

Technical Report Series
Number 77-3

**SAND STABILIZATION ON THE
DUNES, BEACH AND SHOREFACE OF A
HISTORICALLY ERODING BARRIER ISLAND**

Wassaw Island Erosion Study
Part III

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SHOREFACE OF A HISTORICALLY ERODING
BARRIER ISLAND

WASSAW ISLAND EROSION STUDY

PART III

by

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INTRODUCTION

This report is supplemented by two earlier reports on the sedimentary framework and water-flow characteristics adjacent to the north end of Wassaw Island, Georgia. The purpose of this report is to describe the effects of synthetic devices on the sediment budget of a historically eroding area of shore.

Three devices were used to modify the sediment transport patterns in order to control erosion. Snow fences were placed on the backshore portion of the beach in a barren area covered with scattered patches of beach straw. Durabags filled with sand were placed at the low water line between the foreshore and a shore parallel spill-over channel. Mats of artificial seaweed were tested on the foreshore, and the shoreface at depths of -1 m, -2.5m, and -4m.

PRODECURE

On 12 December 1973, snow fences were installed on the north end of Wassaw Island (Figure 1). Four 50 foot long sections of snow fencing were established normal to the direction of dominant winds (Fig. 1). A simple design scheme was used to make comparisons with the more elaborated designs used and suggested by Savage (1963), Savage and Woodhouse (1968), Jagschitz and Wakefield (1971). The four sections of 4-foot high fence were surveyed in with respect to established markers in the stable dunes. Around each snow fence, twelve survey stakes were imbedded into the sand surface. Biweekly measurements were made of each set of stakes to determine the exchange in the thickness of the sediment carpet in the adjacent 168 square meters.

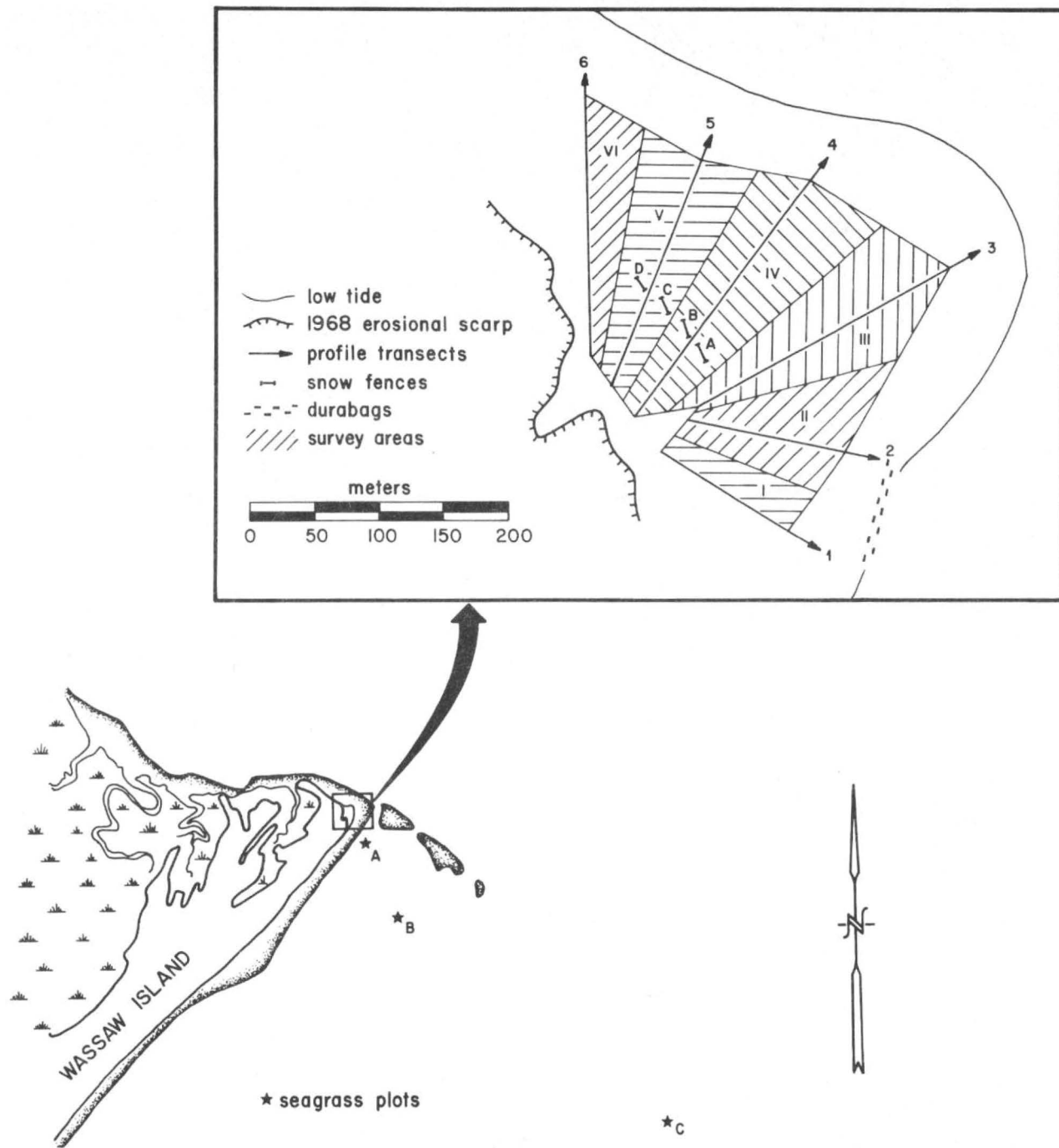


FIGURE 1 - Location map of study area, showing positions of profiles, snow fences, durabags, seagrass plots and survey areas.

The sediment budget of the beach was approximated from biweekly profile surveys that were initiated in November 1973 (Appendix B). Six profile transects were mapped at the north end of Wassaw Island (Fig. 1), using a modified staff and horizon technique (Appendix C). The data points along each profile were 2 m apart and the vertical measurements were surveyed to ± 1 cm. After 8 months of profiling, a checkerboard pattern of sand bags was placed at the toe of the fore-shore between profiles 1 and 2 (Fig. 1). The sand bags formed a semi-pervious dike that was intended to serve several functions toward preventing beach erosion. The structure was intended to dissipate wave energy and to function as a subaqueous dike that would hold sand on the beach. The structure was also to help maintain the integrity of a shore-parallel tidal channel which supplies sediment to the north end of Wassaw Island (Oertel, in press). Beach profile surveys continued for approximately 1 year beyond the initial implacement of the pervious dike.

Patches of seagrass are believed to sufficiently disrupt the flow of sediment laden currents to cause deposition of sediment. Seagrass decreases current energy due to bending of fronds, increased bottom drag, internal deformation and refraction (Wayne, 1974). Four plots of artificial seagrass were tested adjacent to the north end of Wassaw Island to test their potential as sediment traps. Plots were placed in the intertidal zone .25 miles (.46 km) offshore at -1 m depth, 1 mile (1.85 km) offshore at -3 m depth and 3 miles (5.56 km) offshore at -6 m depth. Seagrass plots were 1 x 10 m and fronds were 1.1 meter long and supported by 4 inch diameter styrofoam floats. The frond density was 18 to 24 fronds per square meter. Seagrass plots were fastened to anti-scour blankets (Sea Mats) and secured to the seafloor by pins and weights

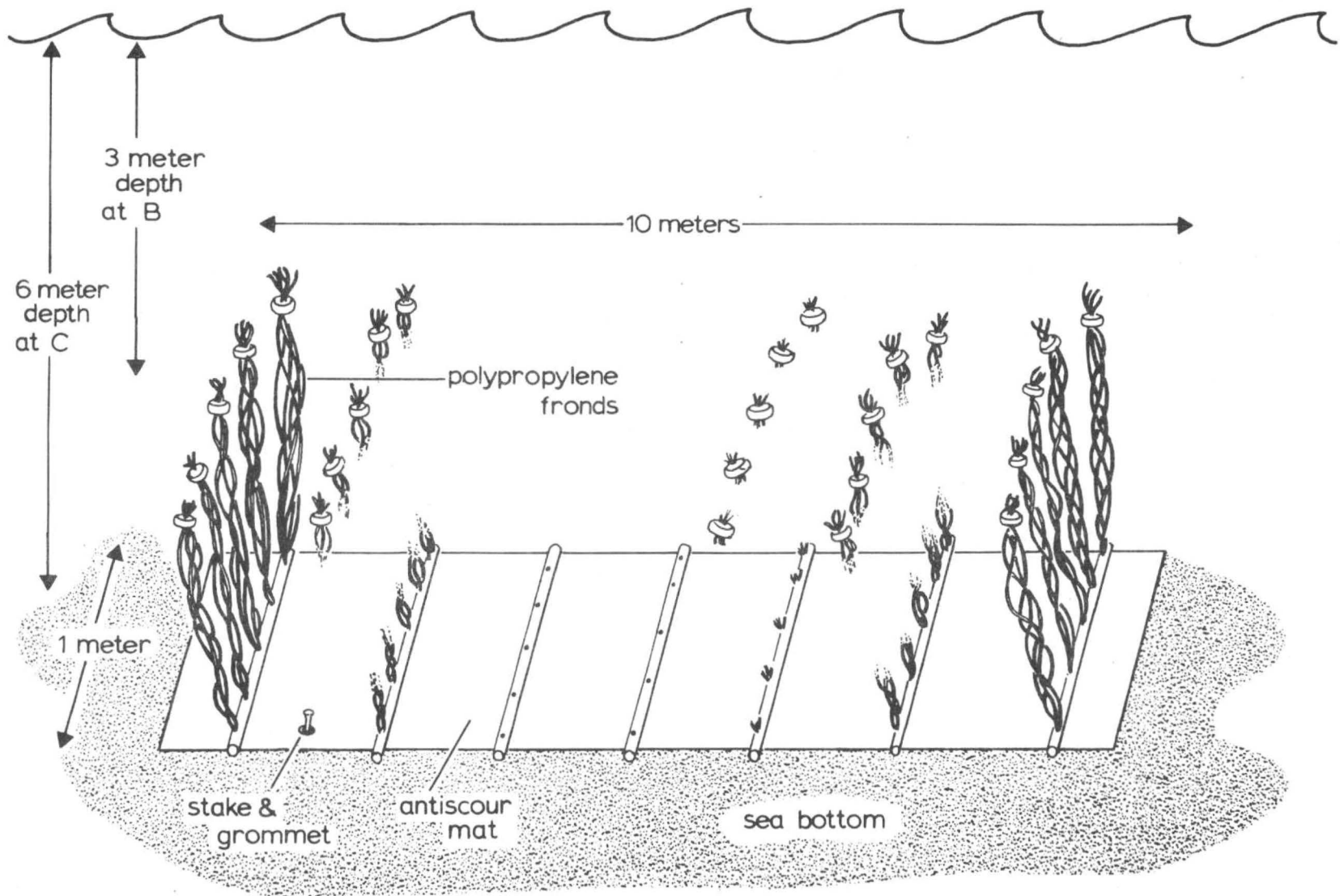


FIGURE 2 - Sketch plan of seagrass plots.

(Fig. 2). The effectiveness of plots was evaluated by SCUBA observations.

OBSERVATIONS

The largest quantities of wind-blown sand were trapped during the first month following snow-fence installation. At the survey area of fence A, approximately 27 cubic meters of sand were trapped during the first month and after 1.5 years of a total of 69 cubic meters of sand was trapped (Fig. 3). Snow fences B, C and D were along the inlet shoreline, and were stepped back from the ocean shore. Initially during the first month, profiles B, C and D collected 36, 35 and 37 cubic meters of sand, respectively. In the pursuing year these volumes all increased to 50 cubic meters only to be followed by a deflationary period, which decreased volumes to 28, 39 and -1.0 cubic meters during the last six months of the 1.5 year.

Sand accumulated on both sides of the fences. On the seaward side of the fences, sand accumulated in broad flat prisms. On the leeward side of the fences, sand formed peaked ridges with steep slip faces. After the initial month, maximum dune heights were .5, .6, .4, and .6 meters at area A, B, C, and D, respectively. During the study period, maximum heights achieved at areas A, B, C, and D were 1.2, .9, .7 and .8 meters, respectively.

Initially, dunes that were formed by snow fences were barren and had active slip faces. In the early spring of the first year, seedlings of the pioneer plants Salsola sp. and Panicum sp. appeared in the area around synthetically formed dunes. By late summer of the same year substantial clumps of Uniola paniculata and Panicum amarum were on the margins of the dunes, but the crests of the dunes were

