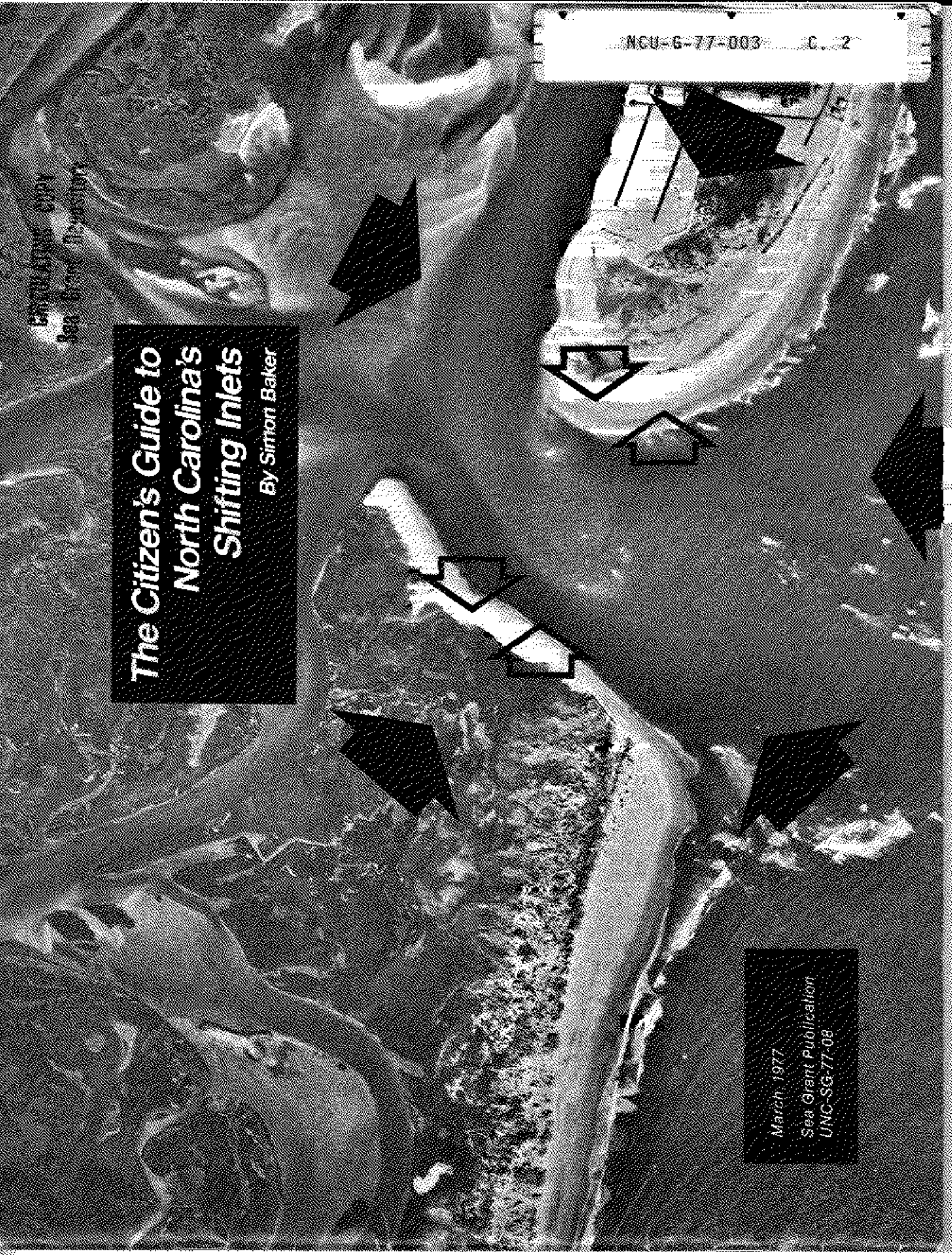


The Citizen's Guide to North Carolina's Shifting Inlets

By Simon Baker

March, 1977
Sea Grant Publication
UNC-SG-77-08



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Center for Urban Affairs and Community Services
Sea Grant Advisory Services*

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Center for Urban Affairs and
Community Services
Information Report No. 2

Acknowledgements

The preparation of this publication would not have been possible without the cooperation and assistance of two members of the North Carolina State University faculty. The first is Professor Jay Langfelder who made available the collection of historical aerial photography of coastal North Carolina held by the Center for Marine and Coastal Studies of North Carolina State University. He also provided the map of coastal inlets which had previously been used in the January 1974 publication of The Center for Marine and Coastal Studies entitled *A Historical Review of Some of North Carolina's Coastal Inlets*. Readers desiring a more detailed analysis of inlet migration dating back, in many instances, to 1938 should consult this publication.

The second faculty member to whom I am indebted is Professor Joe Lamm of the Department of Forestry. He very kindly made the department's Zoom Transfer Scope available to me for a period of two weeks. The preparation of inlets would not have been so easily accomplished without the use of this instrument.

My sincere thanks go to both these colleagues and the members of their staffs who also assisted me.

Design by: K. Jurgensen

This work was sponsored by the Office of Sea Grant, NOAA, U.S. Dept. of Commerce under Grant No. 04-6-158-44054, and the State of North Carolina Dept. of Administration. The U.S. Government is authorized to produce and distribute reprints for any governmental purposes notwithstanding any copyright that may appear hereon.

Introduction

From the Virginia line in the north to the South Carolina line in the south, a chain of narrow barrier islands forms North Carolina's Atlantic Ocean coastline. These islands extend about 304 miles and vary in their distances offshore from the mainland portion of the state.

The segment north of Bogue Inlet stands farther offshore than that to the south and goes by the name "Outer Banks." Behind these northern barrier islands lie the sheltered waters of the Bogue, Core, Pamlico and Albemarle Sounds. Rivers from the mainland flow into the sounds and eventually reach the Atlantic through a series of breaks or inlets in the barrier island chain. The southern barrier islands practically adjoin the mainland, and they are broken in many places by inlets which allow streams to drain the coastal plain lowlands.

Altogether, there are presently some 22 active and open inlets in the entire barrier island system. The number and locations of these inlets have not always been the same in the recent or distant past, nor are they likely to be the same

in the future. The barrier islands themselves and the inlets in particular are subject to a variety of natural forces. Wind, waves, currents and periodic high energy storms move the sands of barrier islands to change their shapes and to open and close inlets.

When the barrier islands were sparsely populated, changes in the configuration of their beaches and inlets were of little account. The earliest settlers from the colonial period onward developed a healthy respect for the dynamic environment of the barrier islands.

However, with the passage of time and particularly in the twentieth century, the growing permanent and seasonal populations of these islands have built larger and more permanent structures. In some instances such construction has occurred in the vicinity of inlets or on sites of former inlets.

Now, when physical change takes place on the islands, there is often a threat to life and property. As population grows there is a tendency to occupy all available land on the barrier islands. Pressure will grow to use the land in the vicinity of inlets in a fashion unsuited to such dynamic environments.

Not only are private cottage or motel builders in danger of suffering monetary loss, but taxpayers whose money is used to build roads or water supply systems in these locations may also have to foot part of the bill. They will pay because of a lack of knowledge of inlets on the part of public officials or because of wishful thinking on everyone's part about how land on the barrier islands can and should be used.

Purpose of Study

Geologists and engineers have done technical studies on many aspects of barrier island environments, but the general public does not usually get to see or easily understand such publications. The purpose of this volume is to reach an audience of citizens who do not have a scientific or engineering background. Most people believe and understand evidence they can see, and much has been said of the comparative force of communication by picture over that by words.

The writer believes that it is impor-

Aerial Photography to Illustrate Change

Transportation and printed at a scale of 1:12,000 or 1" = 1,000'. This scale was particularly appropriate for working with the older smaller scale photographs on the photogrammetric instrument used to plot the inlet boundaries. It was felt that 1974 photography was recent enough so that any person visiting an inlet could orient himself by locating features seen on the ground with those portrayed in the photograph.

The next step was to obtain older aerial photographs of the various inlets. In this, the project was greatly aided by having made available to it the collection of old coastal aerial photographs held by the Center for Marine and Coastal Studies of North Carolina State University.

There were, in fact, more photographs available than could be used for most of the inlets. A decision was made to select photographs showing any given inlet at two times within the 25-year period prior to 1974. This is probably a time span well within the lives of many of the readers of this publication and should not be interpreted as "ancient history."

Because of the varying times the photographs were made, there is no

An aerial photograph is an impartial record of all elements of a scene visible at the time the film is exposed. Any photograph may be full of information which the layman cannot extract. It was felt, however, that most people could see and distinguish between land and water and identify inlets without special training.

The problem was to accurately show on recent photographs where each inlet was located in the past. Here again, the best source of information was felt to be older aerial photographs of inlets. It was necessary to acquire older photographs and then to transfer the information to recent aerial photographs to be used as bases showing each inlet. The details of how this was done are described in Appendix A, and the various aerial photographs used to prepare the plates are listed in Appendix B.

The base photography or recent images showing each inlet in the following plates was made in December 1974 by the North Carolina Department of

tant for coastal people and taxpayers throughout the state to know about the nature of our barrier islands. In particular, the dynamic and changing environments of coastal inlets should be understood by future property owner and taxpayer alike. How better to understand what the future may bring than to see what has occurred in the past?

The writer set about preparing a graphic study sampling what has happened to barrier island inlets within the lifetimes of most of the readers of this publication. This study does not tell the whole detailed story of all the inlets of the North Carolina coast; it may, in fact, be impossible to do such a thing. Enough is shown of inlet behavior within the last 30 or so years, however, for non-technical or non-scientific readers to understand the true nature of inlet instability.

Those interested in a more detailed quantitative analysis of change should refer to *A Historical Review of Some of North Carolina's Coastal Inlets*, Report No. 74-1, by Langfelder, French, McDonald, and Ledbetter, Center for Marine and Coastal Studies, North Carolina State University, January 1974.

uniformity of dates showing former locations of inlets. The solid and dashed lines, then, represent inlet boundaries at two previous times. When these locations are compared with the 1974 photographs on which they are printed, it becomes very clear how dynamic and ephemeral inlets are on this coast.

