidae, Serpulidae) and, on rocks in the surf zone, some small gastropods and anemones. In the surf zone approximately 500 feet south of the tunnel there is a thick layer of black, partially degraded oil residue which is covered by coarse sand in which sea grass grows.

In the area surveyed along the western shore the turbidity was slightly less and small midwater and demersal fish, although not abundant, were noticeably more common. There was an unusually large population of small spiny black urchins here. Although the bottom (sand and rubble) supported no sea grass or macroscopic algae, the fauna in this area, while definitely sparse, is not as depleted as it is along the eastern shore. This suggests that the major source of sediment pollution is the large drainage ditch near the eastern end of the beach. Turbidity and sedimentation from this source would be greater in the northeastern part of the Bay. This is, in fact, the present condition.

IV. SUMMARY

Although on occasion unusually high water temperatures have been reported from the area of the power-desalination plant outfall, temperature and salinity measurements taken on December 12, 1968 and December 30, 1969, indicate that these qualities of the plant effluent are of such a slight difference from the receiving water that any effect they may have on the marine life would likely be confined to the immediate area around the tunnel mouth. However, it is not known if the effluent is now consistently of this quality. On the day of the survey in 1968, the plant's chief engineer claimed that the plant was not in operation, that the cooling jackets were being flushed, but no water was being distilled. On December 30, 1969, however, both brine and cooling water were being delivered to Lindberg Bay. Even if lethal temperatures are reached only occasionally, the fauna in the area near the outfall would be killed. Higher temperatures sustained over long periods would, of course, kill organisms over a wider area.

In the area of the power plant outfall the demise of the fauna may have been caused earlier by heated effluent, but present evidence indicates that continued destruction of benthic organisms over large portions of the bay is due to sustained high levels of suspended and settleable terrigenous solids. This turbidity and siltation causes much greater damage to the overall ecology of the area than does thermal pollution. Visibility is very poor over most of the bay except near the mouth. In large areas, especially along the eastern side, most corals and other sessile animals have been destroyed and conditions remain unsuitable for their re-establishment. This situation has been caused by increasing volumes of runoff as a result of continued bulldozing, construction, and surfacing of land which drains into the bay. It has been particularly severe during 1969 because of unusually heavy rains. The airport probably contributes some aviation fuel and condensed exhaust gases along with a considerable volume of water during the rainstorms. Unless steps are taken to abate runoff the quality of the water and marine life in Lindberg Bay will continue to deteriorate and it may eventually be undesirable as a swimming beach.