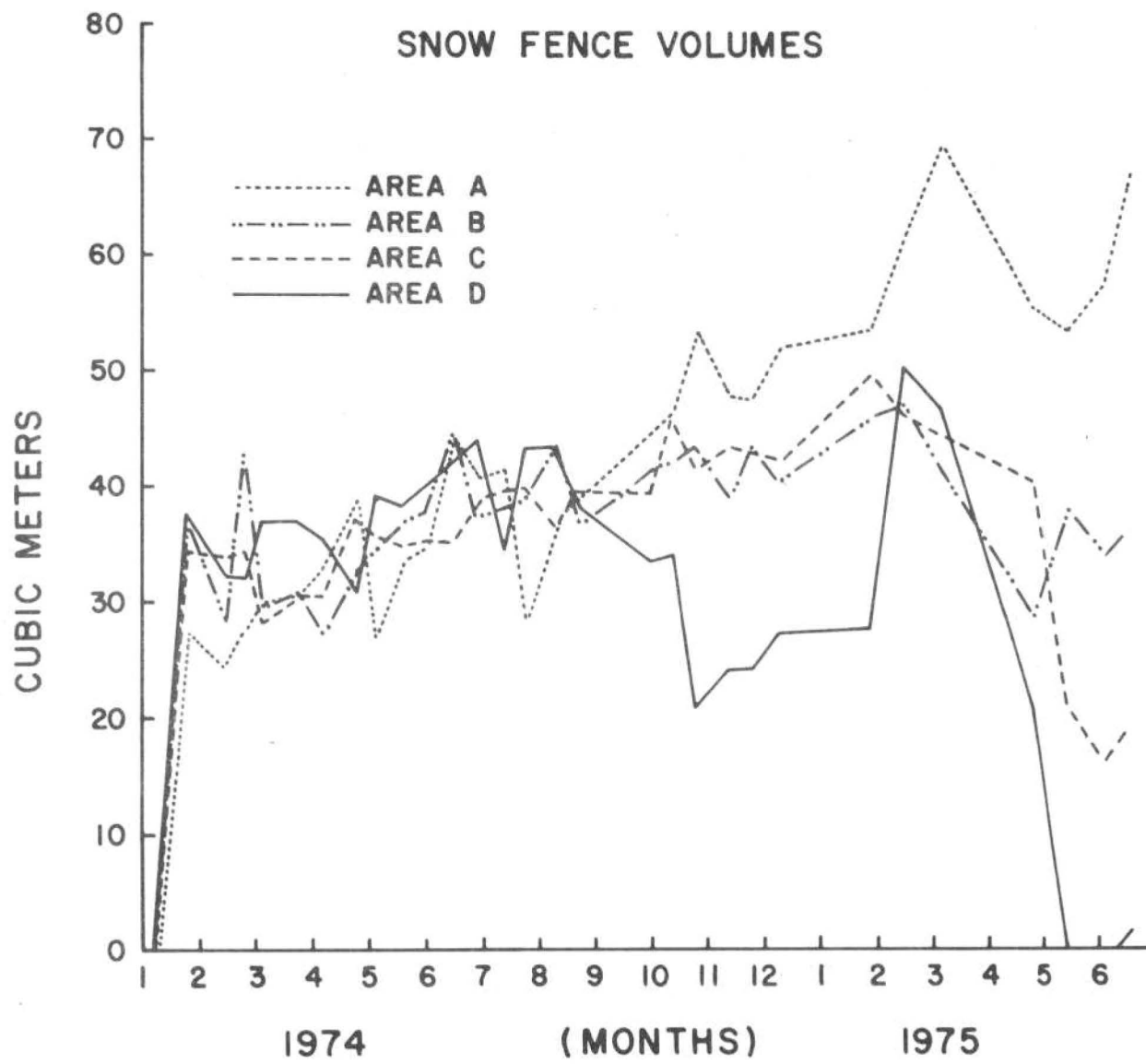
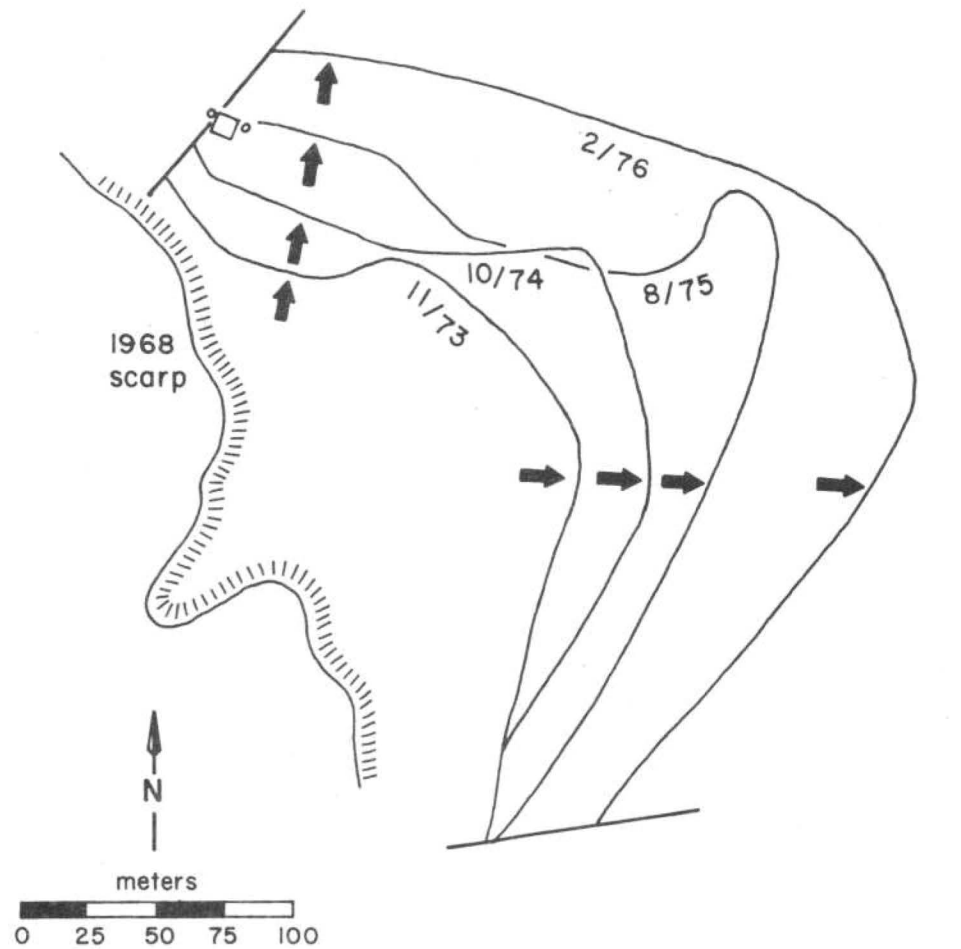


FIGURE 3 - Graph of volumes of sand trap on the vicinity of snow fence A,B,C,D.

still barren. A 50-100 yard wide zone of barren beach was exposed seaward of snow fence areas A and B, however, because of spit configuration, the beach was considerably narrower adjacent to area C and D. As the spit adjacent to areas A and B accreted in 1974 and 1975, the beach adjacent to C and D narrowed, leaving only a very small source area for the sand dunes in areas C and D. Deflation of sand in the dunes from area D began in September 1974. Erosion of sand from the dunes in area C was first observed 6 months later in February 1975. By late summer of 1974 and early spring of 1975, pioneer vegetation and beach straw berms began to appear on the barren beach of the spit. These structures trapped relatively large quantities of wind-blown sand and prevented the transport of sand into the test areas.

Data from previous surveys indicate that the tidal channel adjacent to the beach is a very important supplier of flood water and sand to the northern end of the island (Appendix A). The pervious dike made of sand bags was located on the landward side of this tidal channel and prevented channel silting by inhibiting the flow of beach sand into the channel. A one-year survey period was made following the installation of the snow fences and prior to the installation of sand bags. This survey illustrated a 1.6 acre (.63 Hectare) increase in shore area (Fig. 4). Periodic surveys following the installation of the sand-bag dike showed that the shore continued to accrete. Periodic surveys were made for the one-year period of implacement, and continued for a 3-month period following removal of the sand bags. During the one-year and 3-month period, the beach accreted an additional 6.6 acres (2.7 Hectares) and by comparison there was approximately 4 times as much



ONE YEAR DURATION
WITHOUT BAGS

(11/73 - 10/74)
+ 1.56 Acres

ONE YEAR DURATION
WITH BAGS, PLUS 3
MONTHS WITH BAGS
REMOVED*

(10/74 - 2/76)
+ 6.56 Acres

NET CHANGE

(11/73 - 2/76)
+ 8.12 Acres

*BAGS WERE REMOVED IN LATE
SEPTEMBER 1975

FIGURE 4 - Map of the northeast part of Wassaw Island (Fig. 1) showing 1968 scarp, and the positions of the 1973, 1974, 1975, and 1976 shorelines.

beach accretion with the pervious dike in place, as before installation. In all, approximately 8.12 acres of new shore accreted from November 1973 to February 1976.

At the initiation of the project, the shore that faced the ocean between transects 1, 2, and 3 was eroding and dunes along the back shore were truncated. In the nine months previous to the installation of the pervious dike, the backshore accreted 10 m. Seven months after the installation of the dike the backshore had accreted an additional 24 m and foredunes were developing on the scraps of the truncated dunes. While the beach was advancing seaward, it was also advancing in a shore parallel direction toward the axis of the Wassaw Inlet. Residual flood currents on the beach front were predominantly responsible for the transport of sediment toward the axis of the inlet channel (Oertel, in press). Spits initially formed near profile 3 in the lower part of the intertidal zone. Redistribution of sediments by flooding current caused spits to curve landward and move toward transects 4, 5, and 6. Swash processes also caused the spits to move up the beach face until they "welded" onto the shore near the berm (Appendix A-9, 10, 11, 12). The qualitative and quantitative development of the shore between transects 1 and 6 is illustrated by graphs and profiles in Appendix A.

The artificial seagrass plots had limited success in trapping sand on the foreshore and shoreface. The seagrass plot established at the foreshore trapped 30 cm of sand within the first week. However, the action of breaking waves entangled most of the fronds so that fronds were only able to float approximately 30 cm above the seabed. After

two weeks this plot was removed, untangled and moved to an area approximately 0.2 miles (.37 km) offshore and fastened to the seabed in a shore-parallel orientation. Within a month, the base of this plot was covered with 3 to 15 cm of sand and a shallow depression (20 cm) formed in the lee of the plot. After three months, numerous encrusting organisms had weighed down many of the fronds and no additional sediment had accumulated on the mat between the fronds. After six months, there was a general lowering of the shoreface within one mile of the shore. However, sediment on the seagrass plot remained in place and created a topographic high. A late winter storm eventually removed the marker buoy from the plot and buried all traces of the antiscour blanket and frond materials.

The third plot of artificial seagrass was located leeward of the shoal and .8 miles (1.48 km) offshore. The seagrass plot was installed by first lowering two 100 lb. weights to the sea floor with 1/4" polypropylene line. The upper ends of the lines were attached to two corners of the seagrass plot and pulled taut. The line and plot were slowly lowered to the sea floor keeping both taut. Two 100 lb. weights were also used to secure the trailing end of the seagrass plot. Once the plot was on the bottom and marked with a brightly marked surface float, SCUBA divers were sent down to stretch out the mat, pin it to the substrate, and untangle any fronds as was necessary. Diver work was made difficult because of high turbidity causing approximately 6" visibility and surges from sea swells that tended to roll the divers every eight seconds. The initial implacement took approximately 1-1/2

hours and final securing took approximately 1 hour. The plot was located in -2.5 m of water (MLW) and was oriented along a 243° bearing. This was slightly oblique to the 230° orientation of the shoreline. Installation of the plot was undertaken at half tide when ebb currents in the main channels were achieving maximum speeds. However, the installation site was shielded by a sand shoal and current speeds were almost slack. SCUBA observations after one month illustrated some scour and burial at the edges of the antiscour blanket. Fronds were not severely tangled but extensive floral and faunal communities had attached to many of the fronds. In the pursuing month, a severe northeast storm hit the coast and tore the marker cable from the mat. Numerous tracks with a precision bottom sounder revealed no traces of the plot.

The fourth seagrass plot was located approximately 3 miles (5.56 km) offshore, and leeward of the marginal shoal 1 mile (1.85 km) south of the channel. Installation techniques were similar to those used for the third seagrass plot. The long axis of the plot was secured at -6 m (MLW) and oriented along a 315° bearing. The seabed was composed of coarse sand and shell fragments which at the time of installation was shifting in response to strong waves surges.

After one week SCUBA inspection of the plot was made. No burial was noticed except for a few small lenses of coarse material in the center of the mat. The pins appeared to be elevated slightly, suggesting a lowering of the seabed below and adjacent to the mat. SCUBA observations after one month revealed little change. SCUBA observations for the next three month period were cancelled because the marker floats

were missing and an extensive search with a precision bottom sounder did not show any traces of the plot.

CONCLUSIONS

The flood tidal channel adjacent to the north end of Wassaw Island (Oertel, in press), appears to be the major factor controlling shore accretion. When the channel is open sediment is transported to the north end of the island. Spits on the north end of the island prograde northward and curve into the Wassaw Sound. Data collected during the study periods indicate that a properly oriented pervious dike constructed of sand bags may have had a positive influence on keeping the channel open. As spits prograded toward the axis of Wassaw Sound they begin to curve landward and move up the beach slope. The eventual welding to the shoreline increases the area of exposed beach. Onshore winds transported the dry sand on the exposed beach surface until it came in contact with obstacles such as mounds of beach straw, plants, dunes or snow fences. The accumulation of sand around these obstacles formed foredunes and dune ridges (Oertel and Larsen, 1976). Snow fences were particularly successful in trapping wind-blown sand behind the broad, exposed areas of beach created by rapid spit development. Snow fences adjacent to the narrow sections of beach or beach that was fronted by advanced sediment traps, such as straw berms, plants or snow fences, were not successful in developing dunes.

Small plots of artificial seagrass were not effective for trapping sand on the open ocean coast. The turbulent motion of breaking waves tangled fronds in the foreshore area and reduced their efficiency as

energy dissipators. In the offshore areas, plots had only local effects on sediment accumulation. The loss of energy produced by bending seagrass fronds permitted small amounts of sediment to be deposited on the mat surface at the base of the seagrass. However, adjacent areas of sea bottom illustrated no obvious changes. During periods when the shoreface was lowered by some physical event, the seagrass mat held sediment in place forming a topographic high.

The original intent of the 1 x 10 m seagrass mats was to artificially induce the formation of sand waves that would eventually migrate shoreward and supply sediment to the beach. Insufficient quantities of sediment collected on mat surfaces to form these mounds.

The maximum size of seagrass plots that could be handled and installed was 1 x 10 m, however, this size was relatively insignificant with respect to the beach-shoreface system on the north end of Wassaw Island. Naturally occurring sand waves in the area are at least 2 x 50 m and generally occur in sets of three (Oertel, 1971).

In conclusion, the marginal tidal channel at the north end of Wassaw Island appears to be a critical feature controlling the development of the shore. We feel that submarine pervious dikes such as those constructed with Durabags are useful structures for keeping the marginal channels open. When these channels are open, sediment is transported to and deposited at the north end of Wassaw Island. Snow fences appeared to be an effective means of trapping and storing large quantities of sand on the upper beach. However, fences were only effective where rapid beach growth produced broad areas of loose sand available

for eolian transport. Snow fences were not an effective means of building the beach in areas where the beach is eroding and the shoreline is retreating. Small plots of artificial seagrass had no obvious contributing effect for producing a source of sediment for the beach. However, additional research on larger plots of such mat-frond systems may give more positive results.

ACKNOWLEDGMENTS

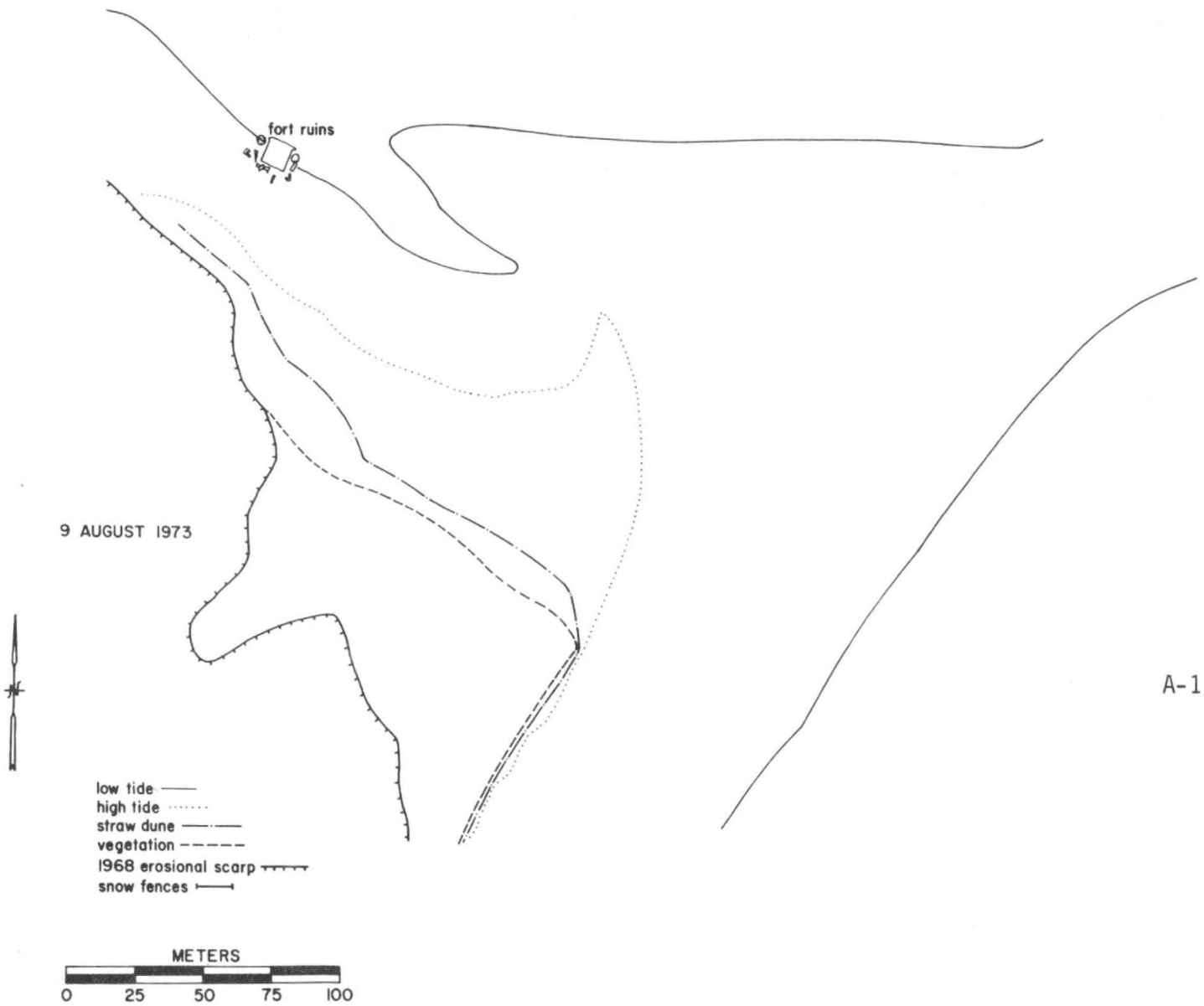
This project was sponsored (in part) by the Georgia Sea Grant Program, supported by N.O.A.A., Office of Sea Grant No. 10-32-RR273-077. Oceaneering International, Inc. of Houston, Texas supplied the sea mats and durabags. The frond material was furnished by the Patchogue-Plymouth Company of Atlanta, Georgia. The U. S. Government is authorized to produce and distribute reprints for governmental purposes not withstanding any copyright that may appear hereon. The authors acknowledge with appreciation the assistance of R. Brokaw, C. Chamberlain, M. Larsen, D. Perlmutter, and R. Wallace.