The reader should be aware that all the plates are not at the same scale. In each case the base photographs were enlarged to display each inlet to best advantage, hence the variability of scale. Also, in a few instances there was either no old photography available or there was so much change between the 1874 and older photographs that alignment was impossible. For these reasons Ocracoke and Drum Inlets are not shown, and the south side of Hatteras Inlet shows no previous shore line.

Evidence of Change

On examining the plates in this book, one is forced to the conclusion that change is the rule. Of the 22 open and closed inlets portrayed, only the Cape Fear and Barden Inlets can be said to appear stable or relatively so. The west

side of Beaufort Inlet also seems to be in this category while the east side shows evidence of great change.

At the other end of the scale of change are the former New and Wrightsville Inlets now closed. In the 1974 photographs these places appear to be solid stretches of coast, but not many years ago they were inlets. The changing nature of the former New Inlet is really appreciated when we realize that the location shifted about 4,000 feet in the 11-year period illustrated.

Most of the inlets of the North Carolina coast would seem to fall between the extremes pointed out above. But even among these inlets we see evidence of shifting location in amounts ranging from hundreds to thousands of feet. The north side of Oregon Inlet is spectacular in this regard. In all cases we see evidence that land is eroded away while at the same time deposition occurs and other barrier island land is built up. This is really the basis for the idea that the physical environment of the barrier islands in general and their inlets in particular is a dynamic one.

Conclusions

Once prudent people understand that change has always occurred, is occurring, and will occur in the vicinity of inlets, they must ask themselves some questions. Would they invest their financial resources to build permanent structures close to such places? Would they risk their safety knowing that erosion may occur at a very rapid rate during hurricanes or northeast storms? Can they agree to the expenditure of tax money for the construction of public improvements in such locations?

It is not possible to predict exactly where, when, and how much change will take place in the vicinity of inlets. The wise use of our barrier island resource should have built into it an attitude of respect and understanding of the forces of nature at work here. People will continue to visit and live on the barrier islands, but their structures should be kept well back from the inlets. How this is done is a decision to be made by the people of North Carolina.