V. APPENDIX

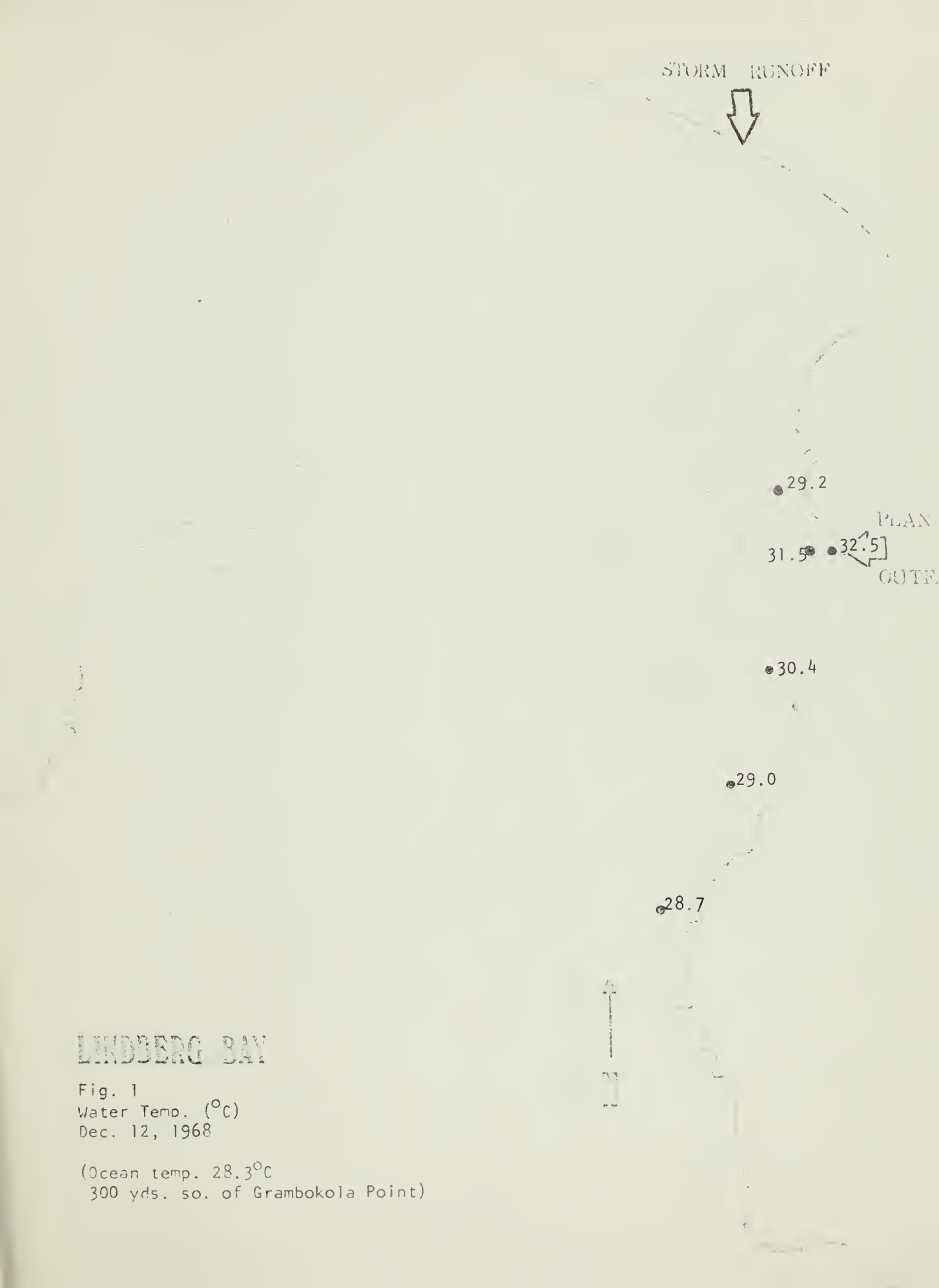

Fig. 1
Water Temp. (^{o}C)
Dec. 12, 1968

(Ocean temp. 28.3^{o}C
300 yds. so. of Grambokola Point)