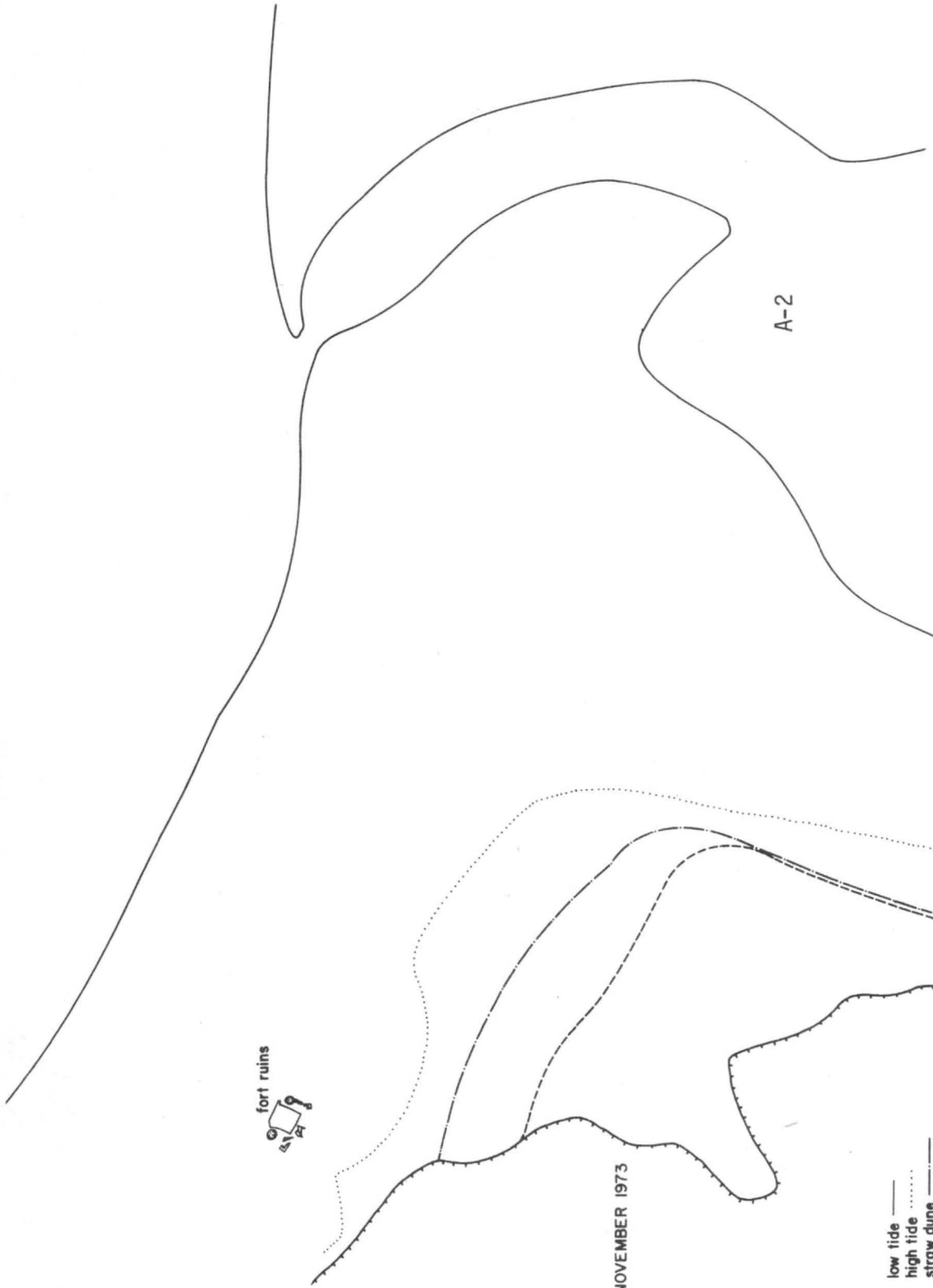
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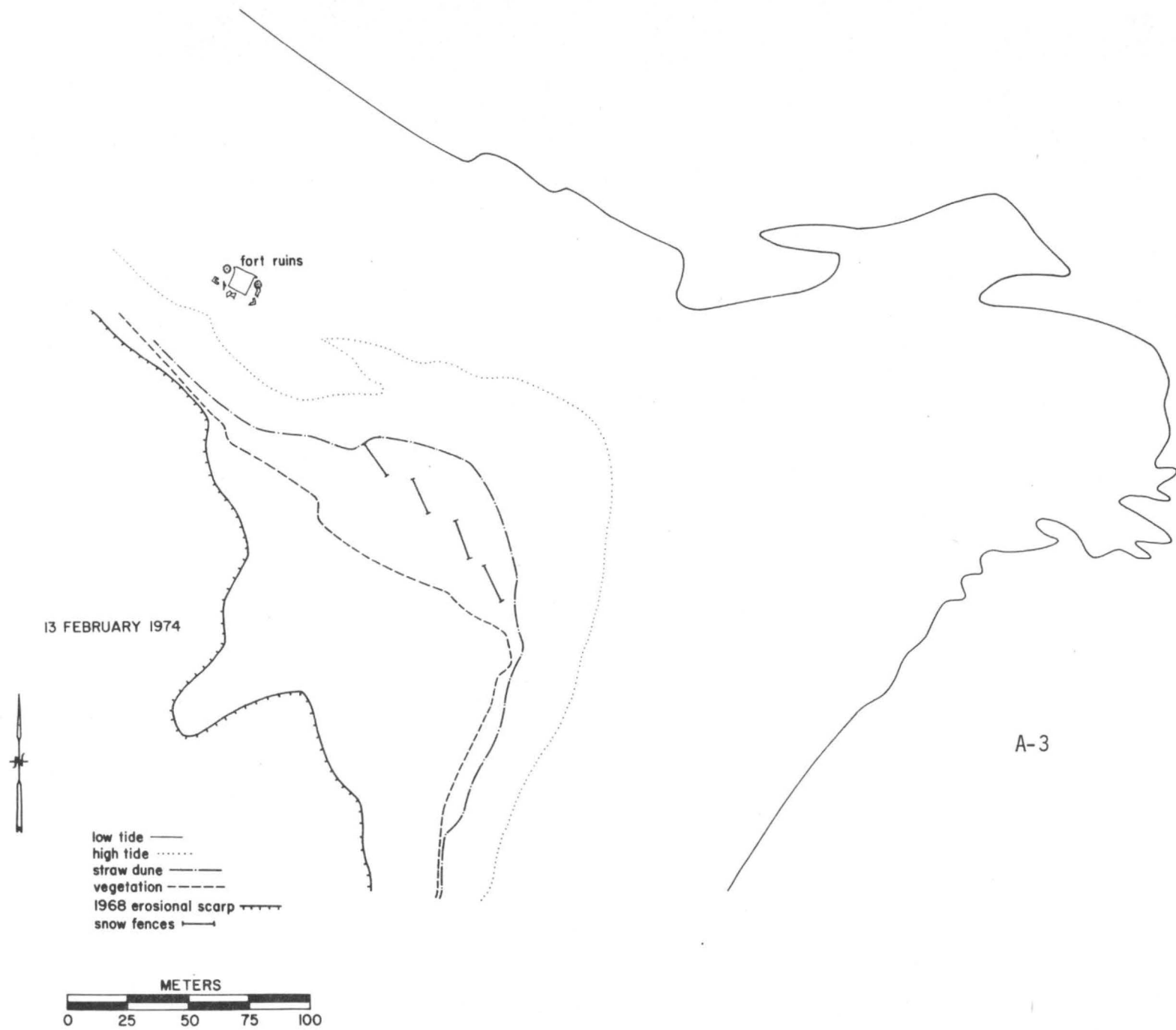
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APPENDIX A

- A-1 9 August 1973 Survey
- A-2 26 November 1973 Survey
- A-3 13 February 1974 Survey
- A-4 19 April 1974 Survey
- A-5 12 July 1974 Survey
- A-6 10 October 1974 Survey
- A-7 13 December 1974 Survey
- A-8 6 March 1975 Survey
- A-9 29 May 1974 Survey
- A-10 21 August 1974 Survey
- A-11 11 February 1976 Survey
- A-12 10 June 1976 Survey







A-4

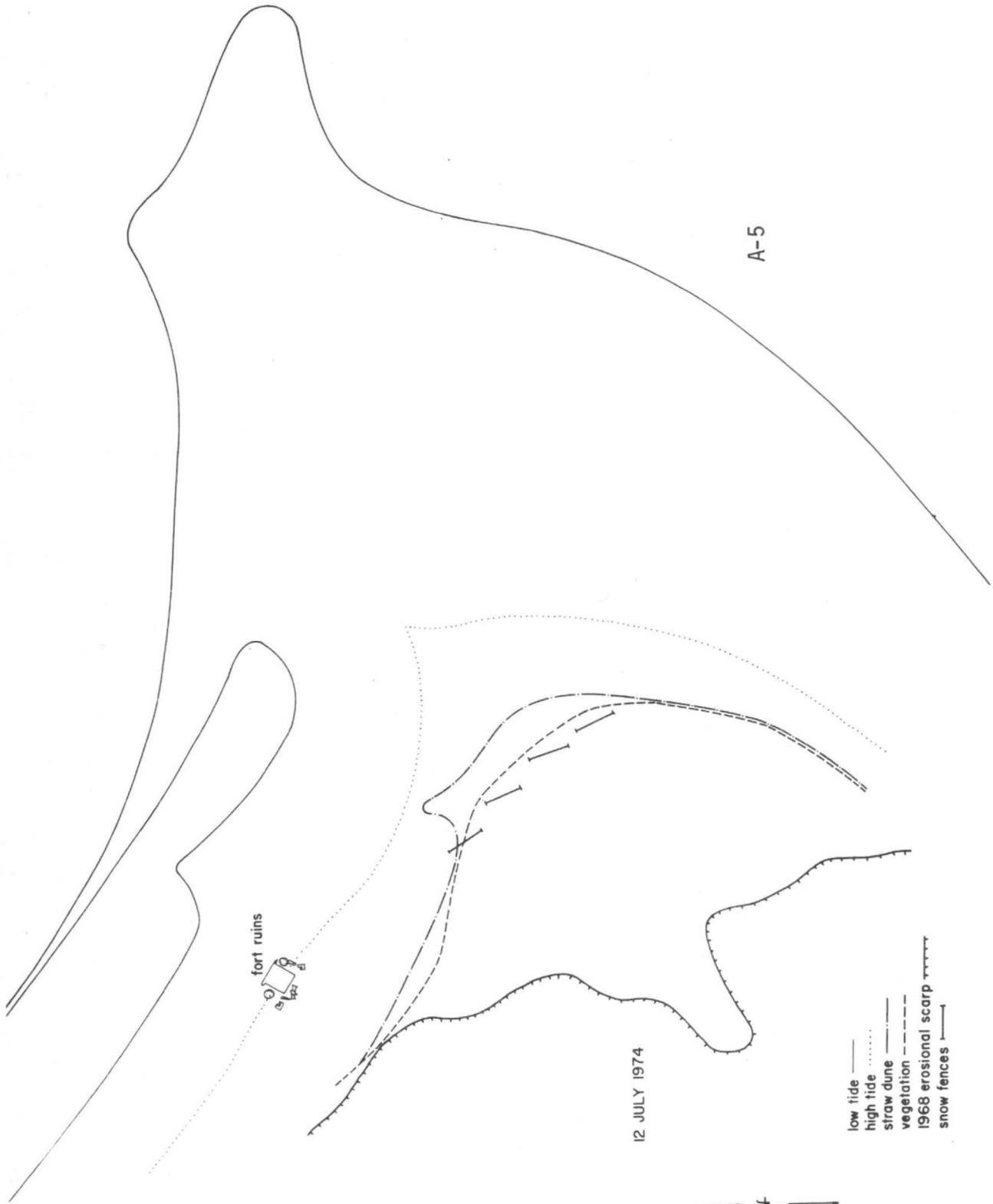
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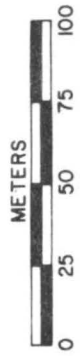
19 APRIL 1974

- low tide ———
- high tide ·····
- straw dune ———
- vegetation - - - -
- 1968 erosional scarp ———
- snow fences ———





- low tide ———
- high tide ·····
- straw dune - - - -
- vegetation - - - -
- 1968 erosional scarp - - - -
- snow fences - - - -



22

A-6



10 OCTOBER 1974

- low tide ———
- high tide ·····
- straw dune ———
- vegetation - - - - -
- 1968 erosional scarp ~~~~~
- snow fences |——|