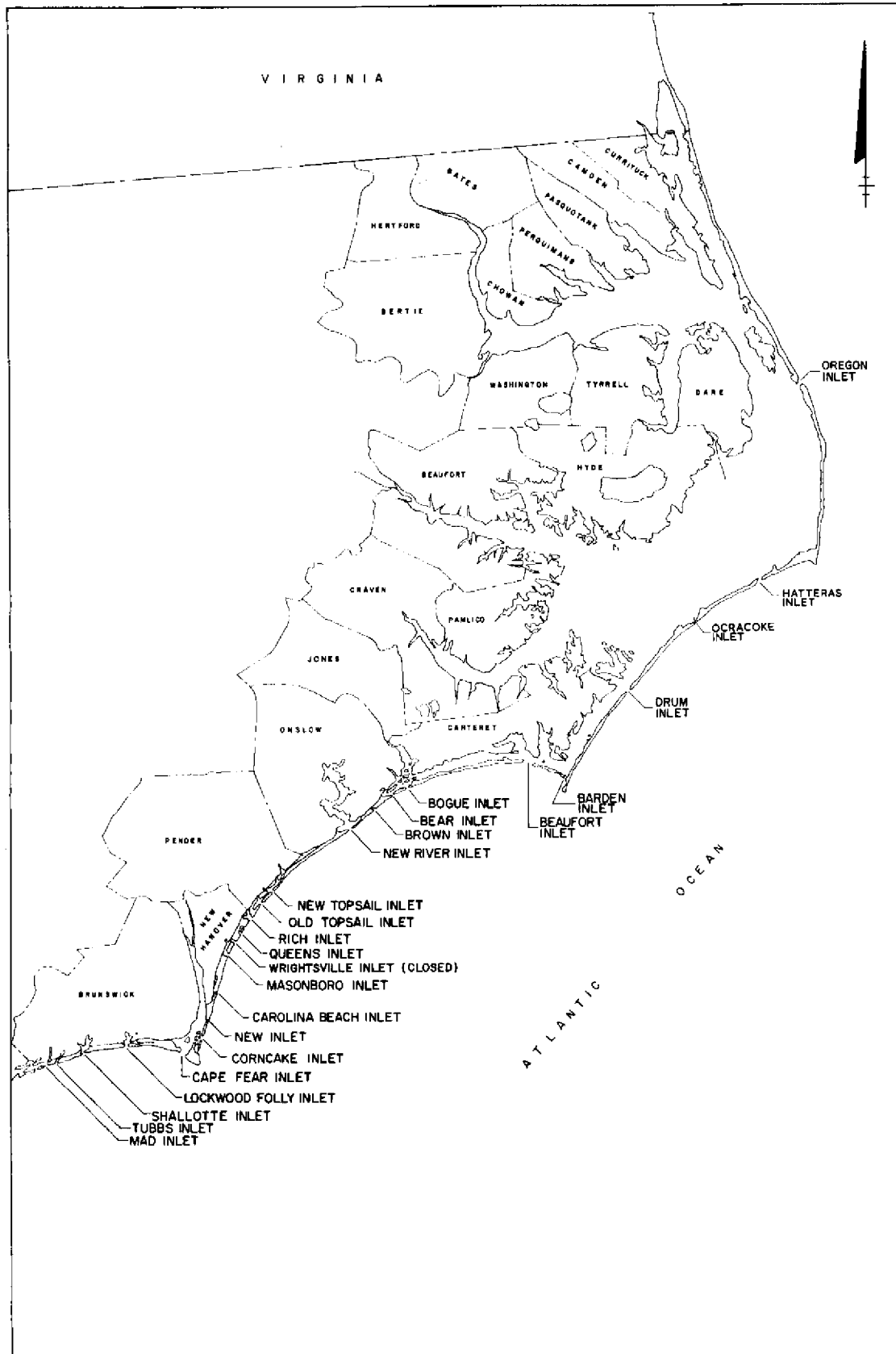


FIGURE 1. LOCATION OF NORTH CAROLINA'S INLETS



MAD INLET
1956
1961



0 5 10 15

FOOTING

FEET IN HUNDREDS

TUBBS INLET
--- 1956
— 1966



SHALLOTTE INLET

-----1956

—————1966

LOCKWOOD FOLLY INLET

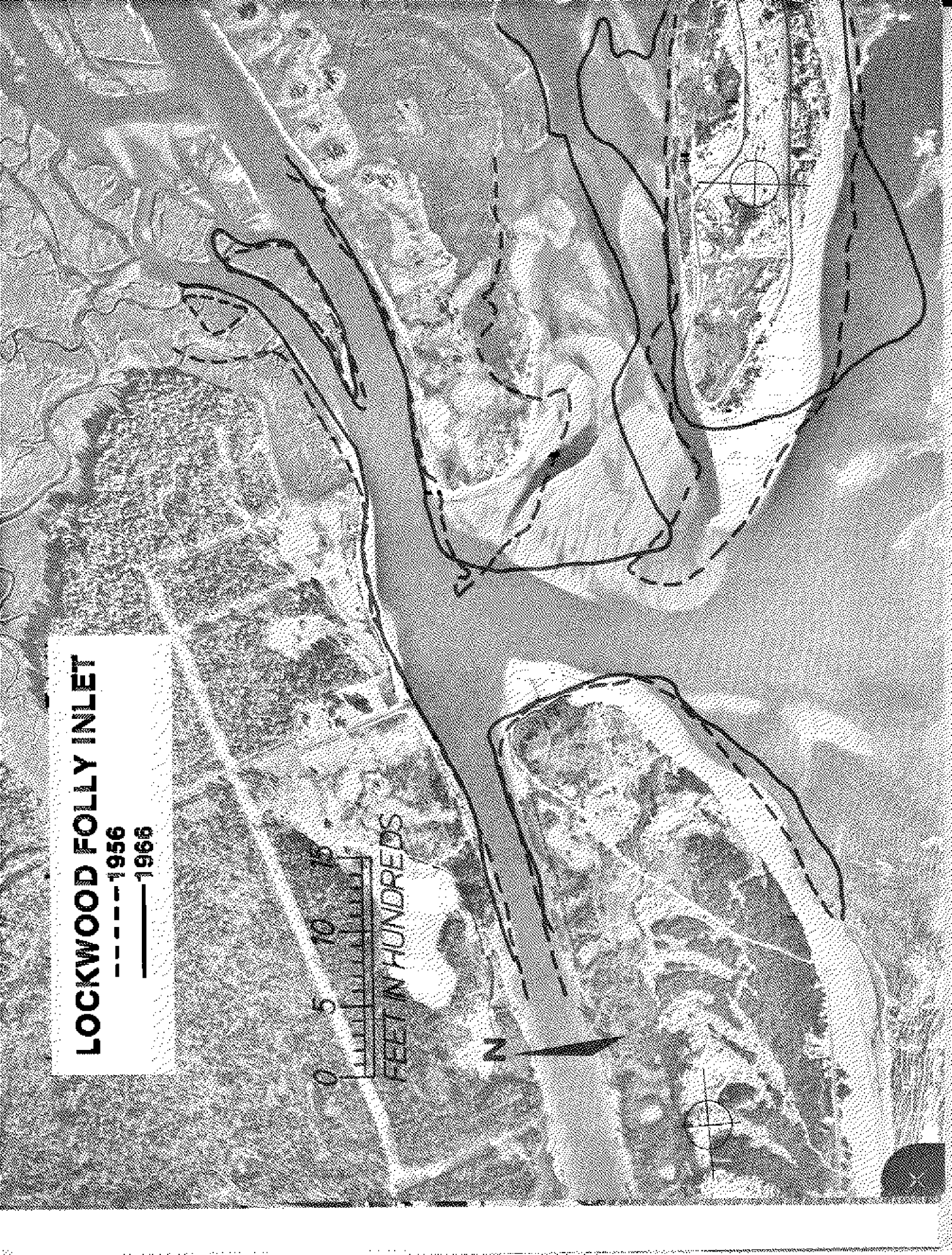
--- 1956

— 1966



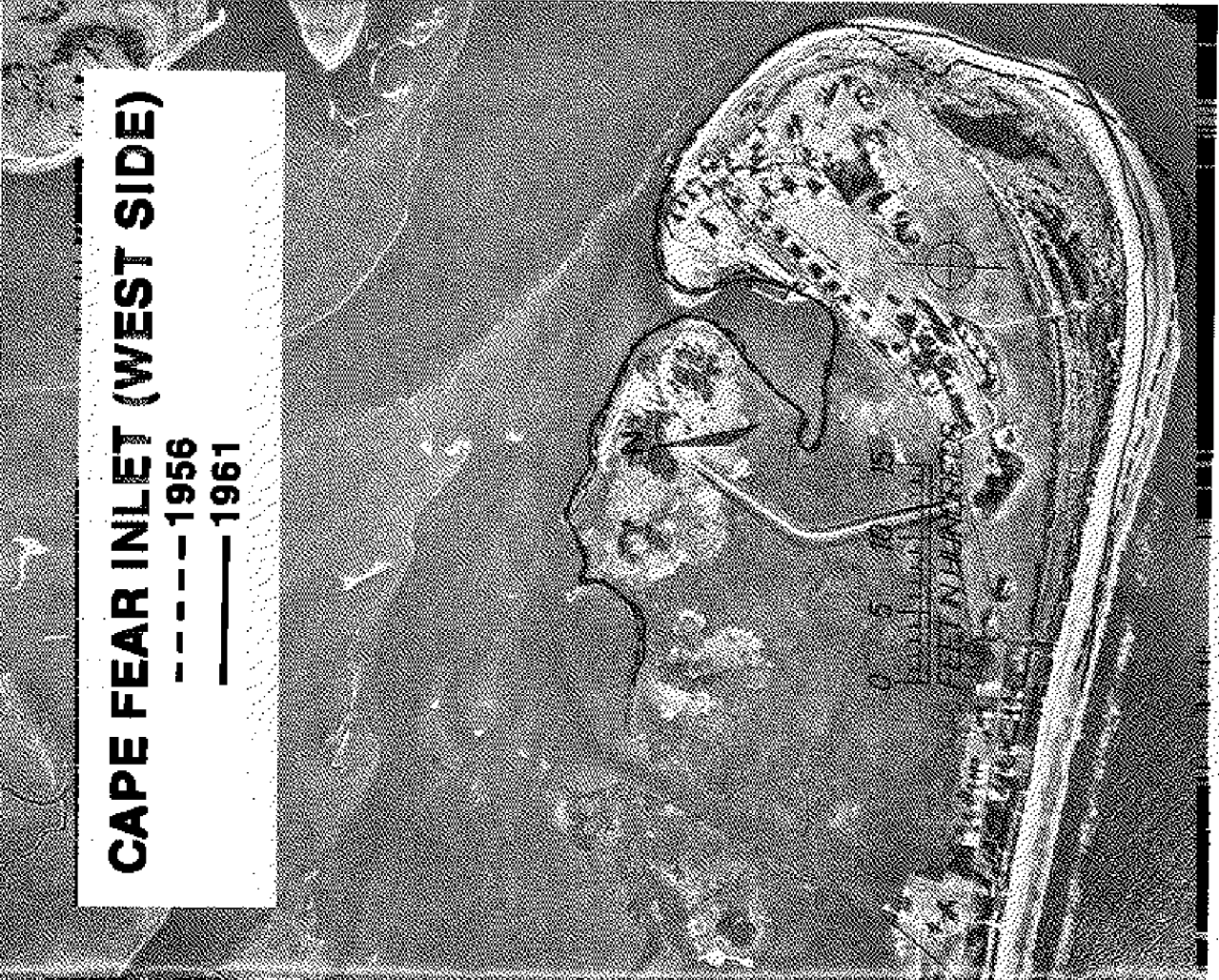
N

A north arrow pointing towards the top of the map.



CAPE FEAR INLET (WEST SIDE)

-----1956
—————1961



CAPE FEAR INLET (EAST SIDE)

-----1956
—————1961

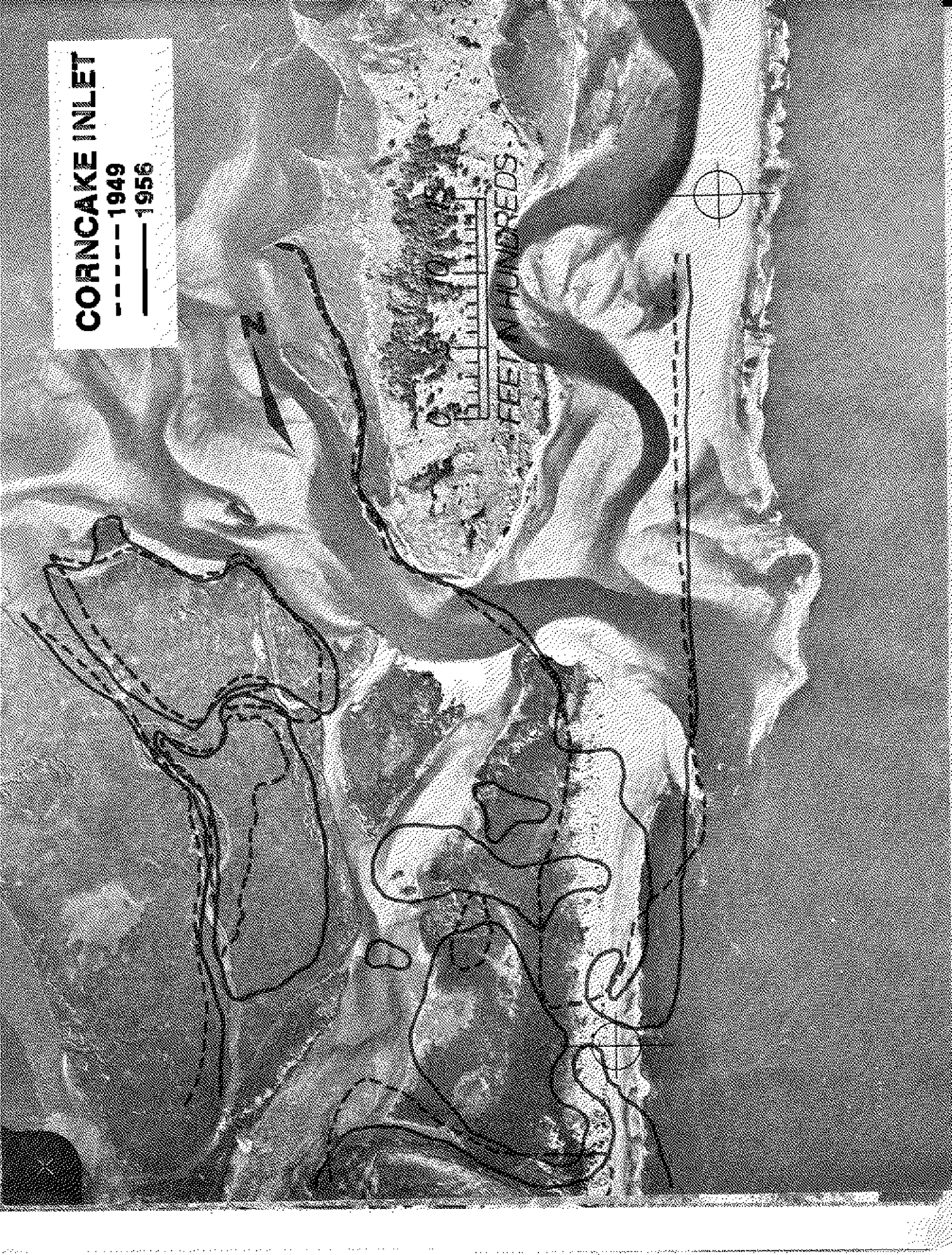


THE SIDES OF THIS WIRE ARE NOT ALIGNED AND THE DISTANCE BETWEEN THEM IS NOT ACCORDING TO SCALE. PHOTOGRAPHS HAVE BEEN THINDED TO FIT THE PAGE.