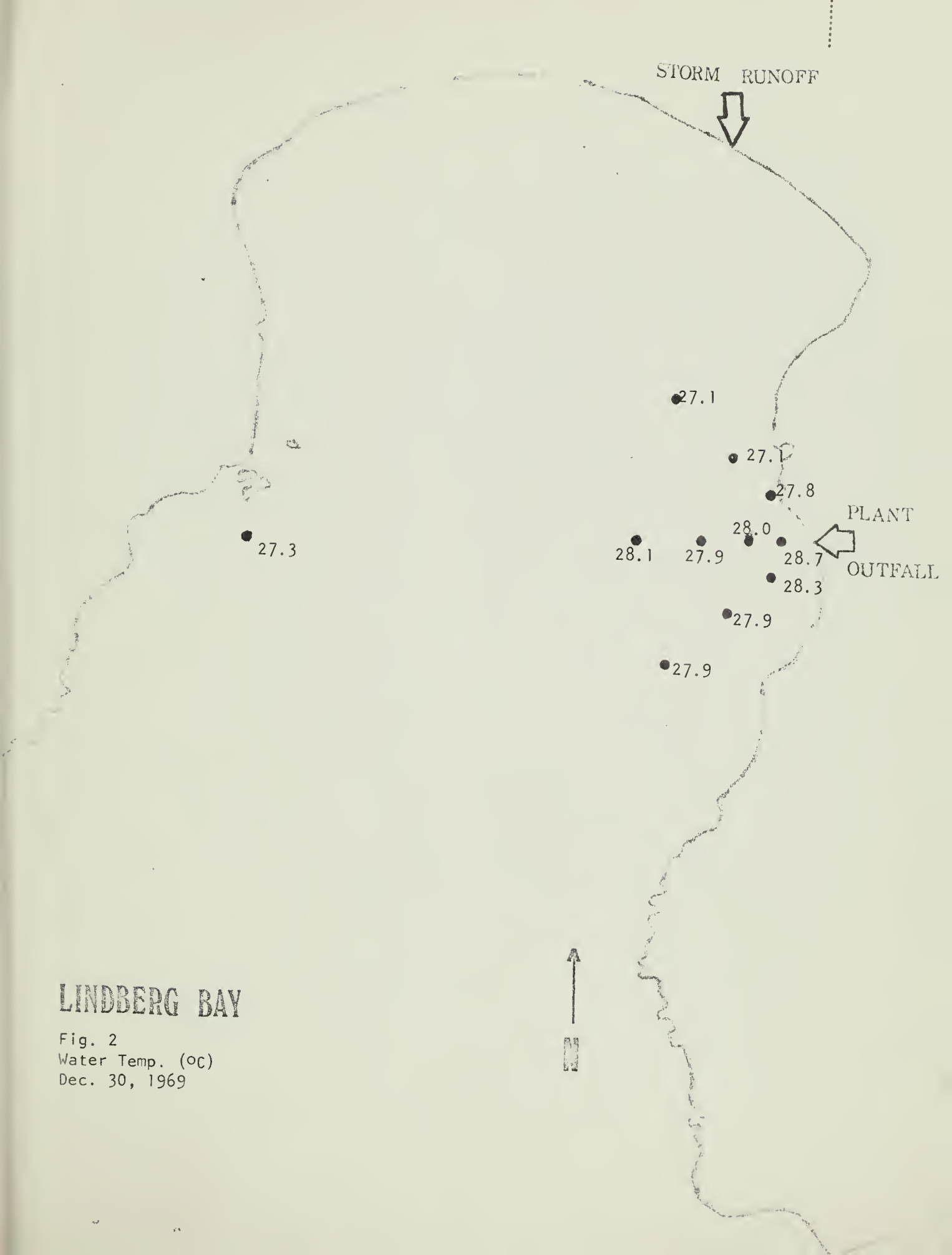

Fig. 2
Water Temp. (oC)
Dec. 30, 1969

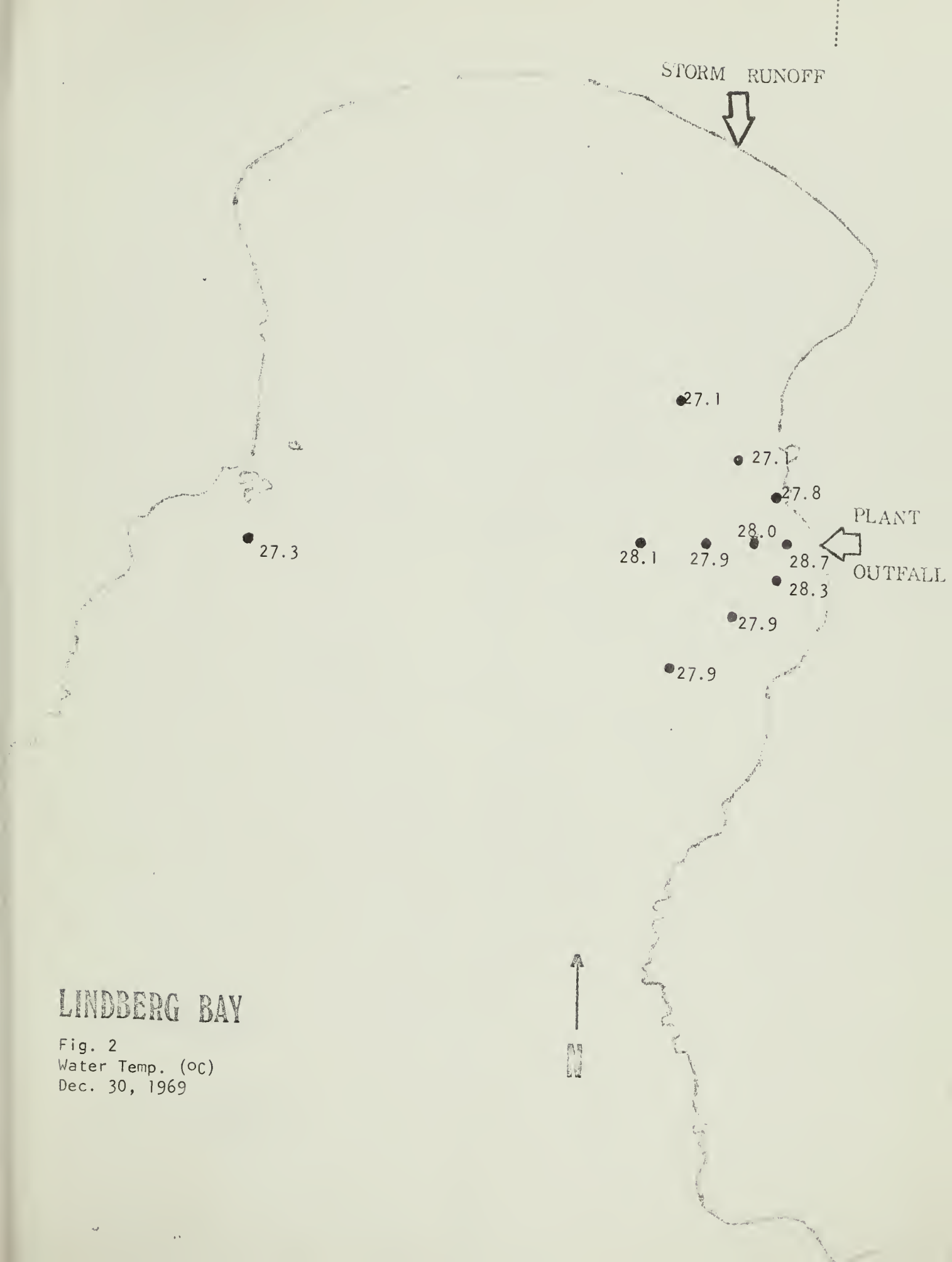

Fig. 2