23

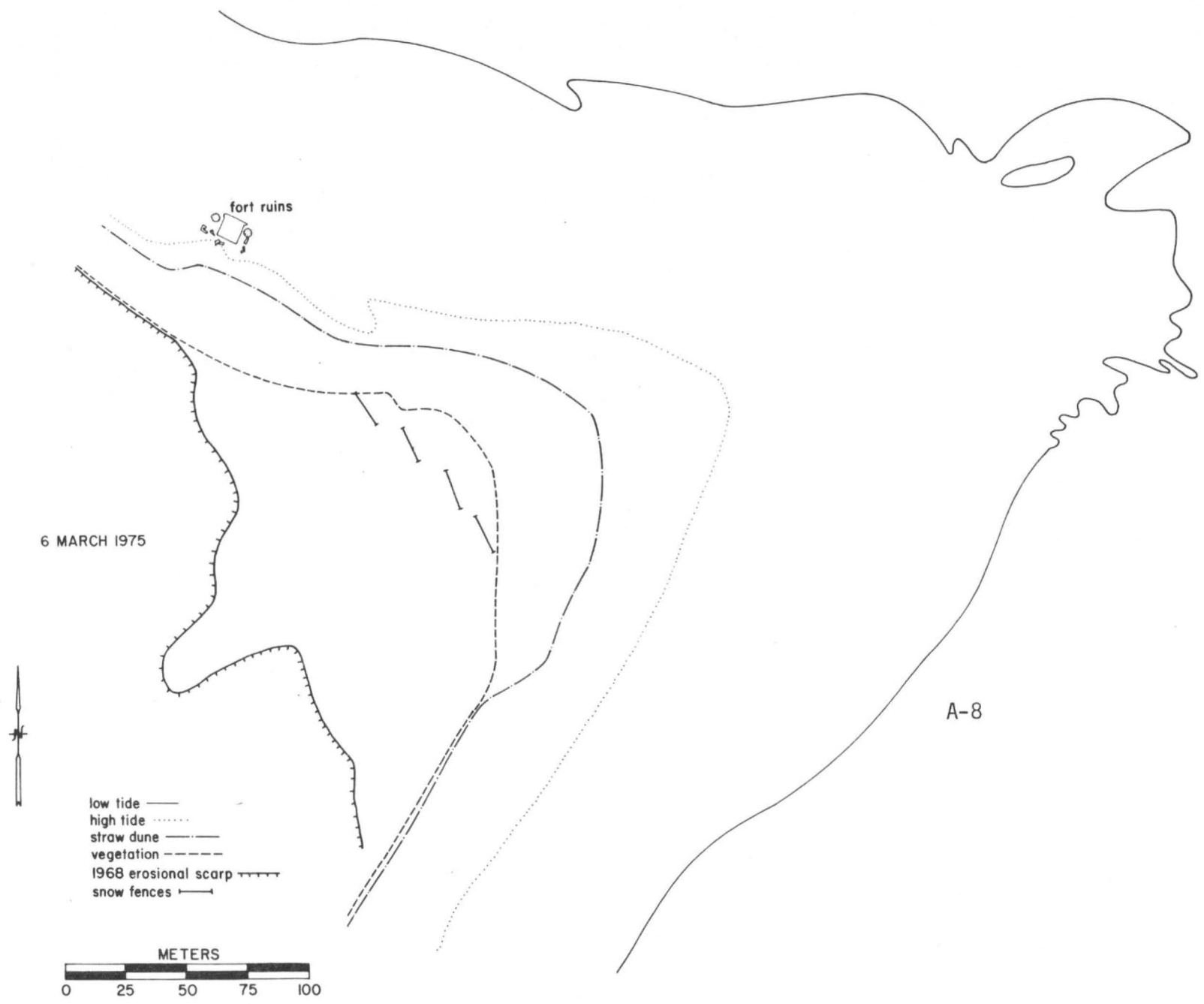
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fort ruins

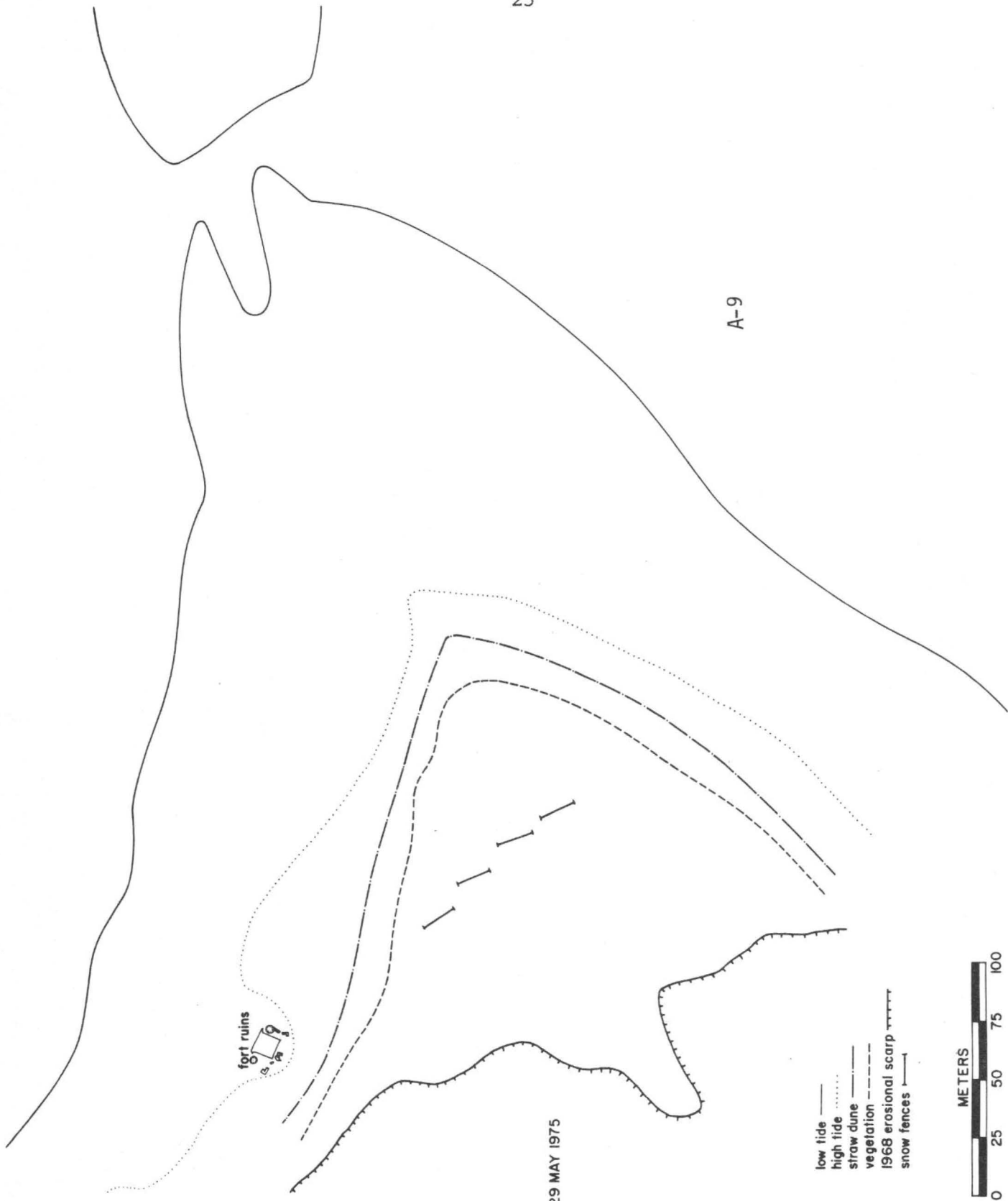
13 DECEMBER 1974

- low tide ———
- high tide ·····
- straw dune ———
- vegetation - - - - -
- 1968 erosional scarp ~~~~~
- snow fences ———|———





A-9



fort ruins

29 MAY 1975

- low tide ———
- high tide ·····
- straw dune - - - - -
- vegetation - · - · -
- 1968 erosional scarp - - - - -
- snow fences - - - - -

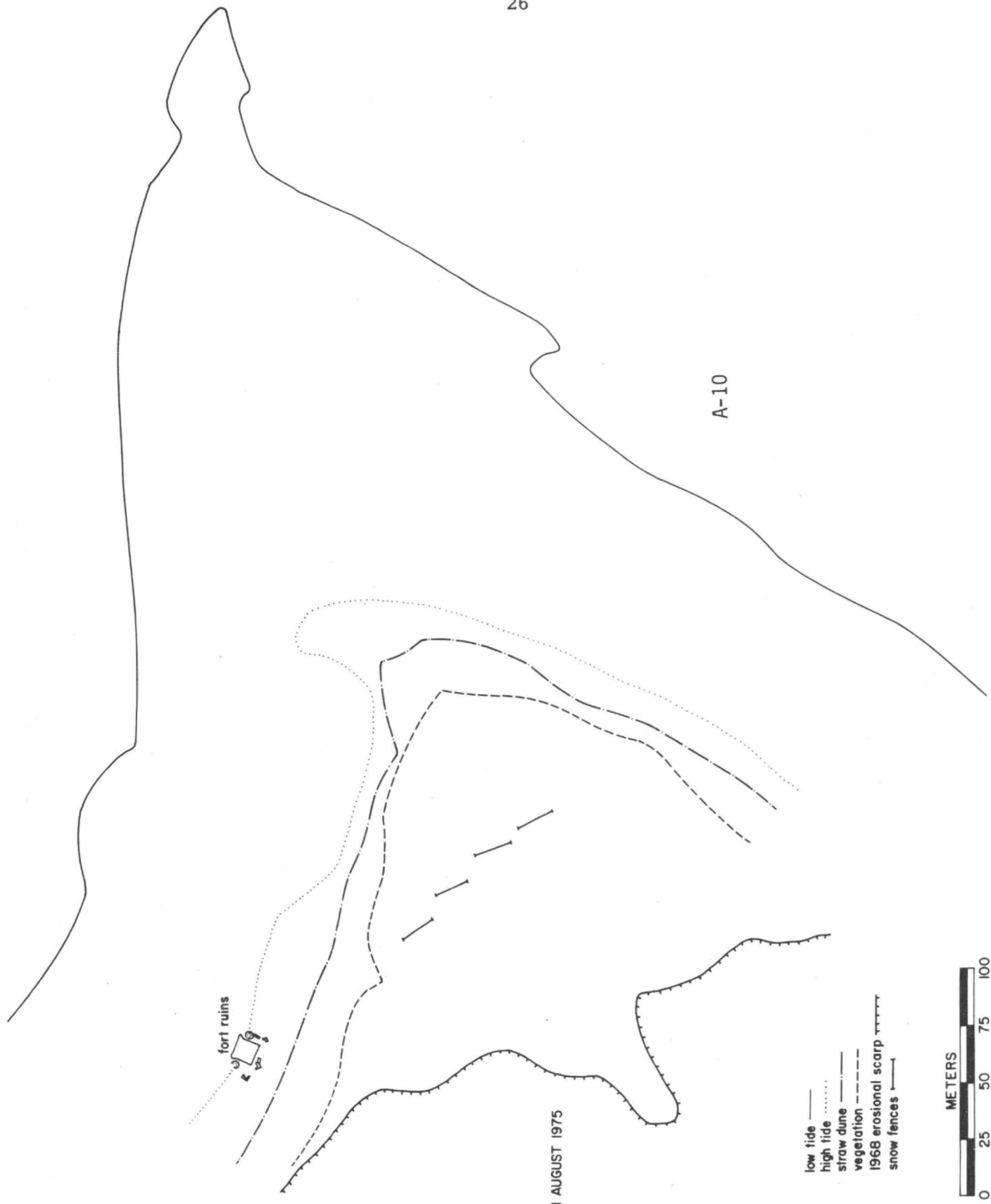
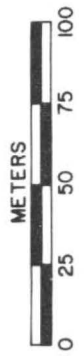


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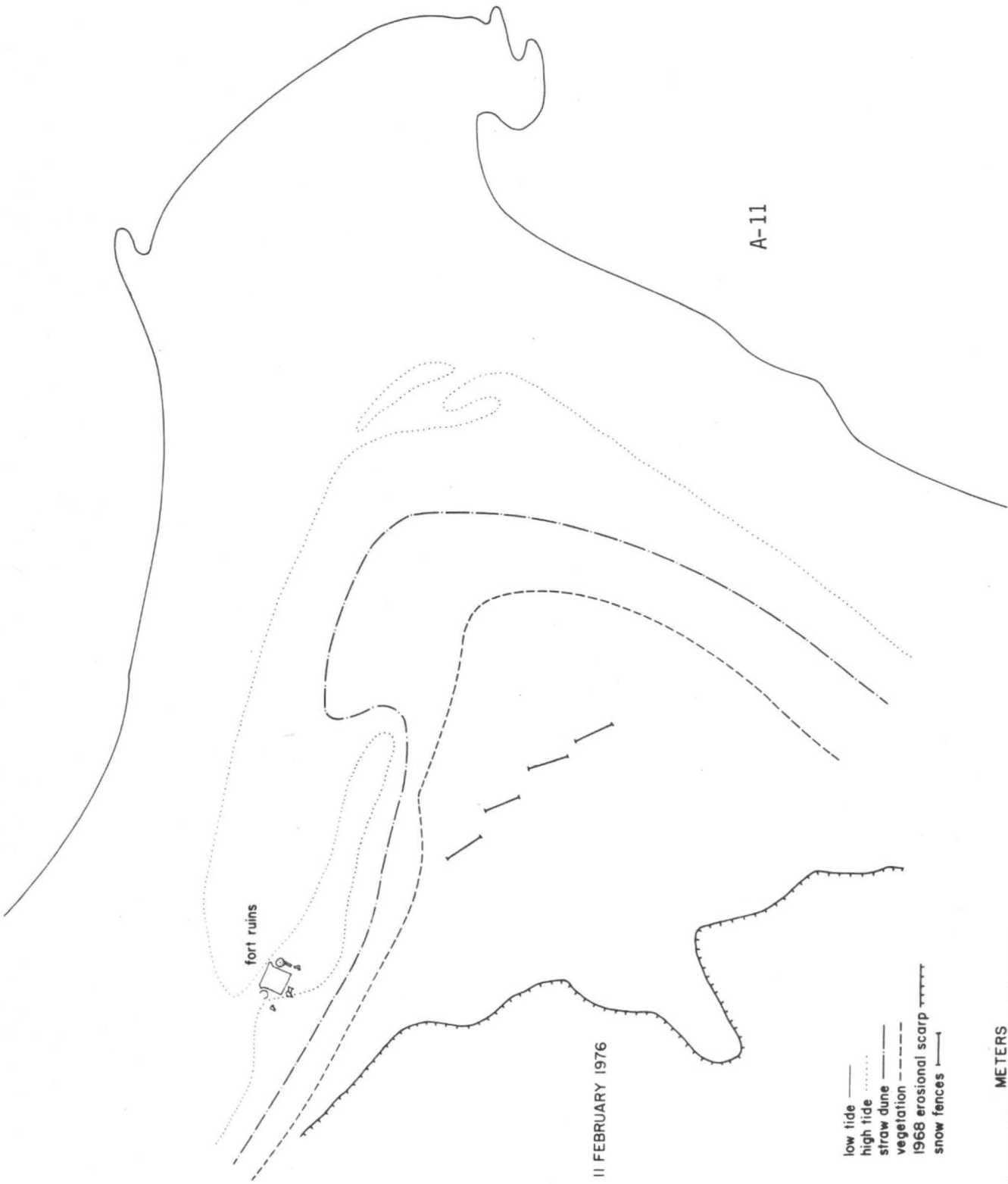
fort ruins