CORNSHORE INLET

----- 1949

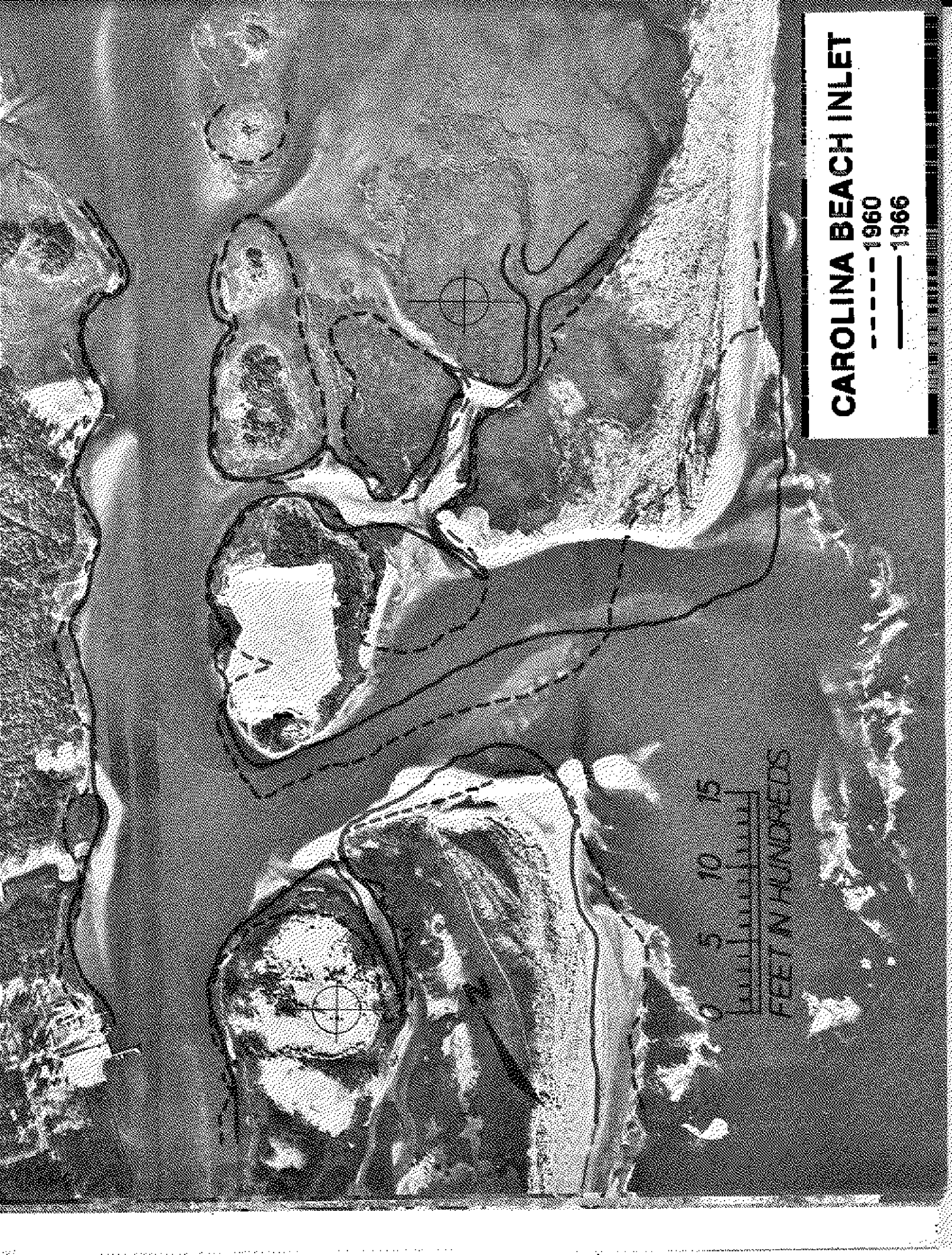
_____ 1956



0 5 10 15
FEET IN HUNDREDS



NEW INLET
1949
1960

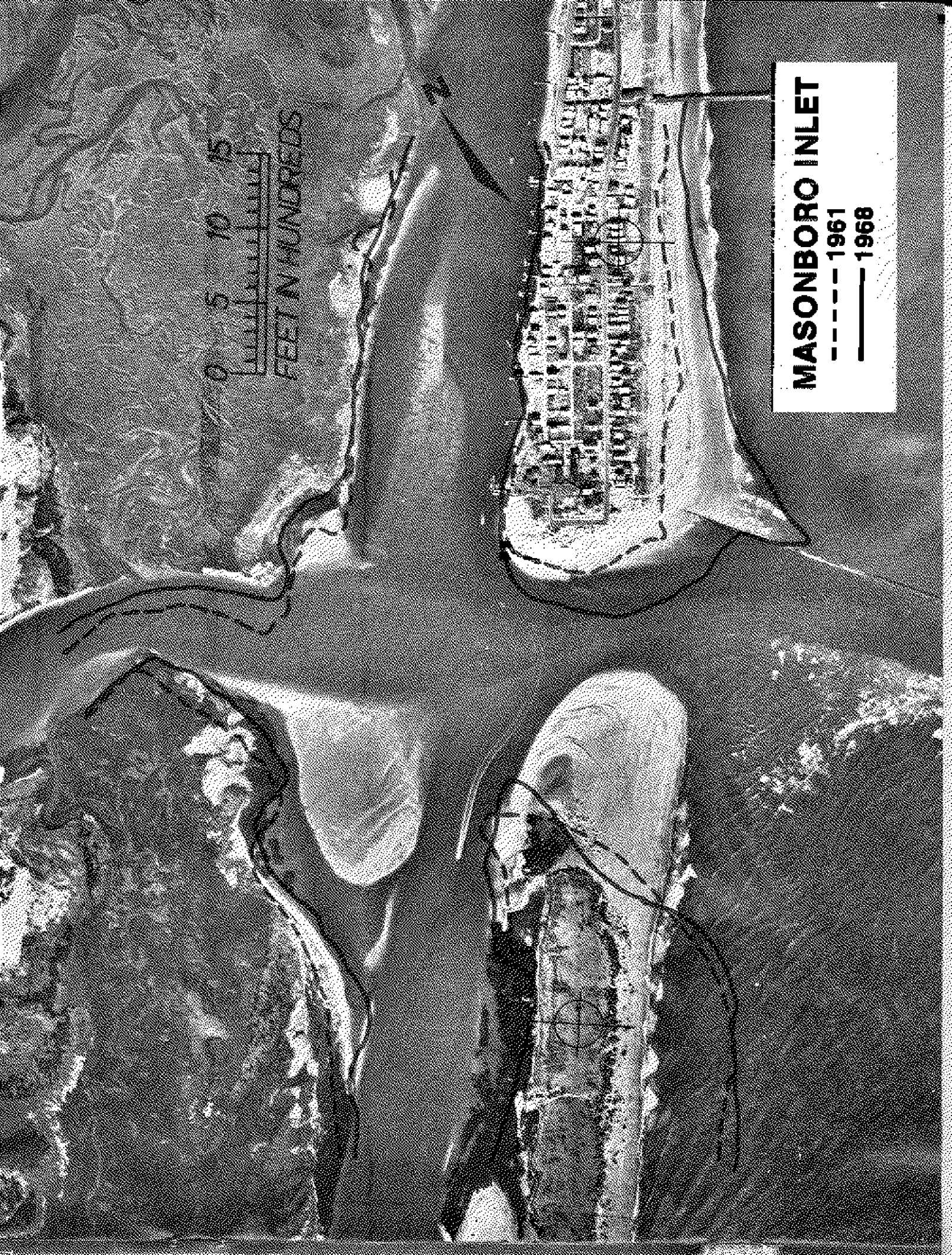


CAROLINA BEACH INLET

----- 1960

_____ 1966

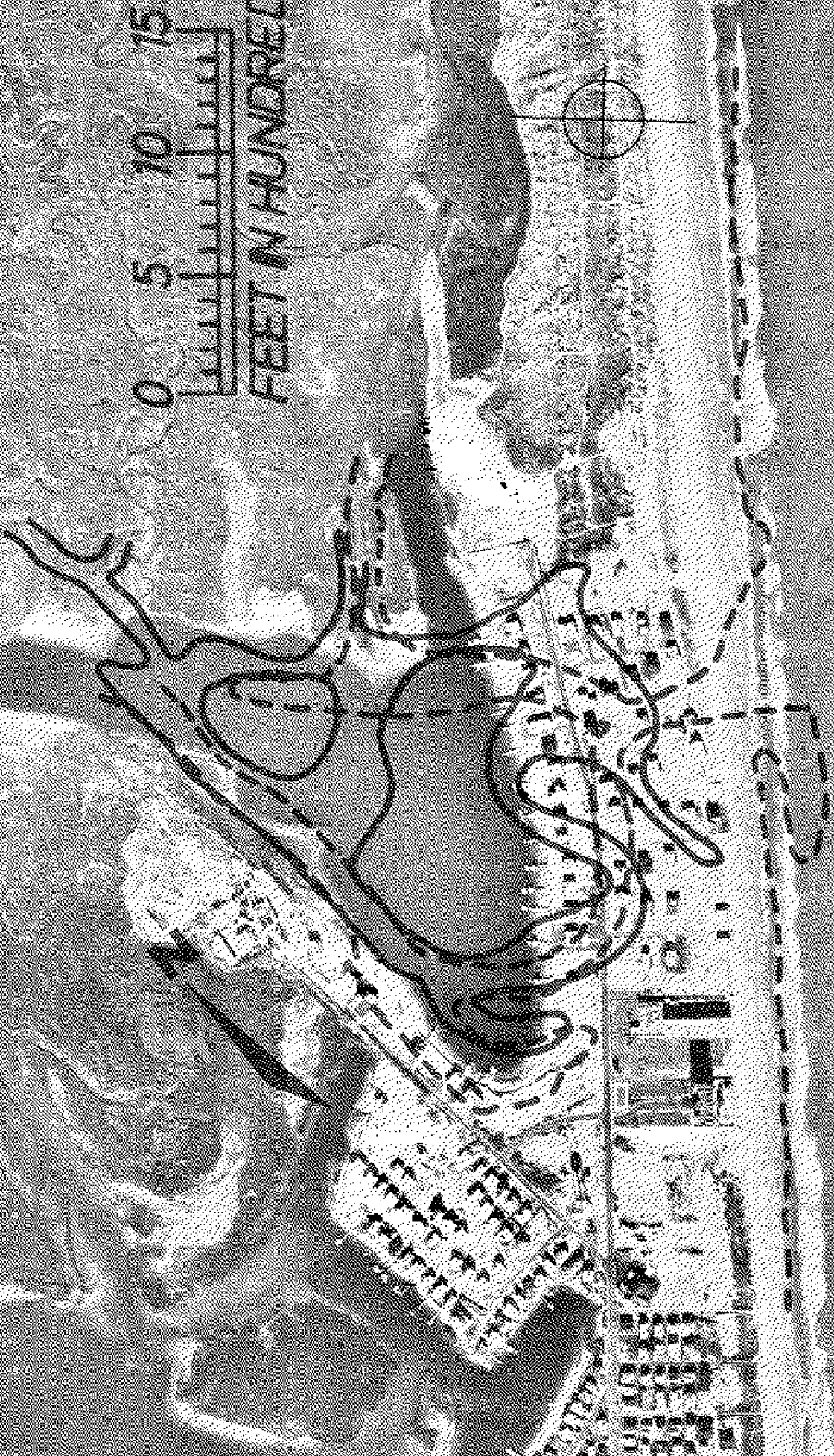
0 5 10 15
FEET IN HUNDREDS



0 5 10 25
FEET IN HUNDREDS

MASONBORO INLET
- - - - - 1961
————— 1968

0 5 10 15
FEET IN HUNDREDS



WRIGHTSVILLE INLET
- - - - - 1960
————— 1966



0 3 6 9 12 15
FEET IN THOUSANDS