Water Temp. (oC)
Dec. 30, 1969

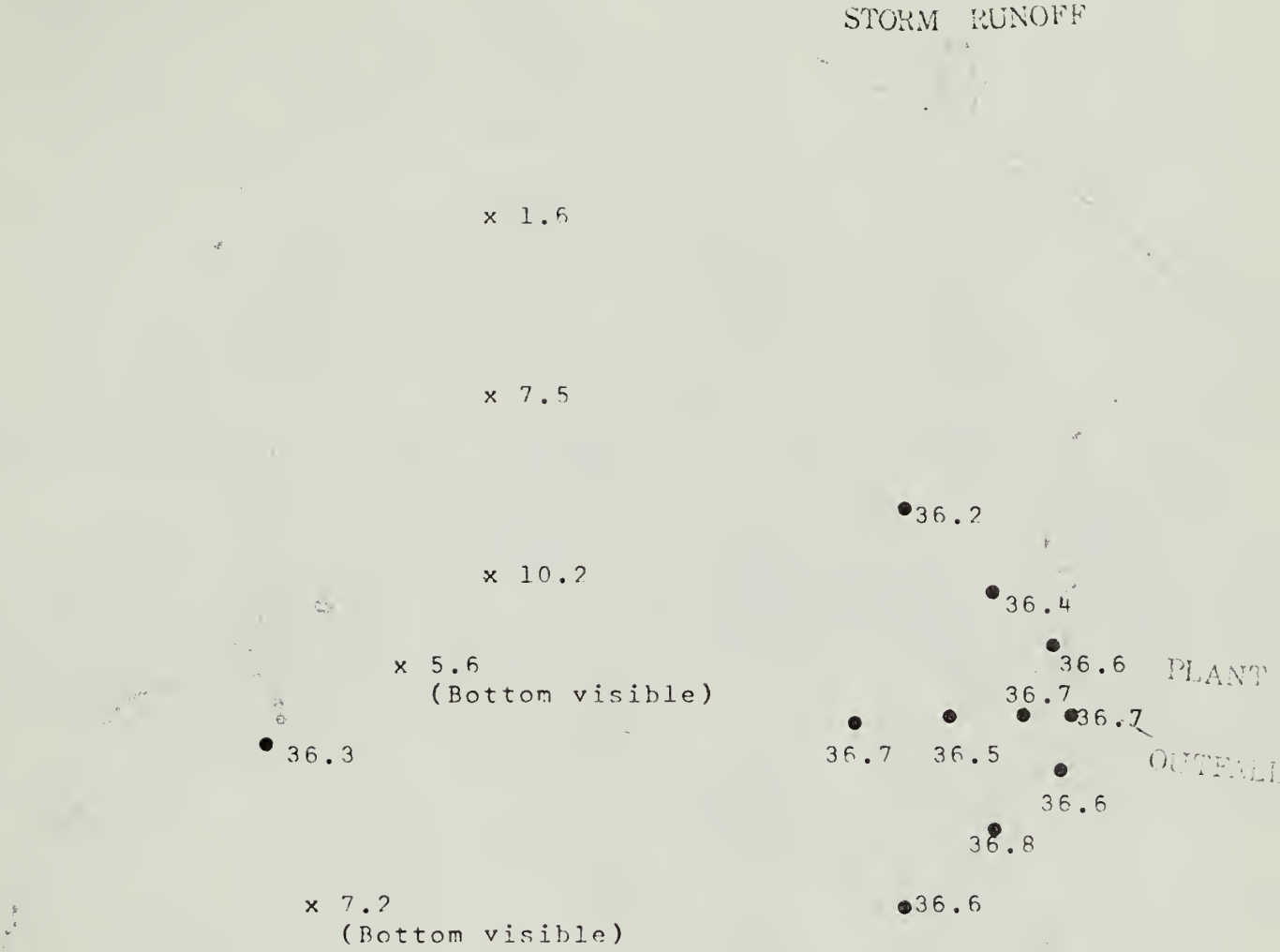

Fig. 3
Salinity, ppt. ●
Depth, meters x
Dec. 30, 1969