21 AUGUST 1975

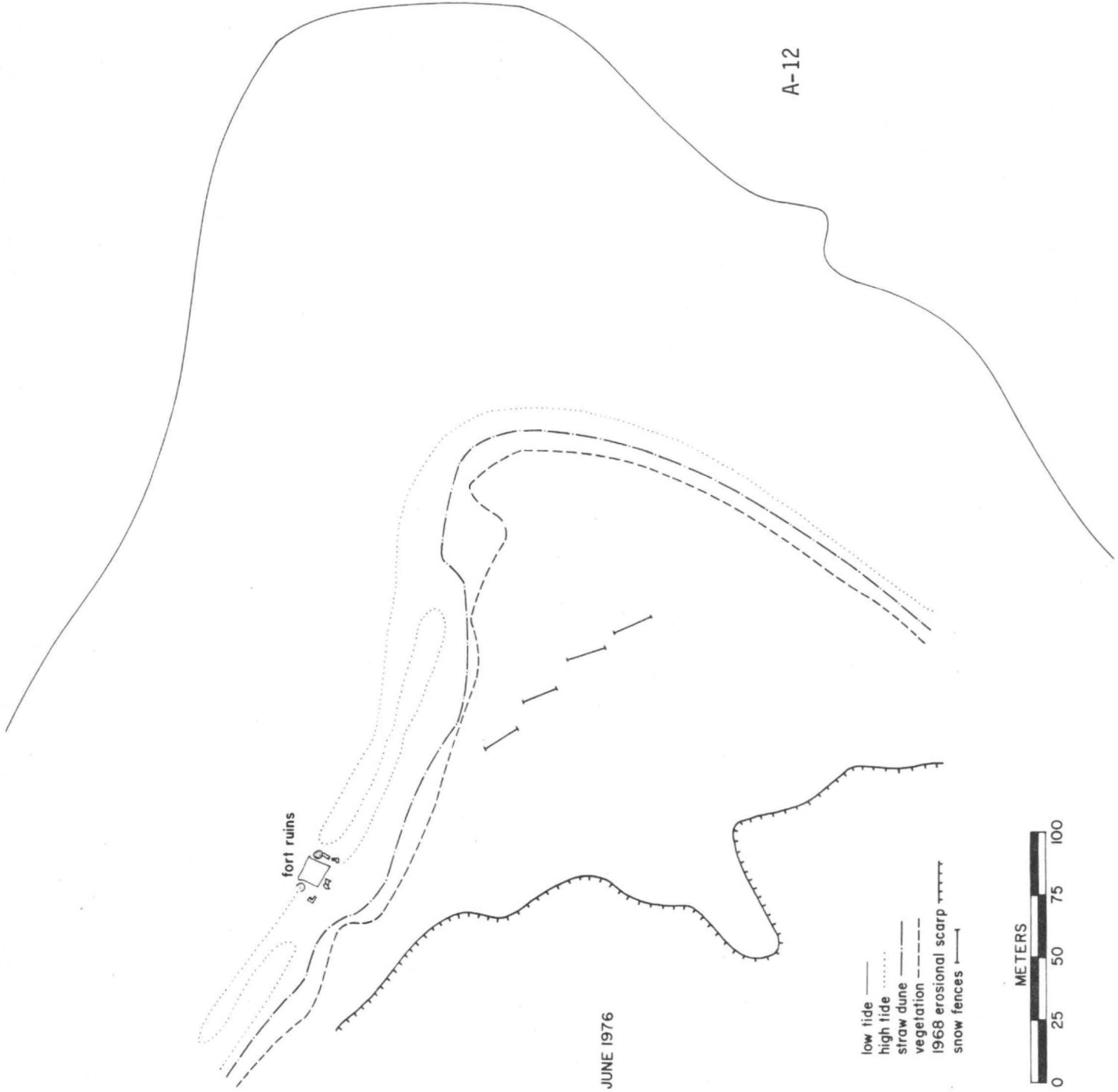
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- high tide ·····
- straw dune ———
- vegetation - - - - -
- 1968 erosional scarp - - - - -
- snow fences ———



A-11



A-12



fort ruins

- low tide ———
- high tide ·····
- straw dune - - - -
- vegetation ———
- 1968 erosional scarp - - - -
- snow fences ———

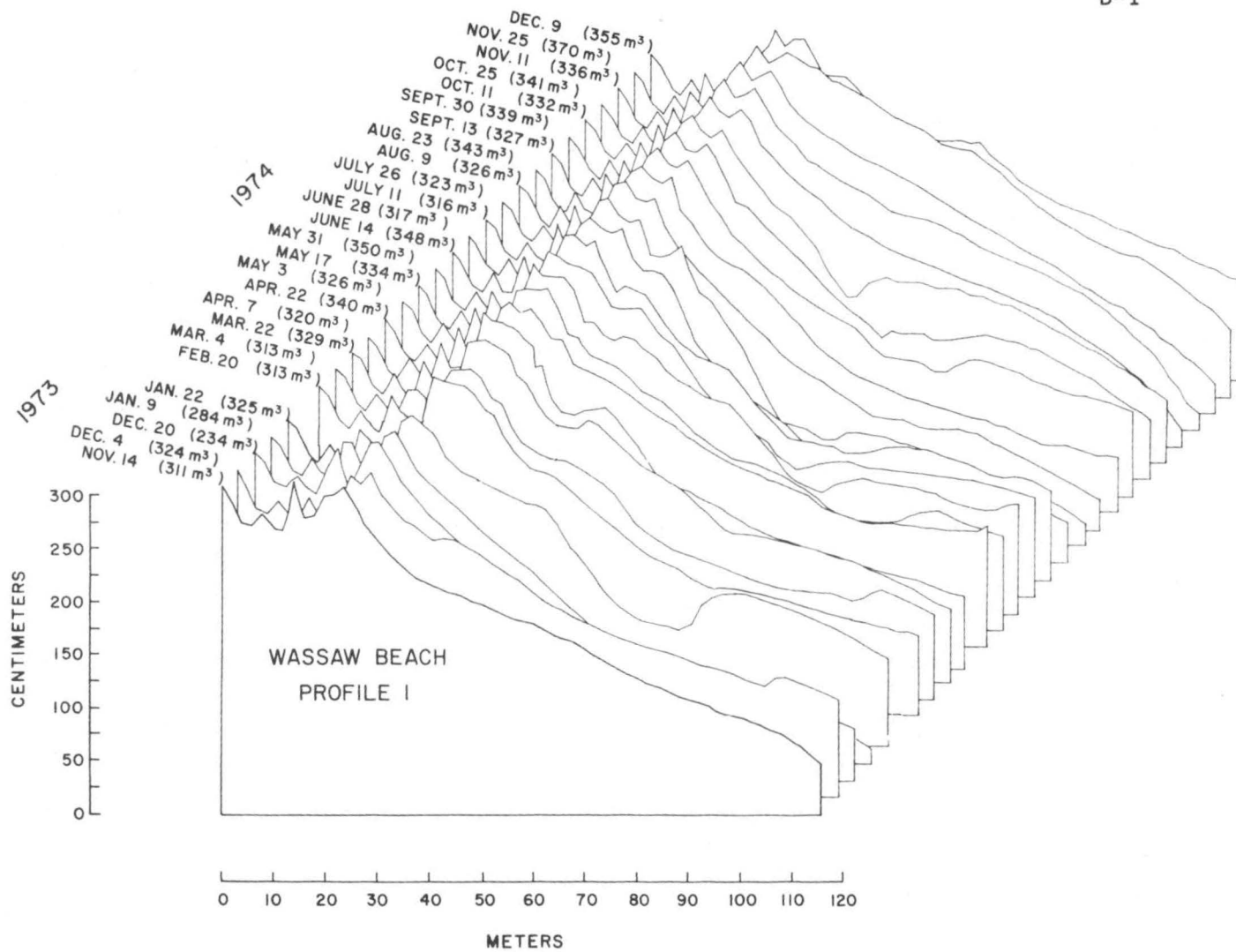
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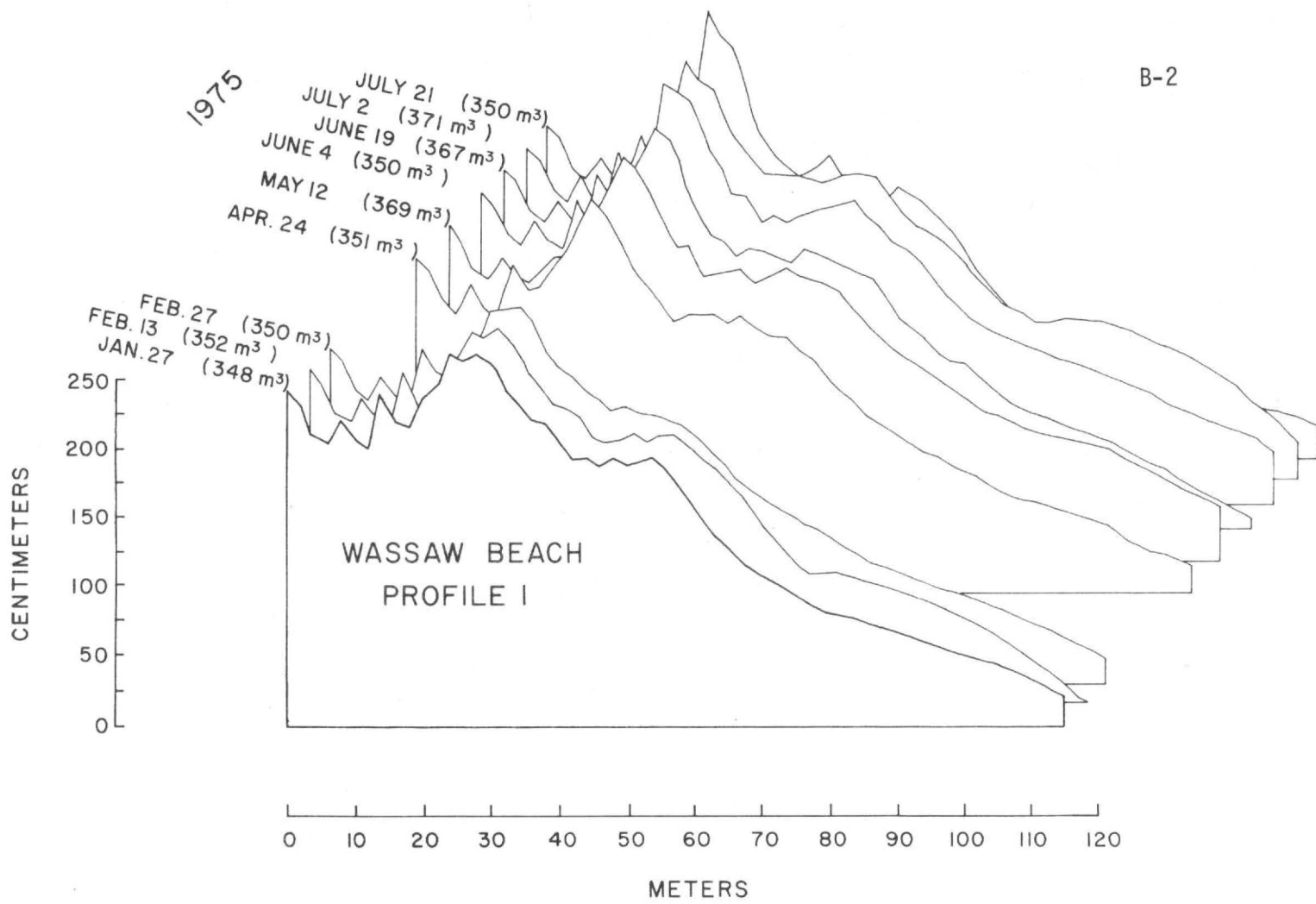
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APPENDIX B