QUEENS INLET

----- 1960

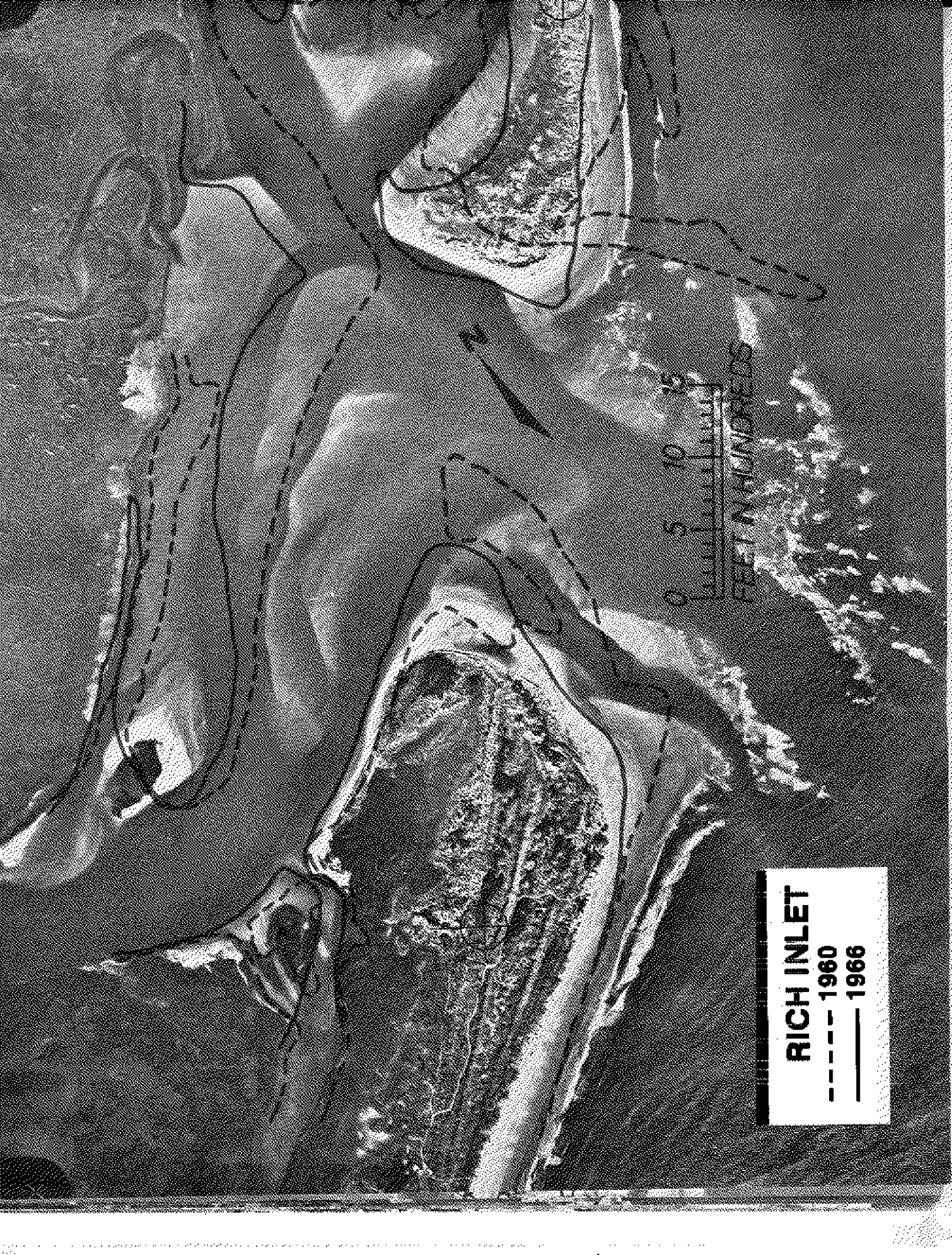
_____ 1966



SHALLOTTE INLET

-----1956

—————1966

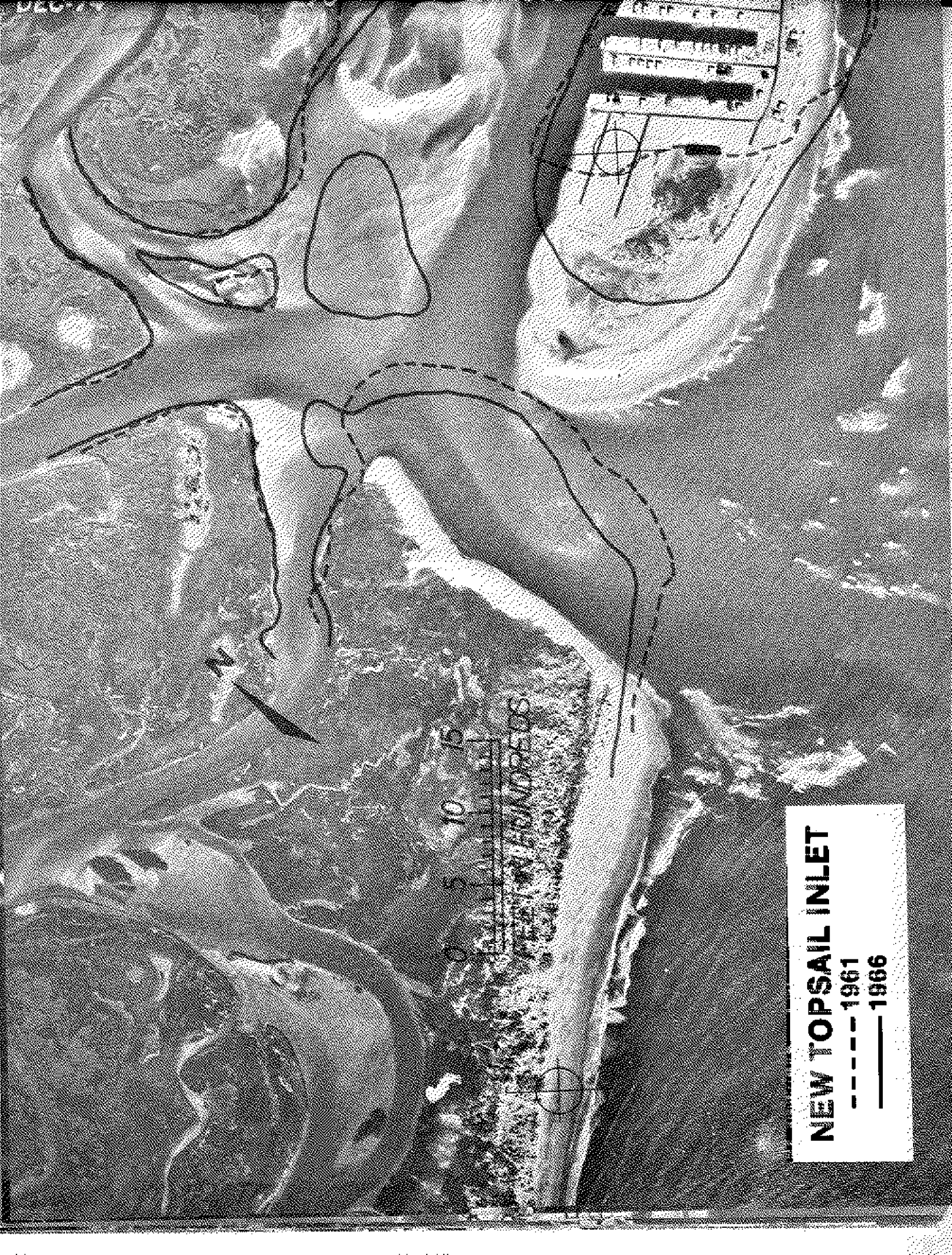


0 5 10 15
FEET IN HUNDREDS

RICH INLET

----- 1960

_____ 1966



0 5 10 15
MILES

NEW TOPSAIL INLET
----- 1961
_____ 1966



5 10 15
1" = 100'
FEET IN HUNDREDS

NEW RIVER INLET
- - - - - 1949
————— 1960

0 31 10 15
EAST INLET
EAST INLET



BEAR INLET
--- 1956
— 1964

BROWN INLET

--- 1960

— 1964