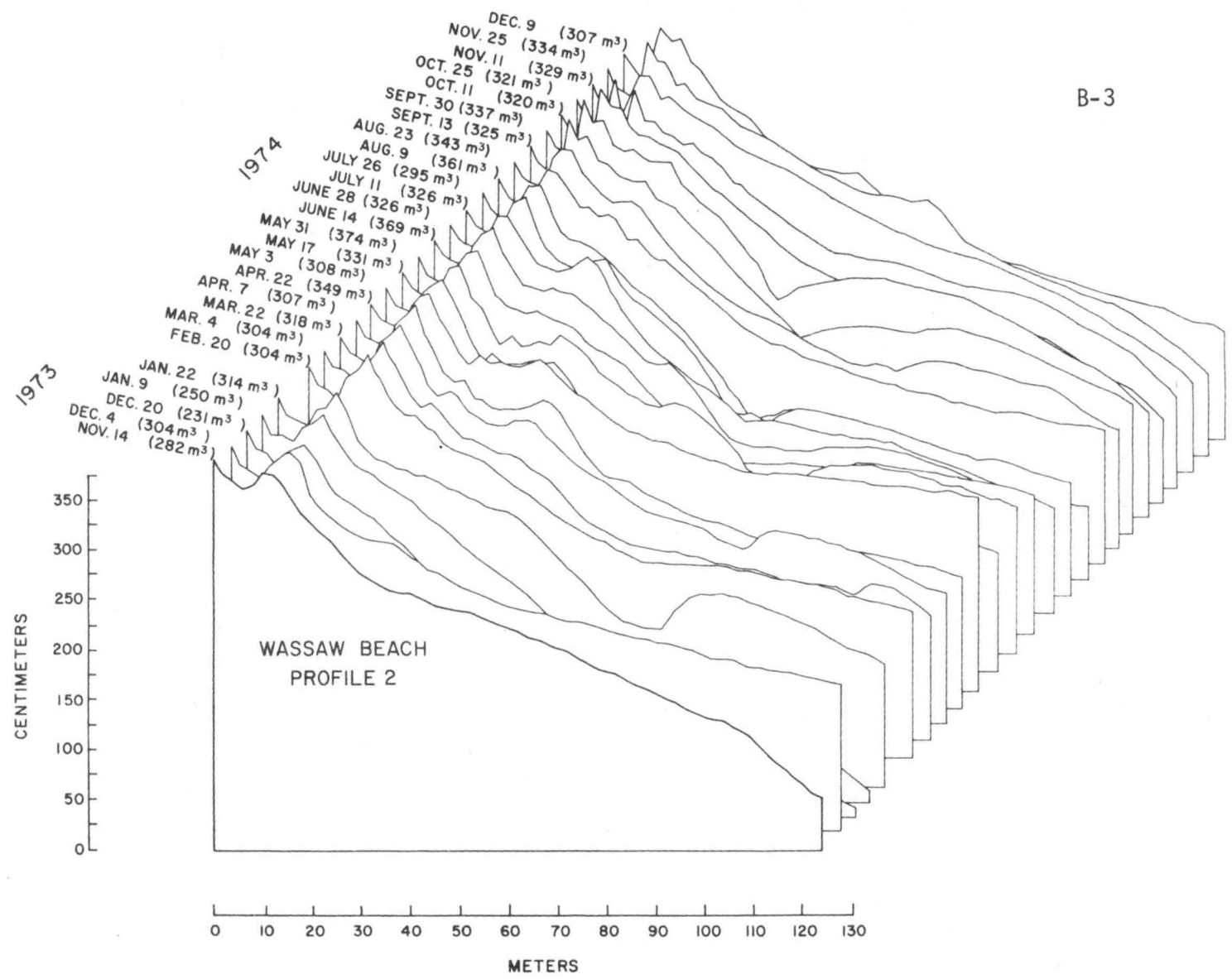
WASSAW BEACH PROFILE DATS

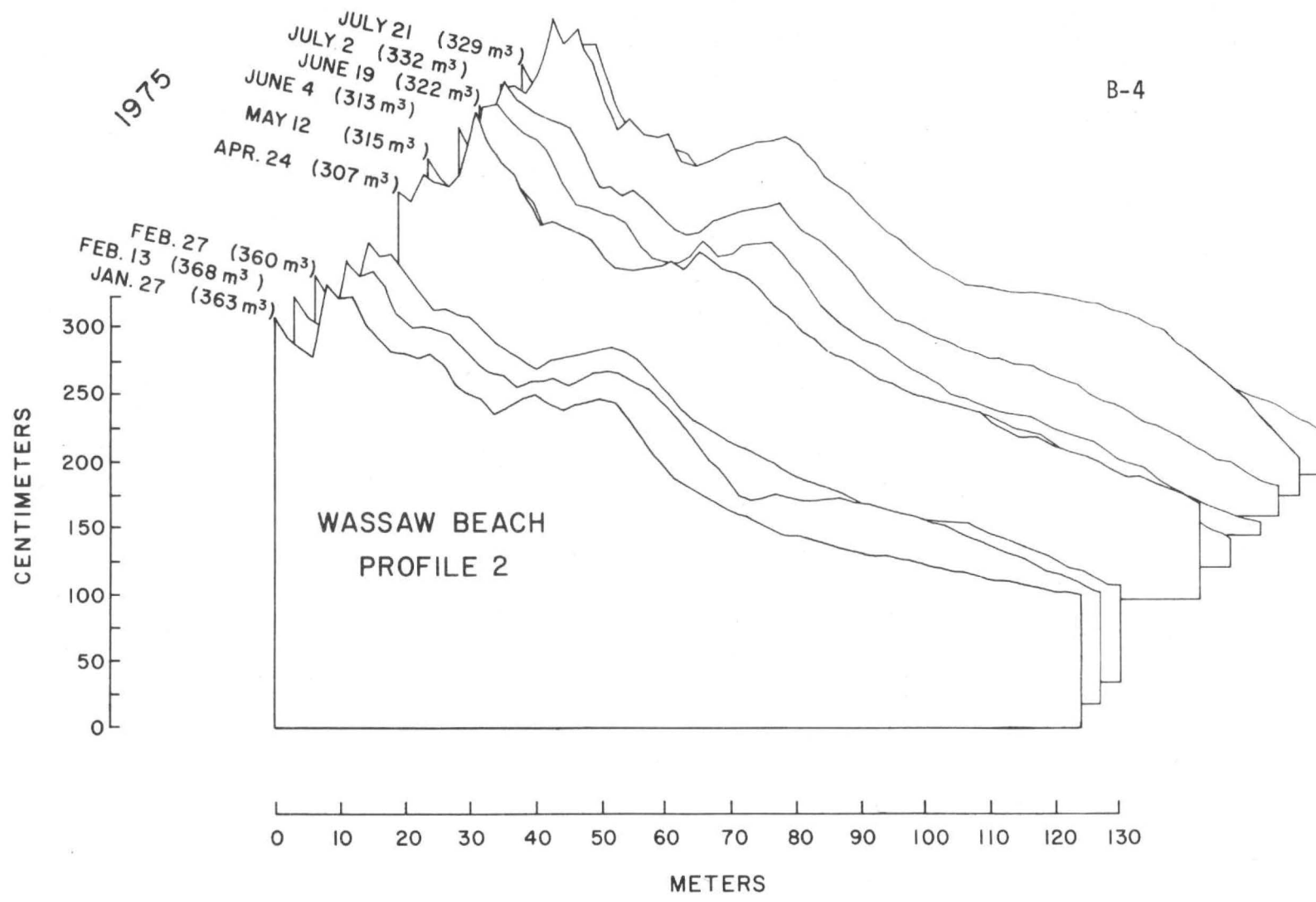
- B-1 Profile 1, 1973-1974
- B-2 Profile 1, 1975
- B-3 Profile 2, 1973-1974
- B-4 Profile 2, 1975
- B-5 Profile 3, 1973-1974
- B-6 Profile 3, 1975
- B-7 Profile 4, 1973-1974
- B-8 Profile 4, 1975
- B-9 Profile 5, 1973-1974
- B-10 Profile 5, 1975
- B-11 Profile 6, 1973-1974
- B-12 Profile 6, 1975
- B-13 Profile Volumes 1-6, December 1973-June 1975
- B-14 Beach Section Volumes, November 1973-July 1975



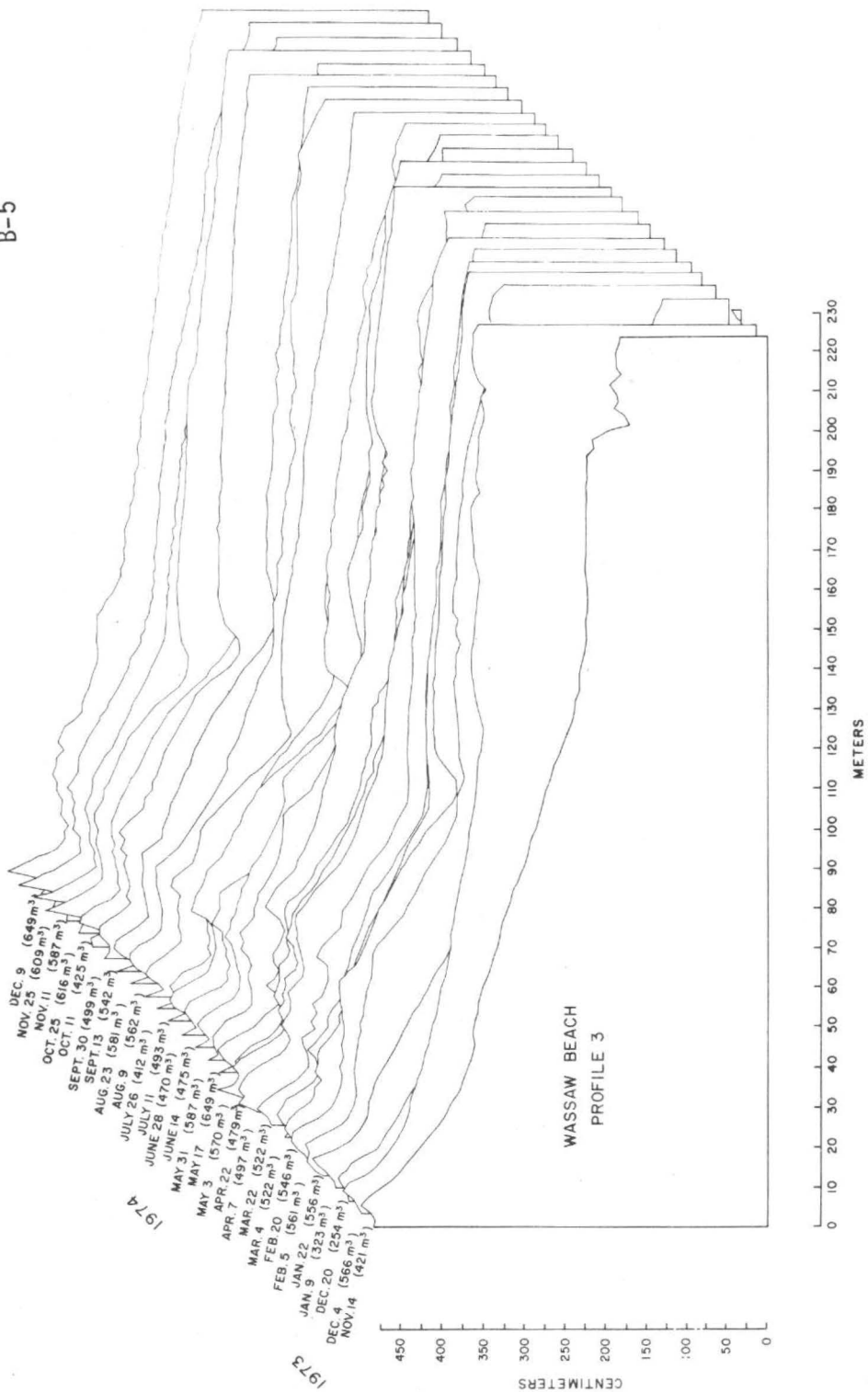


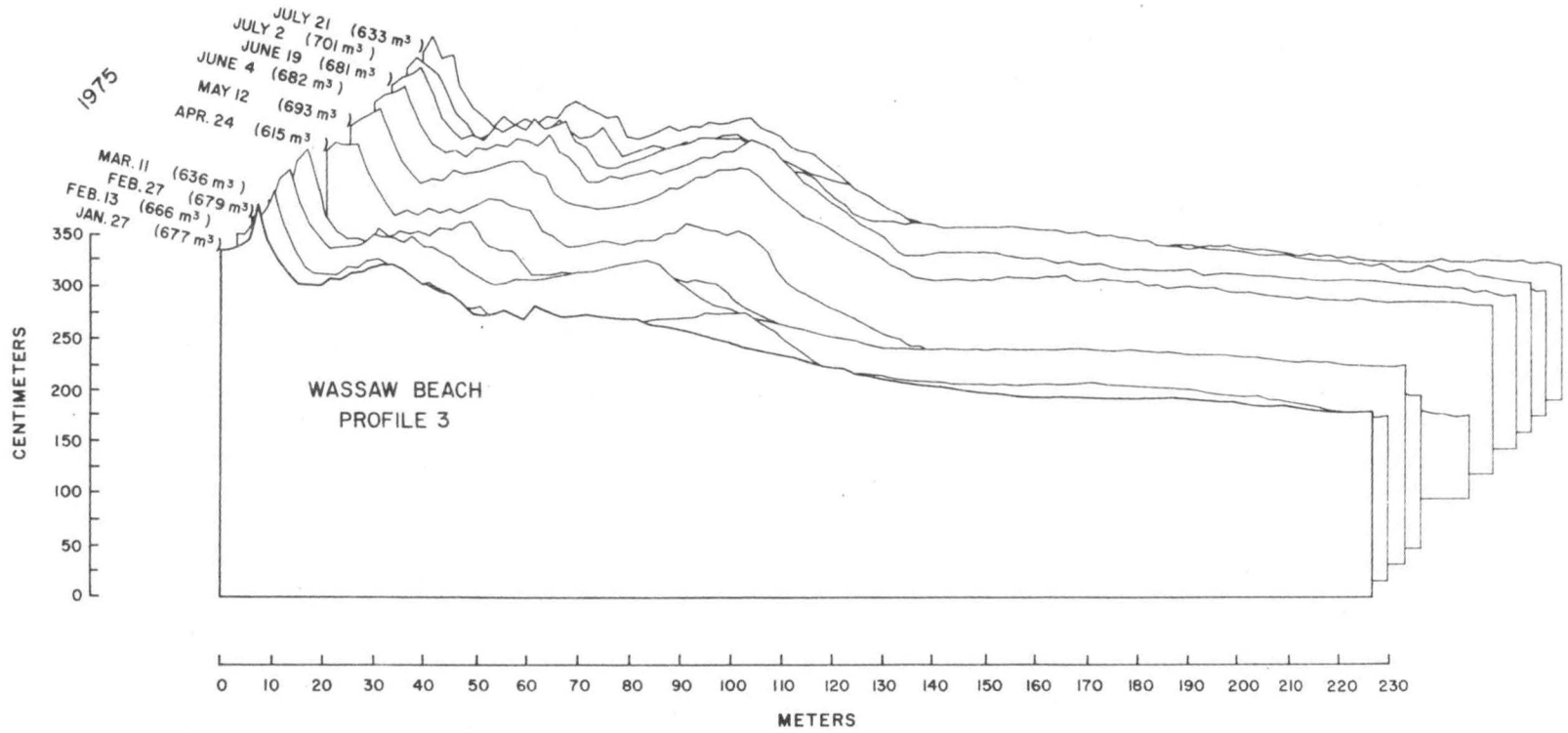
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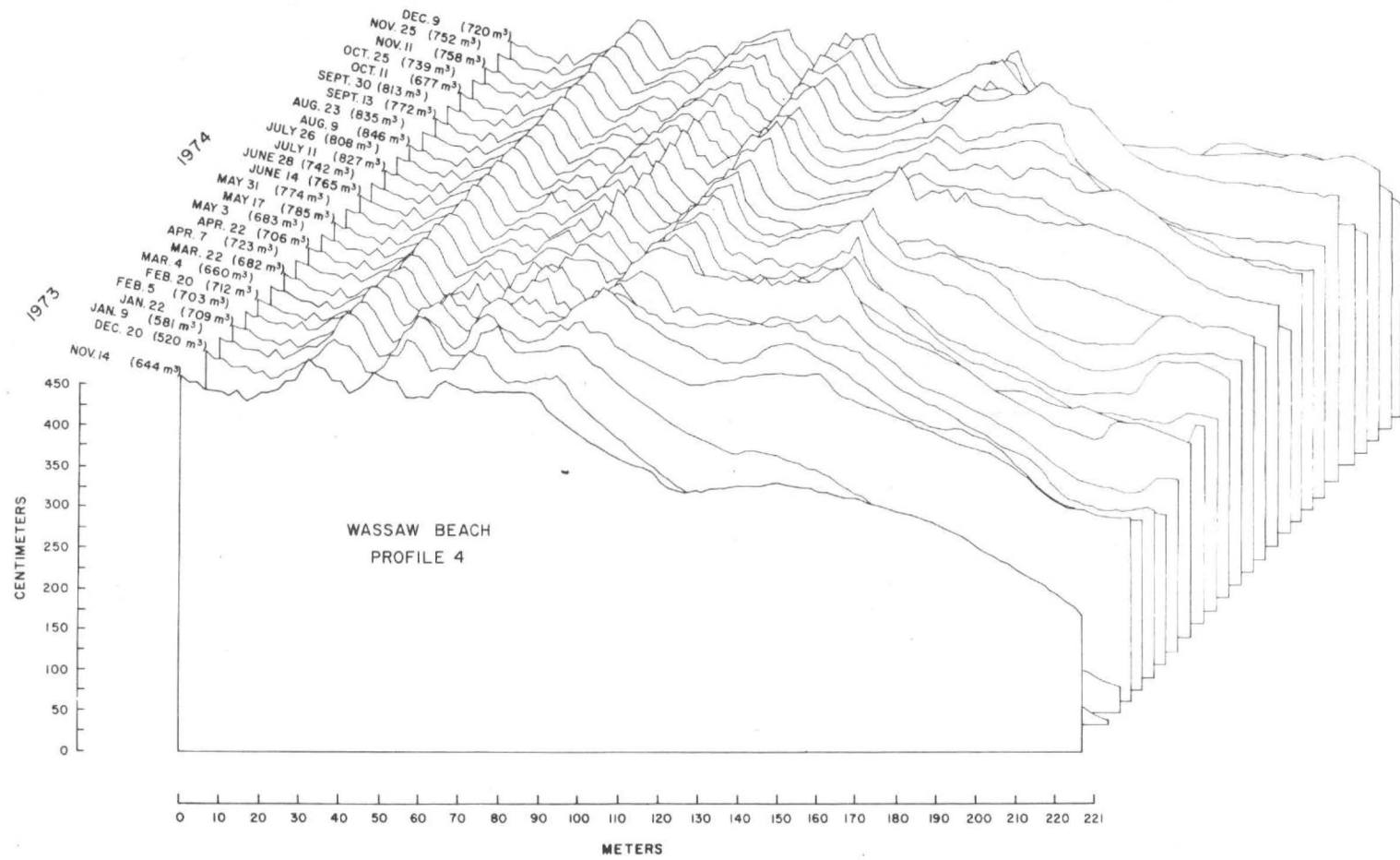


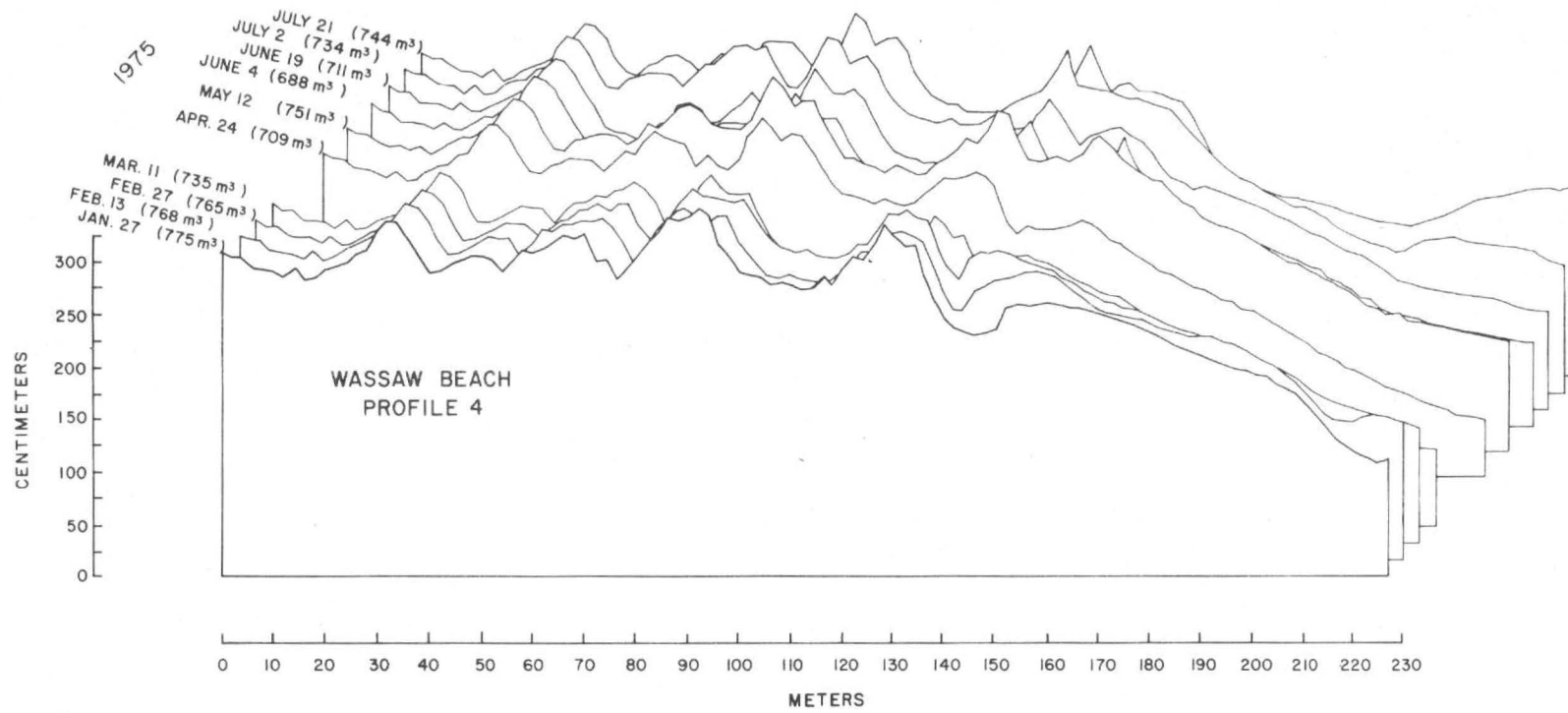


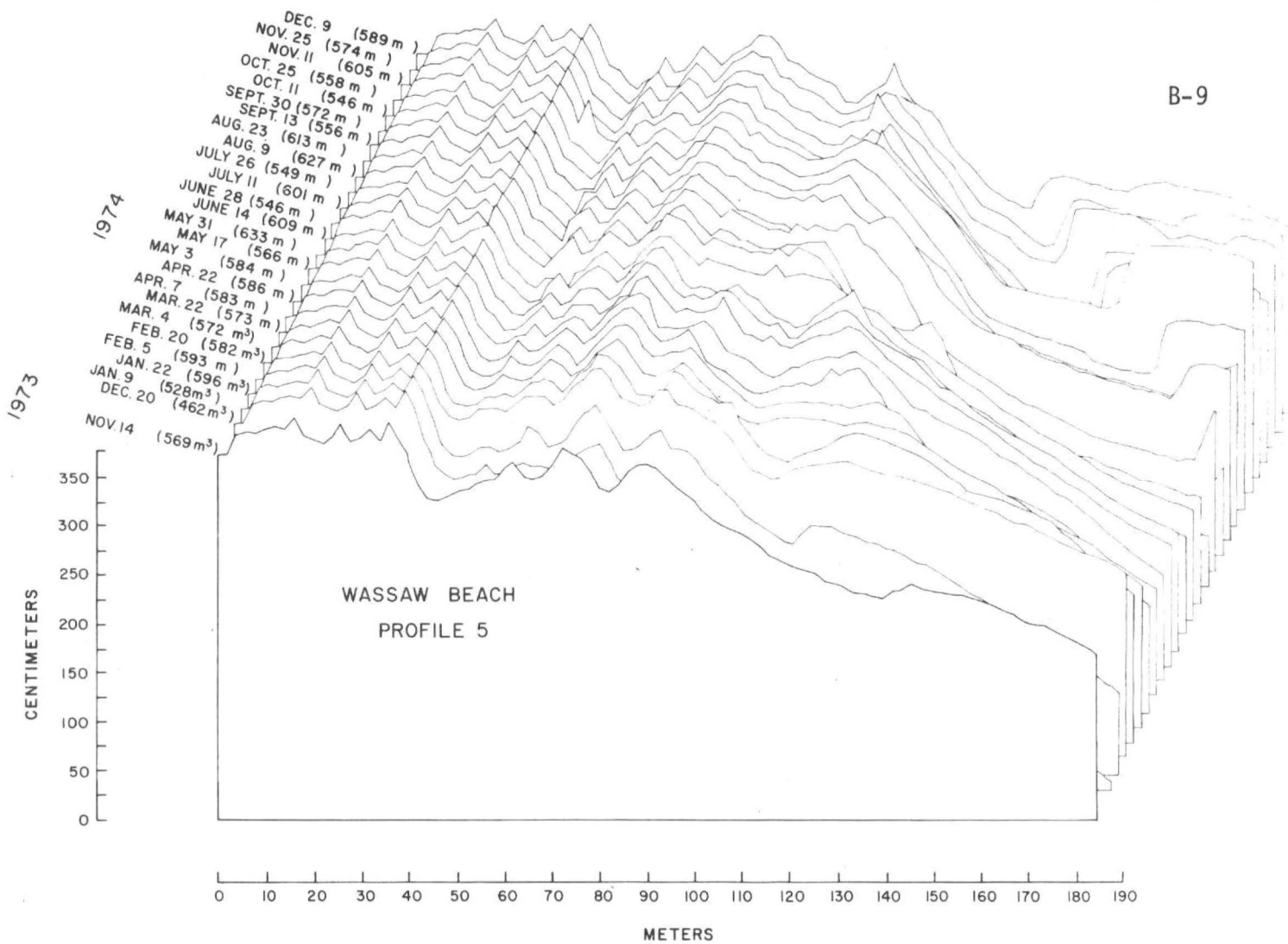
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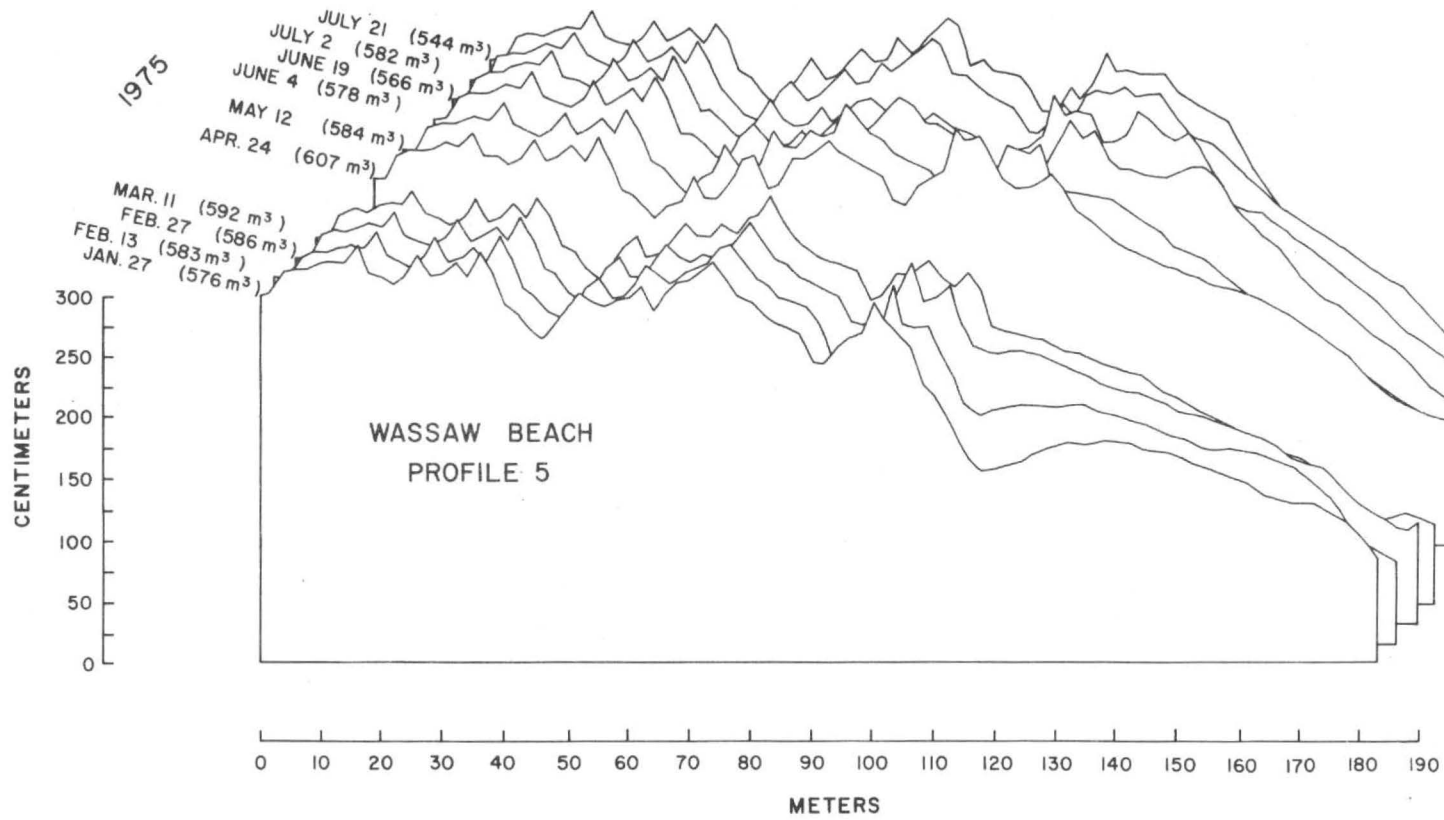