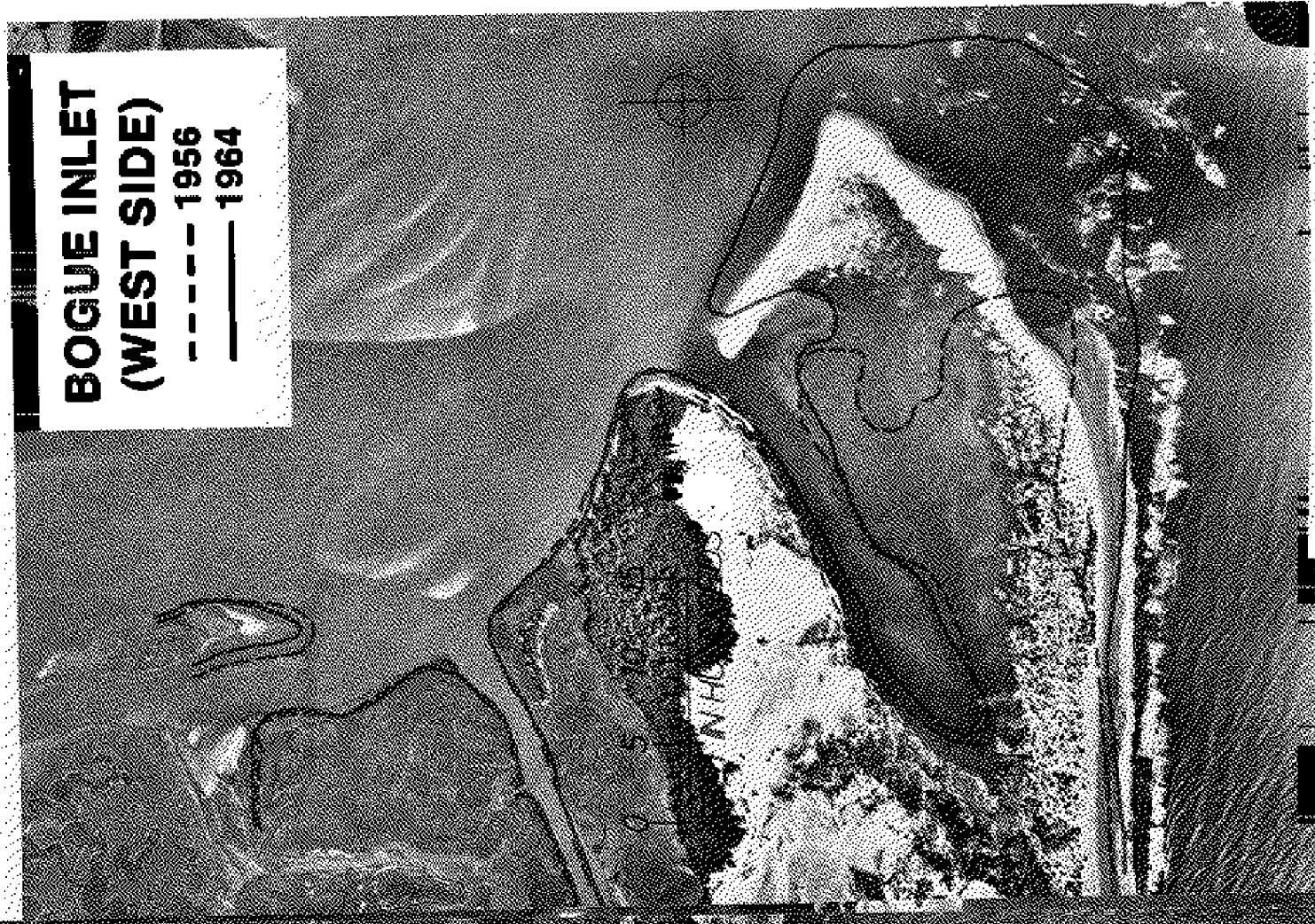
0 5 10 15
FEET IN HUNDREDS



200 METERS
FEET HUNDREDS

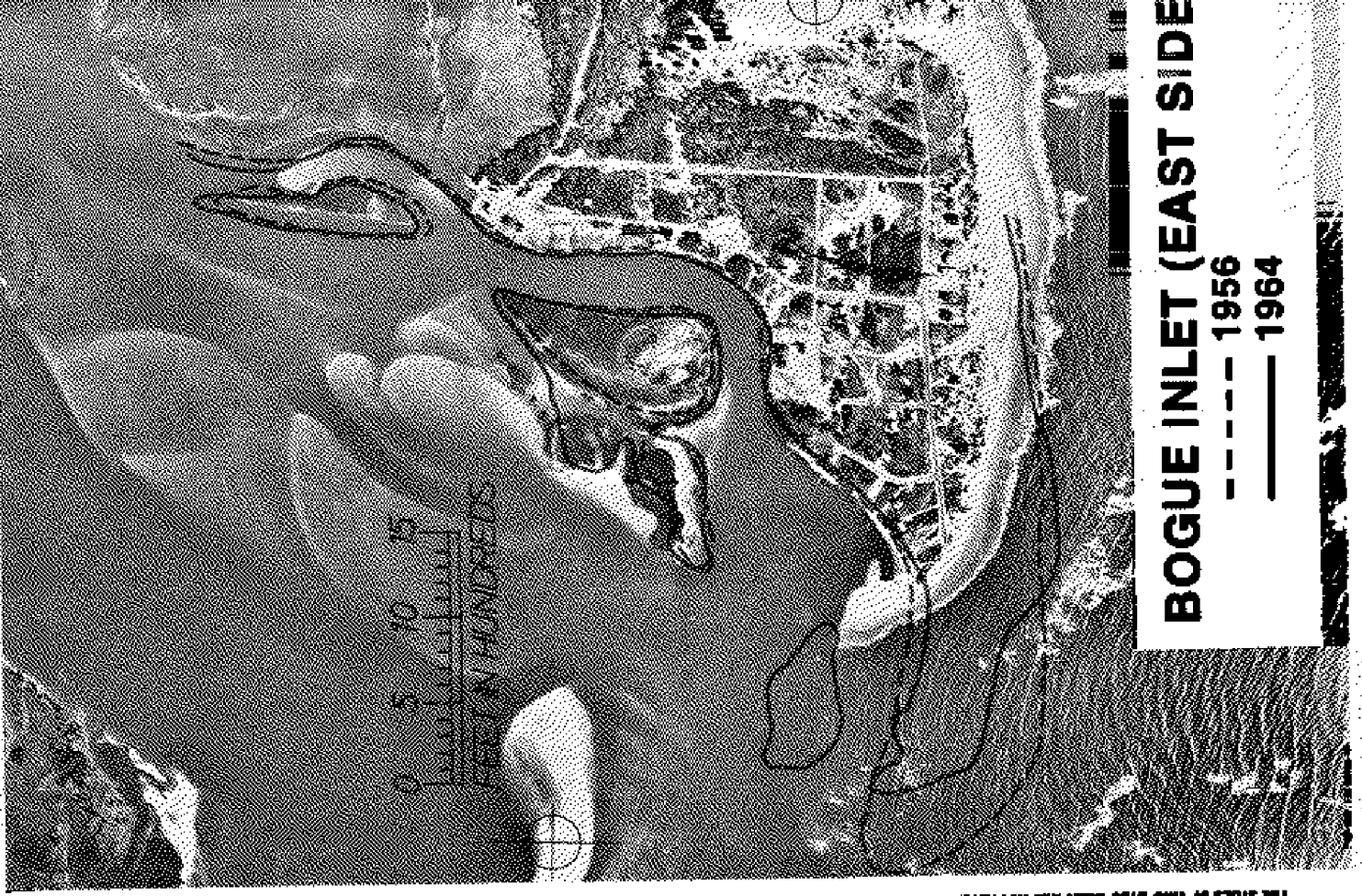


BEAR INLET
----- 1956
_____ 1964



**BOGUE INLET
(WEST SIDE)**

----- 1956
 _____ 1964



BOGUE INLET (EAST SIDE)

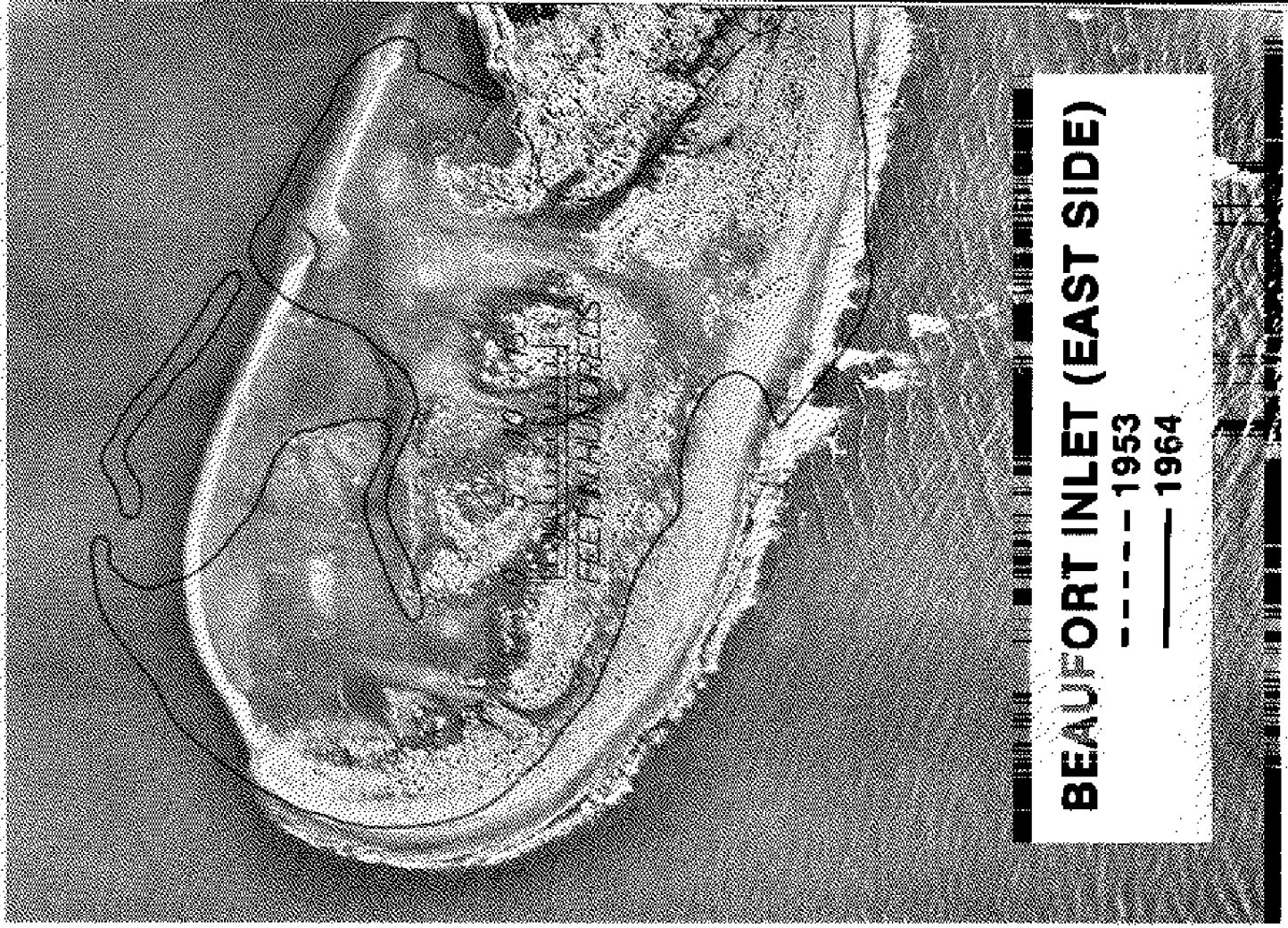
----- 1956
 _____ 1964

THE SIDES OF THIS WIDE INLET ARE NOT ALIGNED AND THE DISTANCE BETWEEN THEM IS NOT ACCORDING TO SCALE. PHOTOGRAPHS HAVE BEEN TRIMMED TO FIT THE PAGE.