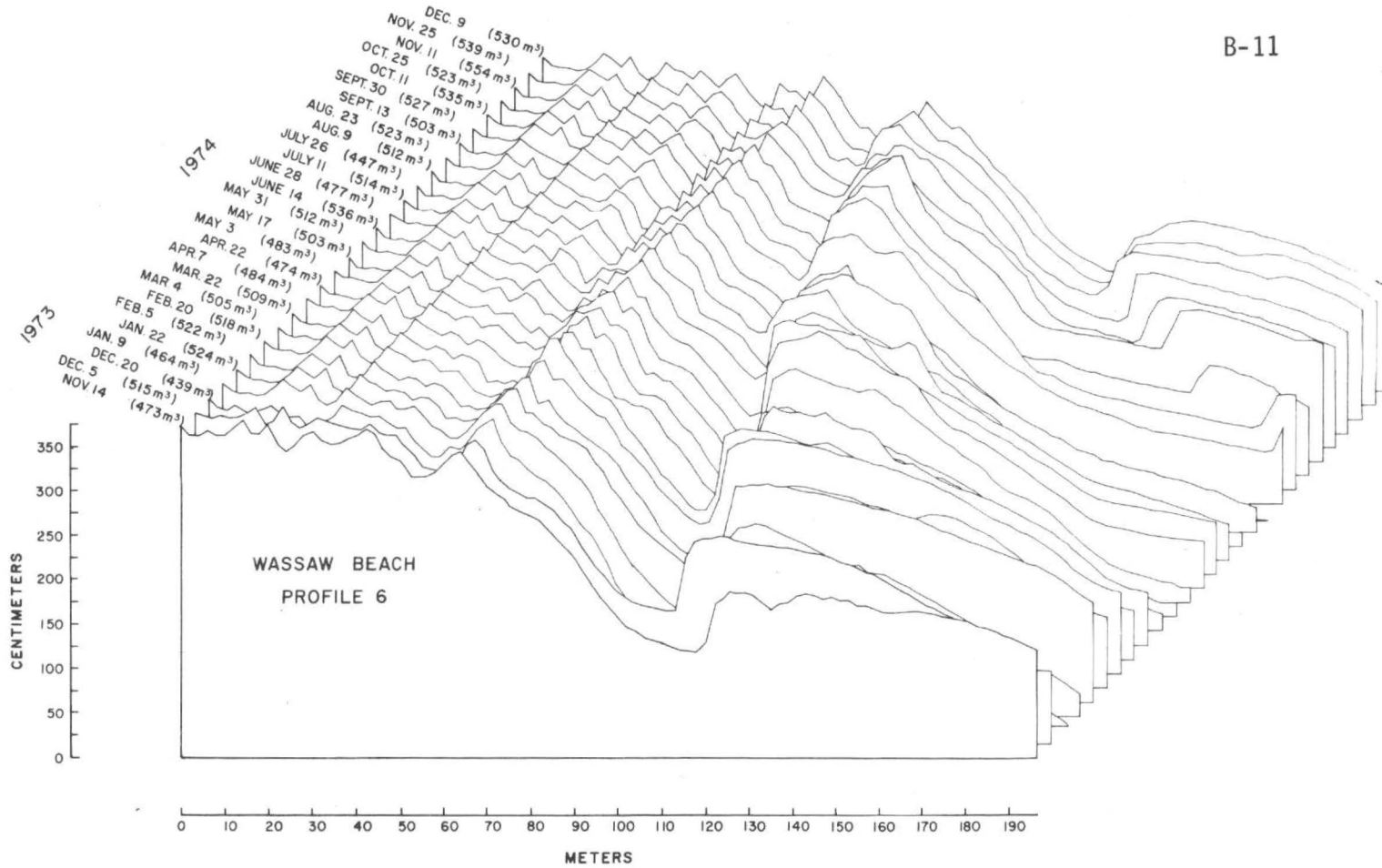


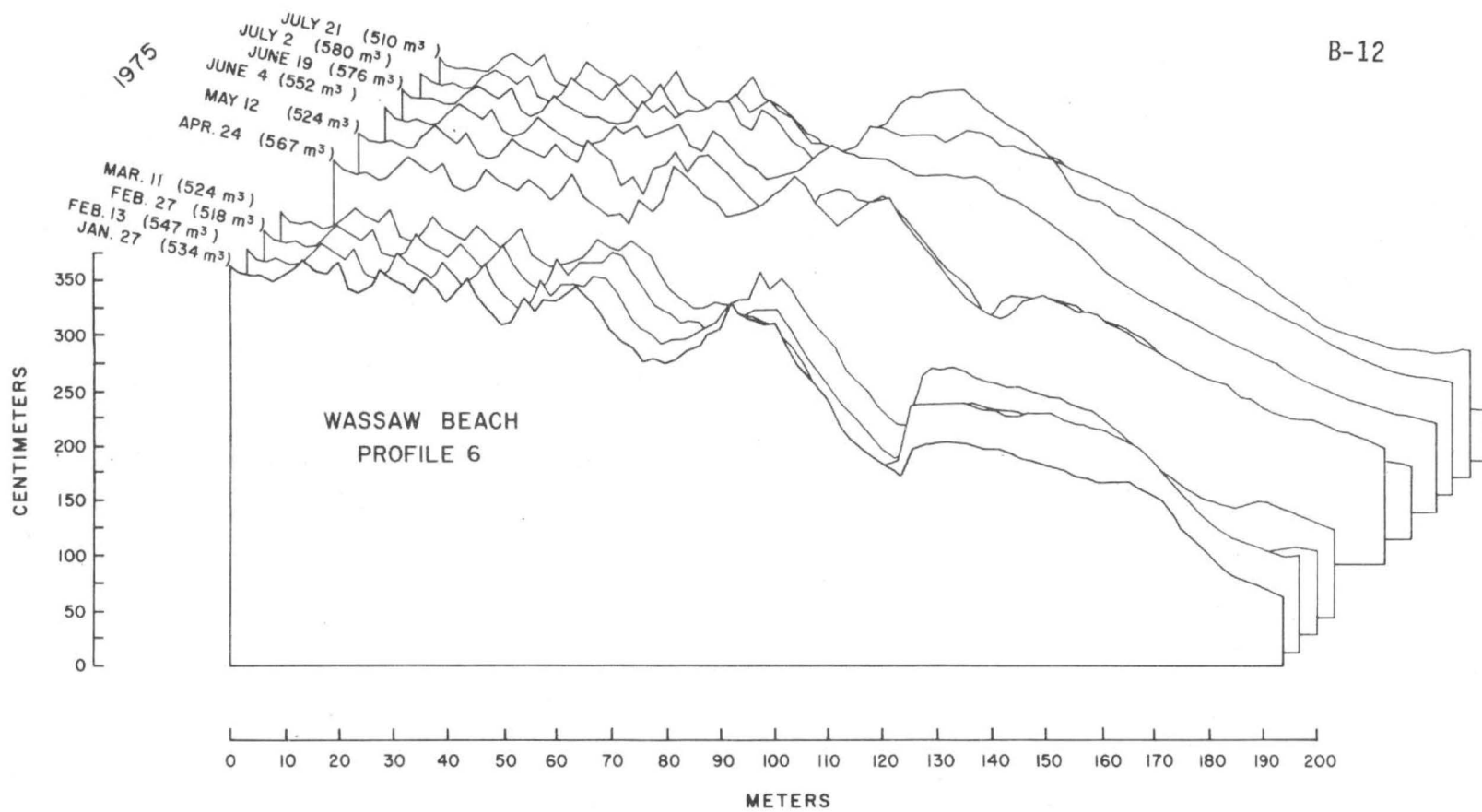


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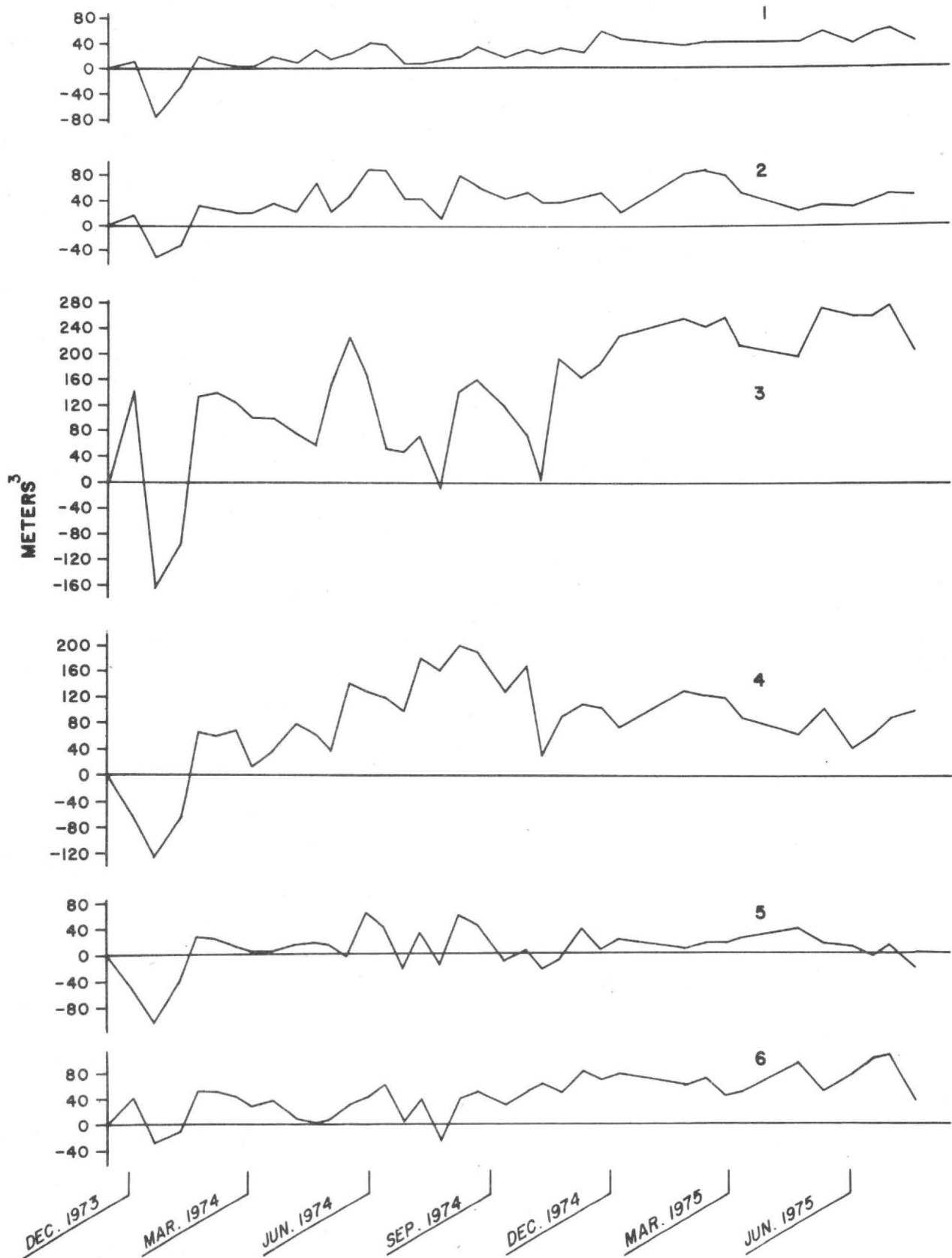
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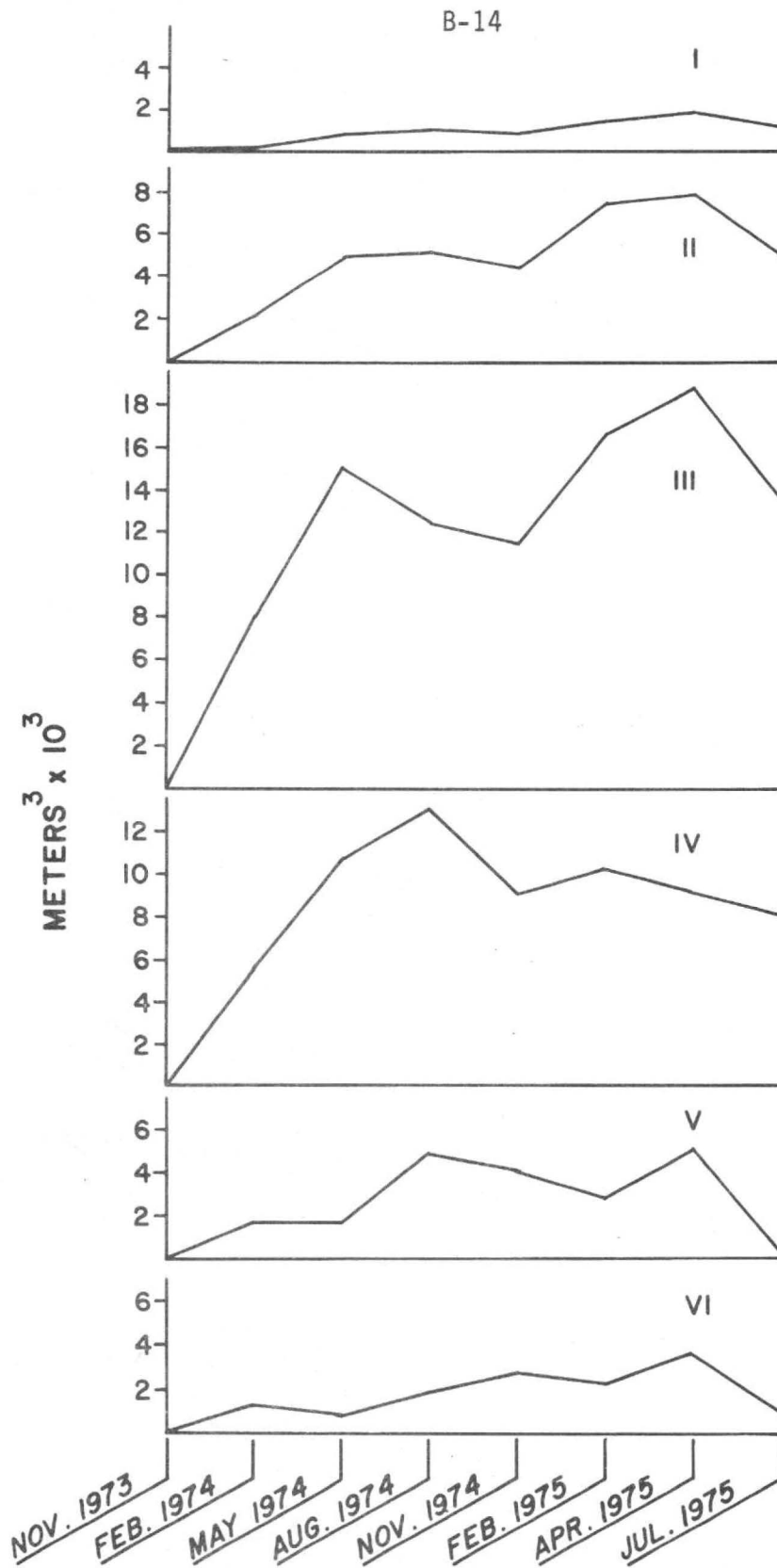


PROFILE VOLUMES

B-13

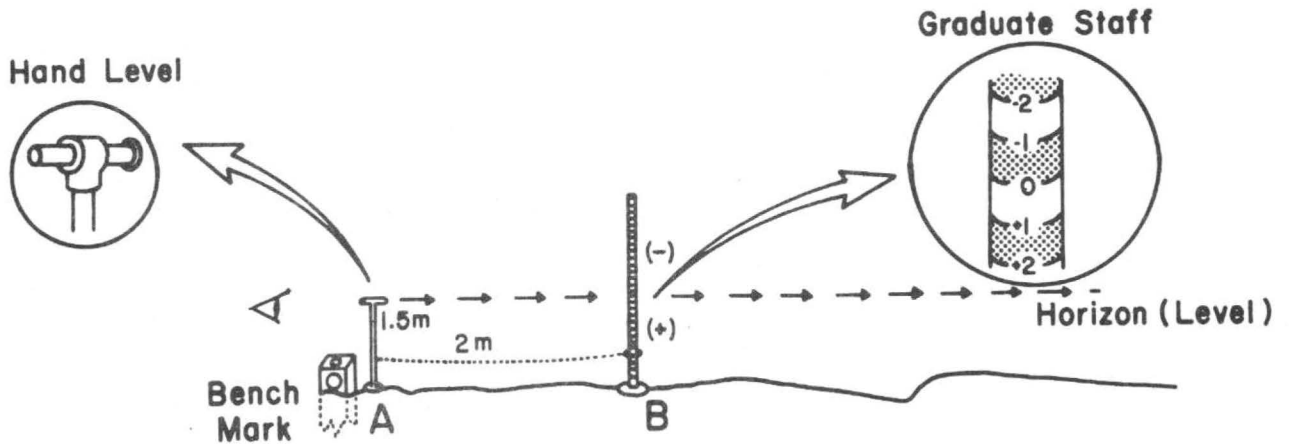


SECTION VOLUMES



APPENDIX C

MODIFIED STAFF AND HORIZON TECHNIQUE FOR PROFILING



EQUIPMENT:

Hand Level

1.5m staff for hand level, with 2m light weight chain with loop on the end.

2.5m staff graduated in 1cm intervals, with zero located at 1.5m from base.

FIELD PROCEDURE:

Profiling is done normal to the trend of the beach.

The elevation of the sand surface with reference to a stable marker (i.e., sea wall, bench mark, curb, etc.) is measured with the graduated staff. The hand level staff (A) is set up on that sand surface with the hand level viewing offshore. The graduated staff is moved seaward until the 2m chain is taut and level. The graduated staff is held directly upright and viewed with the hand level. When the center line on the hand level is super-imposed on the horizon, the the number on the graduated staff is recorded. If the horizon is poor, then the bubble in the hand level can be used for leveling.

Positive readings are located below the zero point and negative number above. After the number is recorded the hand level staff is moved forward to the position of the graduated staff and the procedure is repeated. We have found that a small tape recorder is two to three times more rapid than the pencil and paper recording method.

GRAPHIC PROCEDURE:

Plotting the data is done by establishing the marker on graph paper and plotting the sand surface from the initial measurement from the graduated staff. Each successive point is measured from the prior point and not the original marker.

Acknowledgement: This three-part study was supported partially with funds from the National Sea Grant Program (U. S. Department of Commerce, Grant Number 04-5-158-4).