BEAUFORT INLET (WEST SIDE)

----- 1953
 _____ 1964



BEAUFORT INLET (EAST SIDE)

----- 1953
 _____ 1964

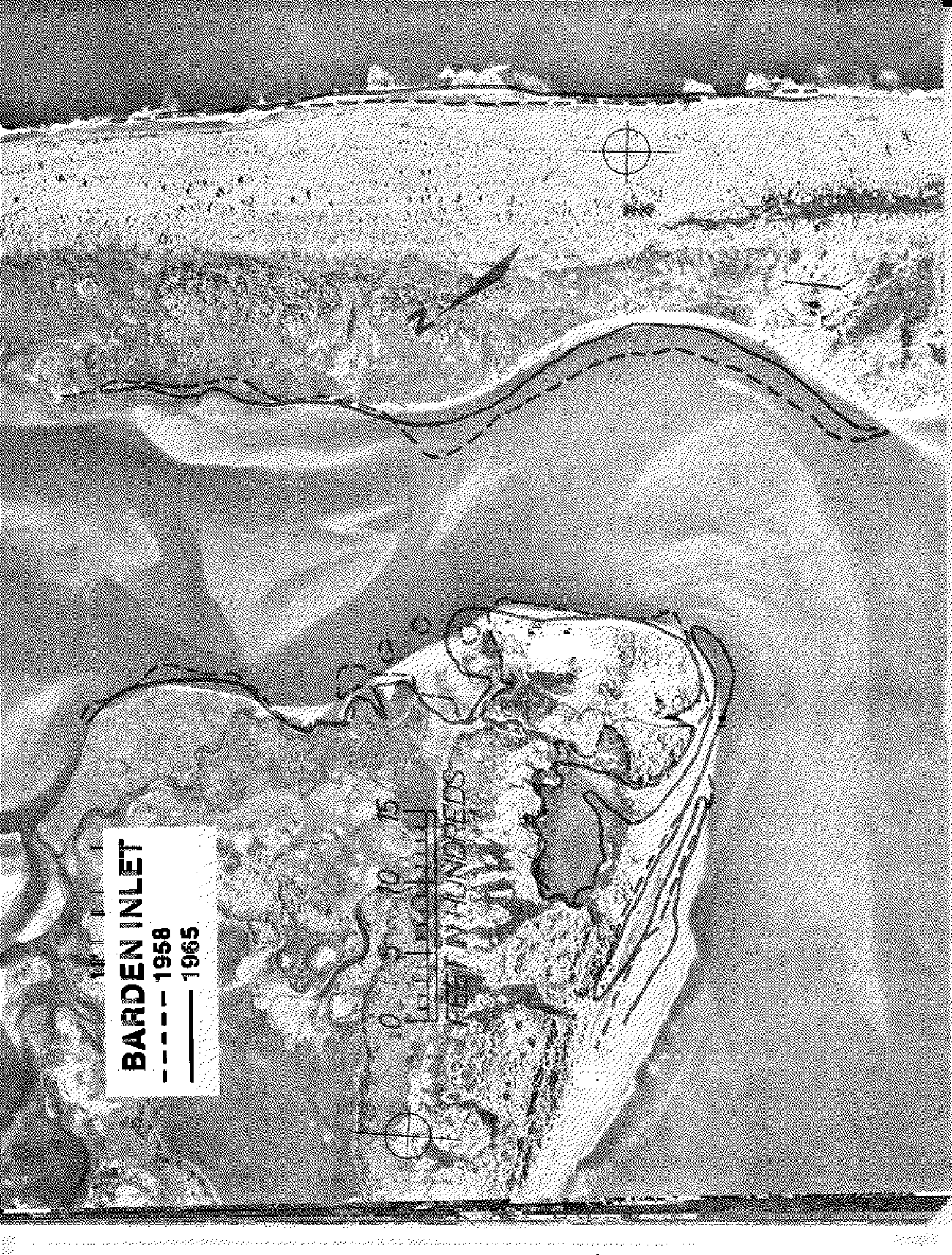
THE SIDES OF THIS WIDE INLET ARE NOT ALIGNED AND THE DISTANCE BETWEEN THEM IS NOT ACCORDING TO SCALE. PHOTOGRAPHS HAVE BEEN TRIMMED TO FIT THE PAGE.

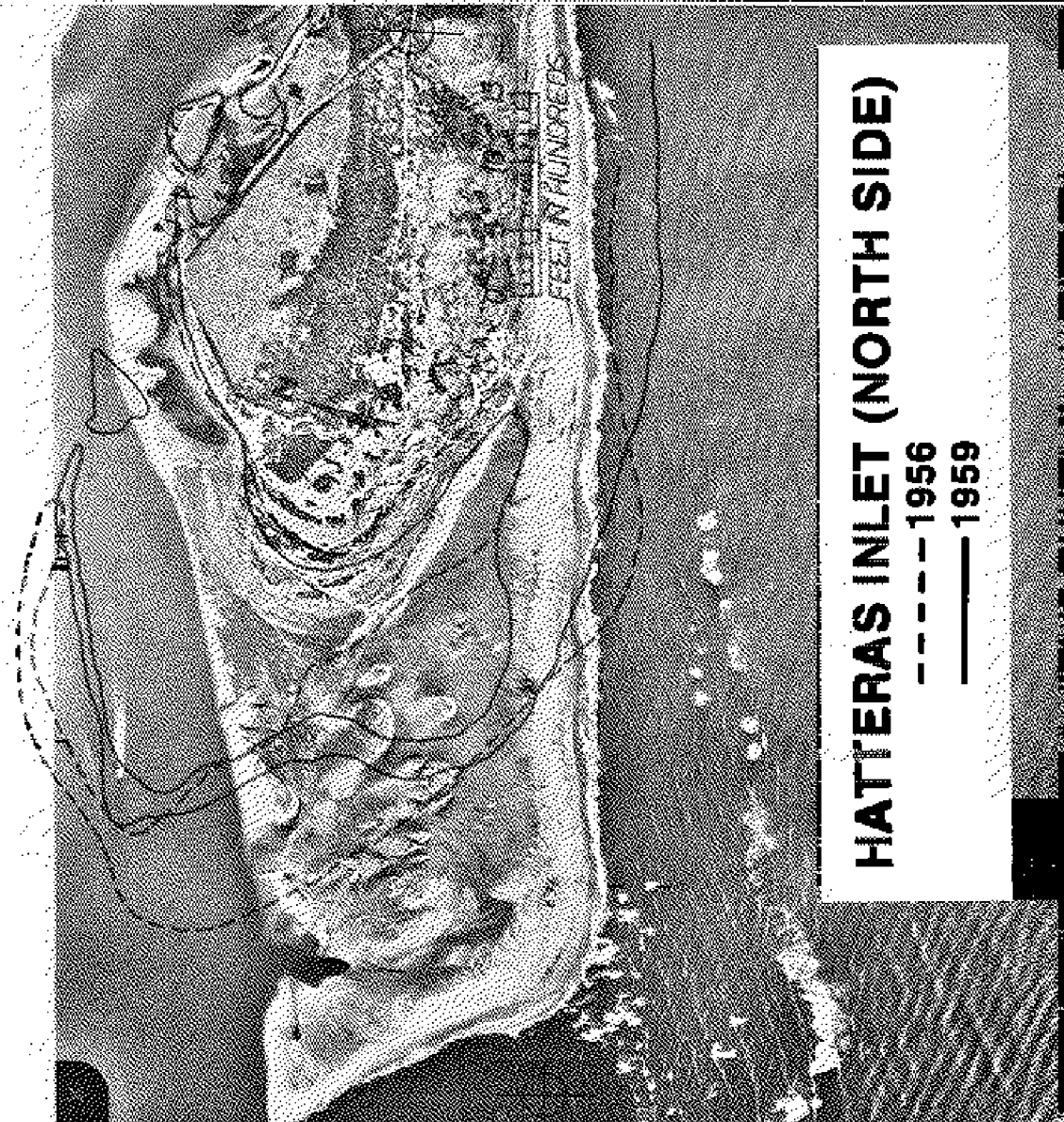
BARDEN INLET

----- 1958

_____ 1965

0 5 10 15
FEET DEPTHS



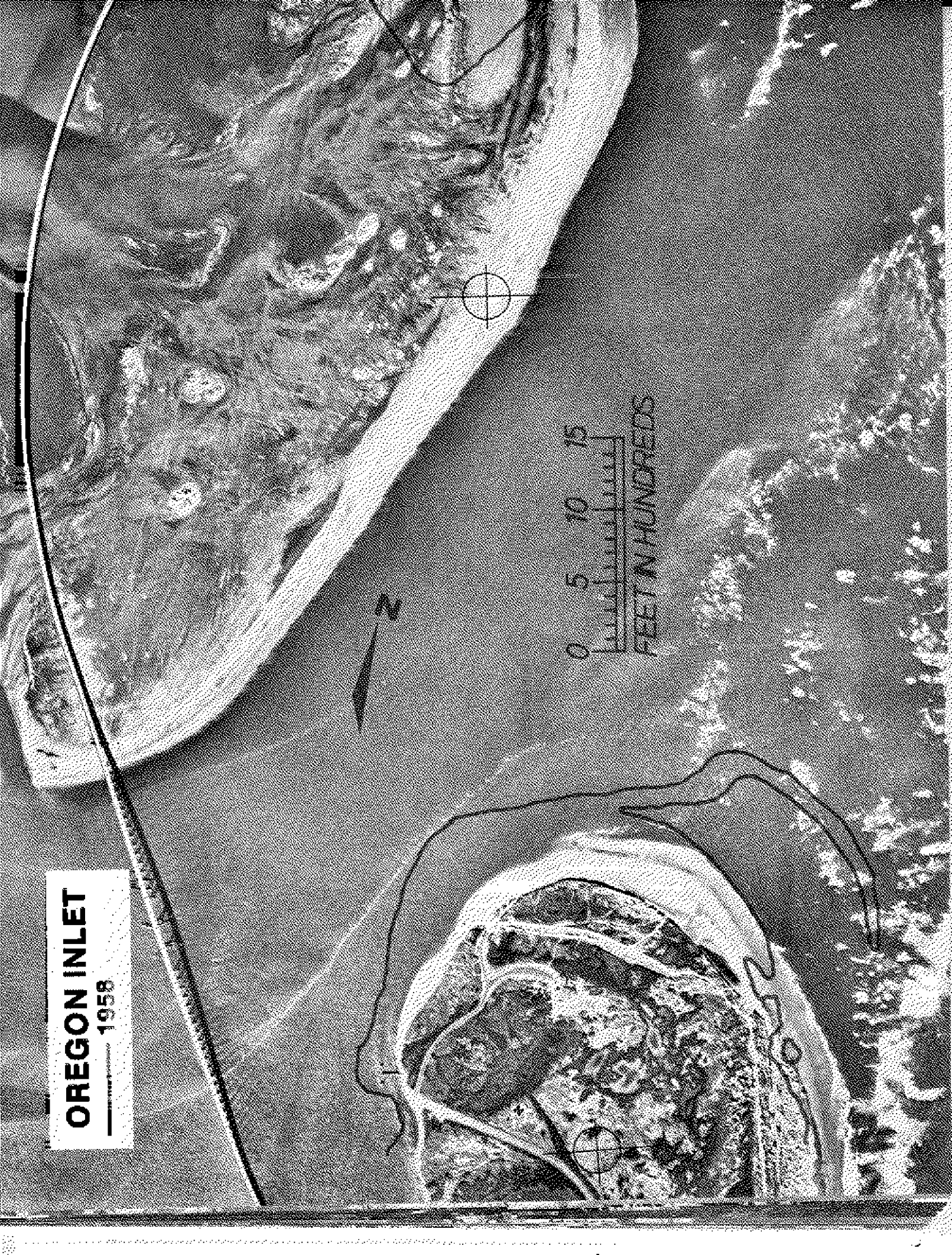


HATTERAS INLET (NORTH SIDE)
- - - - - 1956
————— 1959



THE SPACES OF THIS GRID ARE NOT ALIGNED AND THE DISTANCE BETWEEN THEM IS NOT ACCORDING TO SCALE. PHOTOGRAPHS HAVE BEEN TRIMMED TO FIT THE PAGE.

OREGON INLET
1958



Appendix A

Method

The aerial photographs used in the preparation of the plates were at several scales and had to be adjusted to fit the 1:12,000 ($1'' = 1,000'$) scale of the 1974 North Carolina Department of Transportation images. This was accomplished using a Bausch and Lomb Zoom Transfer Scope, an instrument which optically enlarged the smaller scale pre-1974 photographs and superimposed these images upon the 1:12,000 Department of Transportation photographs.

This is a straight-forward procedure which was complicated by the necessity to find similar points or features on both the old and new photographs in order to properly align the inlets. In the dynamic and changing environment of coastal barrier island inlets it was very difficult, and in a few instances impossible, to find similar points on the 1974 photographs and those taken up to 25 years previously. Both sides of Drum Inlet and the south side of Hatteras Inlet fell into this situation and are not depicted in this volume.

Registration points were placed on each 1974 photograph. A sheet of Albanene tracing paper was fixed to the photograph and the registration marks inked on it. The tracing paper overlay was folded back on its mounting hinge of masking tape exposing the photograph. The older photograph was attached to the front vertical mount of the Zoom Transfer Scope, and its image was superimposed on the 1974 photo-

graph on the table surface in front of the operator.

After common points on both photographs were found, scale adjustments were made to obtain the best equal scale fit of both images. The 1974 photograph was then fastened to the table surface with masking tape, the tracing paper laid back over it, and the projected inlet outlines on the earlier photograph traced off. This procedure was repeated for the second pre-1974 photograph and the end result was a pencil tracing showing two previous shorelines at the same scale and in registration with the 1974 photograph.

In preparing drawings of the inlet boundaries for the printer, tracings of the Albanene sheets were done in ink on polyester film with a matte surface. The registration points on each 1974 photograph were duplicated on the polyester film, and these were superimposed on those of the Albanene tracings before inking was carried out. Later, north arrows and scales were added to the polyester film drawings making them ready for the printer. These drawings comprise the red line portions of the plates in this publication.

The red lines, then, represent the visible land-water boundaries of the inlets. No attempt was made to determine tide levels seen in the various photographs. It is possible that sand bars depicted as dry land at low tide may have been partially submerged at high tide. Consequently, the red line boundaries must not be interpreted as precise delineations of the inlets at high

water. They represent the best possible approximations of the appearance of the various inlets, given the types of data sources available. These data sources or aerial photographs often represent the only records of inlet configurations we have available for the times they were made.

Appendix B

Data Sources

Aerial photography from several sources was used in preparing the plates appearing in this publication. They are identified below in an alphabetical list of inlets. Each inlet is depicted on photographs taken in December 1974 by the North Carolina Department of Transportation (NCDOT), Division of Highways. The outlines of inlet land-water boundaries overprinted in red were derived from earlier aerial photographs obtained from other sources. These were the Agricultural Stabilization and Conservation Service (ASCS), and the Soil Conservation Service (SCS) of the United States Department of Agriculture. Some photography of the National Ocean Survey formerly the Coast and Geodetic Survey (C&GS) was also used. All photography used in the preparation of this volume was black and white panchromatic.

Readers who wish to obtain aerial photographs from the above mentioned agencies will find directions for doing so in *Aerial Photography for Planning and Development in Eastern North Carolina: A Handbook and Directory* by Simon Baker. This is a University of North Carolina Sea Grant College Program publication dated April 1976 and designated UNC-SG-76-03. Lists of available aerial photography held by several governmental agencies covering the counties of the coastal plain as well as the actual coast are also included.

In the following list the dates, sources, print

numbers and scales of the aerial photographs used will be found under the name of each inlet depicted:

Barden Inlet

December 1974, NCDOT, No. 464, Mission 1:12,000
 November 1958, ASCS, No. BUS-2W-104, 1:20,000
 October 1965, C&GS, No. 65S 710, 1:20,000

Bear Inlet

December 1974, NCDOT, No. 293, Mission 1:12,000
 January 1956, ASCS, No. AOR-3N-50, 1:20,000
 February 1964, ASCS, No. AOR-3EE-106, 1:20,000

Beaufort Inlet—West Side

December 1974, NCDOT, No. 436, Mission 1:12,000
 November 1953, SCS, No. BUS-2L-70, 1:20,000
 February 1964, ASCS, No. BUS-7EE-32, 1:20,000

Beaufort Inlet—East Side

December 1974, NCDOT, No. 434, Mission 1:12,000
 December 1953, SCS, No. BUS-4L-207, 1:20,000
 February 1964, ASCS, No. BUS-7EE-80,

1:20,000

Bogue Inlet—West Side

December 1974, NCDOT, No. 366, Mission 1:12,000
 March 1956, ASCS, No. AOR-4N-119, 1:20,000
 February 1964, ASCS, No. AOR-3EE-81, 1:20,000

Bogue Inlet—East Side

December 1974, NCDOT, No. 369, Mission 1:12,000
 March 1956, Same as West side
 February 1964, Same as West side

Brown Inlet

December 1974, NCDOT, No. 288, Mission 1:12,000
 November 1960, ASCS, No. AOR-1AA-53, 1:20,000
 February 1964, ASCS, No. AOR-2EE-3, 1:20,000

Cape Fear Inlet—West Side

December 1974, NCDOT, No. 57, Mission 1:12,000
 March 1956, ASCS, No. AOH-1N-42, 1:20,000
 February 1961, ASCS, No. AOH-4AA-35, 1:20,000

Cape Fear Inlet—East Side

December 1974, NCDOT, No. 166, Mission

1156, 1:12,000
March 1956, ASCS, No. AOH-1N-36, 1:20,000
March 1961, ASCS, No. AOH-6AA-3, 1:20,000

Carolina Beach Inlet

December 1974, NCDOT, No. 123, Mission
1156, 1:12,000
November 1960, ASCS, No. AQQ-1AA-99,
1:20,000
March 1966, ASCS, No. AQQ-3GG-21,
1:20,000

Corncake Inlet

December 1974, NCDOT, No. 106, Mission
1156, 1:12,000
April 1949, ASCS, No. AOH-1F-68, 1:20,000
March 1956, ASCS, No. AOH-2N-52, 1:20,000

Hatteras Inlet—South Side

December 1974, NCDOT, No. 611, Mission
1156, 1:12,000

It was impossible to find common points for
matching the old and new photography; there-
fore, no lines could be drawn.

Hatteras Inlet—North Side

December 1974, NCDOT, No. 638, Mission
1156, 1:12,000
March 1956, ASCS, No. AOO-3N-108, 1:20,000
August 1959; C&GS, No. 59W7522, 1:25,000

Lockwood Folly Inlet

December 1974, NCDOT, No. 65, Mission

1156, 1:12,000
March 1956, ASCS, No. AOH-5N-76, 1:20,000
March 1966, ASCS, No. AOH-1GG-262,
1:20,000

Mad Inlet

December 1974, NCDOT, No. 5, Mission 1156,
1:12,000
March 1956, ASCS, No. AOH-5N-24, 1:20,000
April 1961, ASCS, No. AOH-7AA-45, 1:20,000

Masonboro Inlet

December 1974, NCDOT, No. 187, Mission
1156, 1:12,000
January 1961, ASCS, No. AQQ-8AA-41,
1:20,000
March 1966, ASCS, No. AQQ-3GG-68,
1:20,000

New Inlet

December 1974, NCDOT, No. 108, Mission
1156, 1:12,000
April 1949, ASCS, No. AQQ-AOH-1F-4,
1:20,000
November 1960, ASCS, No. AQQ-1AA-3,
1:20,000

New River Inlet

December 1974, NCDOT, No. 277, Mission
1156, 1:12,000
October 1949, ASCS, No. AOR-2F-37, 1:20,000

November 1960, ASCS, No. AOR-1AA-76,
1:20,000

New Topsail Inlet

December 1974, NCDOT, No. 207, Mission
1156, 1:12,000
April 1961, ASCS, No. AOU-5AA-129, 1:20,000
March 1966, ASCS, No. AOU-1GG-122,
1:20,000

Old Topsail Inlet

December 1974, NCDOT, No. 205, Mission
1156, 1:12,000
April 1961, ASCS, No. AOU-5AA-129, 1:20,000
March 1966, ASCS, No. AOU-3GG-194,
1:20,000

Oregon Inlet

December 1974, NCDOT, No. 731, Mission
1156, 1:12,000
October 1958, C&GS, No. 58W1461, 1:18,000

Queens Inlet

December 1974, NCDOT, No. 194, Mission
1156, 1:12,000
November 1960, ASCS, No. AQQ-1AA-168,
1:20,000
March 1966, ASCS, No. AQQ-3GG-89,
1:20,000

Rich Inlet

December 1974, NCDOT, No. 200, Mission
1156, 1:12,000
November 1960, ASCS, AOQ-1AA-181,
1:20,000
March 1966, ASCS, AOU-2GG-15, 1:20,000

Shallotte Inlet

December 1974, NCDOT, No. 27, Mission
1156, 1:12,000
March 1956, ASCS, No. AOH-4N-99, 1:20,000
March 1966, ASCS, No. AOH-1GG-64,
1:20,000

Tubbs Inlet

December 1974, NCDOT, No. 8, Mission 1156,
1:12,000
March 1956, ASCS, No. AOH-4N-143, 1:20,000
March 1966, ASCS, No. AOH-1GG-113,
1:20,000

Wrightsville Inlet

December 1974, NCDOT, No. 191, Mission
1156, 1:12,000
November 1960, ASCS, No. AOQ-1AA-153,
1:20,000
March 1966, ASCS, No. AOQ-3GG-87,
1:20,000