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16. Abstract

Water samples taken in offshore waters between Cape Cod, Massachusetts, and Charleston, South Carolina have been used with other sea truth information as a basis to correlate productivity values with ERTS sensory data. Positive correlations were established on January 26, 1973 regarding chlorophyll concentrations and optical density values.

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S E M I - A N N U A L R E P O R T

(February through July 1973)

Principal Investigator: Harold G. Marshall
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Title: Use of ERTS-1 to utilize and apply marine station data to study productivity along the eastern shelf waters of the United States. Contract No. NAS5-21816 (Task 3).

Abstract: Water samples taken in offshore waters between Cape Cod, Massachusetts, and Charleston, South Carolina have been used with other sea truth information as a basis to correlate productivity values with ERTS sensory data. Positive correlations were established on January 26 regarding chlorophyll concentrations and optical density values.

Objectives:

a) Relate sea truth data concerning productivity values based on phytoplankton composition and chlorophyll values, to specific sensor obtained data from ERTS-1. Relationships of color bands to sea truth data will be made and contours plotted by computer.

b) to determine the feasibility of accurate mapping of productivity values in marine waters.

Test sites:

1. Offshore coastal waters between Cape Cod, Massachusetts and Charleston, South Carolina.

2. Waters over the shelf off the mouth of the Chesapeake Bay.

Procedures:

1. A broad data base source was provided through the cooperation of the U. S. National Marine Fisheries Services (formerly Bureau of Commercial Fisheries). This agency has underway extensive sampling programs in the eastern coastal shelf waters of the United States. These include the MARMAP and Groundfish Survey programs from which permission was granted for obtaining water samples and sea truth data taken at a series of sea stations. Samples were taken in July-August 1972 and again in January-February 1973 for a summer and winter series. There were 225 water samples collected during these two cruises. Note collection area is given in Figure 1. On board these vessels, surface water samples are taken at designated stations sites that generally follow a transect line from the coast seaward over the continental shelf. The 500 ml water sample is preserved immediately for later phytoplankton analysis. Additional water collection for chlorophyll determination and salinity values are also taken; surface temperature was taken as well.

2. In addition to the National Marine Fisheries vessels, the research vessel LINWOOD HOLTON from Old Dominion University was used for collections. The Old Dominion University vessel has been used over one dozen times for collections at the mouth of the Chesapeake Bay.

3. After a cruise has been completed, water samples are returned to the principal investigator. A research space has been provided to analyze the water samples in the Science Building (Department of Biology), at Old Dominion University. These samples have to be processed to prepare them for microscopic examination. In addition to the principal investigator's facilities are present for three graduate students, each equipped with research area and inverted plankton microscopes, to study the phytoplankton samples. One of these students is funded by the ERTS grant, with two sponsored from other sources. These three have been trained by the principal investigator and have at their disposal an extensive litature collection and identification keys for their exclusive use. Their work is very time consuming for they have to analyze each sample and make quantitative and qualitative evaluations of the phytoplankton. Close relationships exists in the direction and verification of their work by the principal investigator. Their studies will provide results from several cruises, including those directly related to the ERTS dates, for an understanding of the seasonal composition and distribution off the east coast. This type of information will be applied to the ERTS results for a broader interpretation of productivity values in this extensive area. However, it is this phase of microscopic examination of water samples that involves considerable time. Yet this information will provide the true standing crop and base for production values to compare with the chlorophyll index. The product from the phytoplankton analysis will be a species list of plankters from each station sampled. Actual numbers of organisms will be included to give separate species totals, as well as, the total phytoplankton concentrations per liter of water sample.

4. Once actual plankton concentrations have been determined, they are associated with the corresponding chlorophyll data, salinity, and temperature values.

5. The major goal is to have good weather over collection sites coincide with the opportunity to take sea truth data in these areas. This combination has been a significant problem in the large scale vessel operations of the National Marine Fisheries Services, which has the ships dates and cruise tract planned months in advance. The problems that resulted in a delayed launch date for the satellite proved costly to my first series of collections in July and August. The second cruise series in January-February had times of heavy cloud cover. In order to be assured of a more flexible sea truth data source to provide information for the project, in January the collection potential of the Old Dominion University vessel the LINWOOD HOLTON was added. This vessel has made regular collections at originally 3 sites off the mouth of the Chesapeake Bay; now 4 sites are being taken to approximately 20 miles seaward. The combination of the broad synoptic potential of the original sea truth collection efforts will continue, with

the expection of good weather and broad coverage. In addition supportive efforts will be continued for sea truth data along 2 transects. One will include the present one extending off the Chesapeake Bay. The other will be north of this point off Assateague Island (near Wallops Island). Plans include future collections along these 2 transects after September.

6. When chlorophyll and other data are available for a site under study, an isodensity trace of the ERTS positive transparancies for the different bands is made. This work is conducted by Dr. David Bowker of the NASA Langley Research Center. Using a Joyce Lobel microdensitometer an isodensity trace is produced that can subsequently be plotted showing regions of similar optical density values for these areas. These contours are then matched with the sea truth data points for correlation. An example of this plot is provided and discussed below.

Results:

1. Over 250 water samples have been taken for plankton analysis. Microscopic examination of these samples has been underway since September 1973. Three series are specifically being examined. Over 100 samples each from the summer (1973) and winter (1973-74) cruises over the Atlantic coastal waters. The third collection represents those taken by the Old Dominion University vessel off the mouth of the Chesapeake Bay.

2. Attached are figures 2-6 that depict results of the 26 January 1973 overpass and correlations to ground truth data. The true chlorophyll values were found to relate directly to specific density areas plotted at this site for the three data points (stations).

3. Continued sampling at these three stations (plus an additional station) off the Chesapeake Bay have continued with each ERTS overpass. The combination of this seasonal series of collections with the more extensive coastal collections will assure significant data base. To date collections have been made with eight overpasses for this area in January, April, May, June, and July. The only delay at the present time is the obtaining of the additional ERTS transparancies for the new dates. Once this material has arrived correlations for these months and the summer period will follow. The additional station off the Bay area will add another further data point for analysis. Continued collections at this site will hopefully add the seasonal aspect of changing phytoplankters and chlorophyll types to This analysis. Complete results for collections through the summer months is planned to be completed by December 1973. Final conclusions for the overall study would not be ready until March 1974.

Conclusions:

1. The principal investigator considers results from this 26 January 1973 sampling and ERTS overpass data to provide a sound base for continuing the research along the original premise. This data has illustrated a relationship between phytoplankton populations and concentrations, chlorophyll values, and MSS data from ERTS.

2. The isodensity plot for this site showed different optical density values for the 3 data point sites that had specific variations in chlorophyll concentrations (values decreased seaward).

3. In order to develop this study further, more sea truth sites will be required. A fourth station has been added to the Bay transect. As mentioned above plans are being negotiated to have samples taken along transects north of the Bay area from the Wallops Island area.

4. Application of the isodensity plots would appear to have specific value in identifying broad areas of high and low phytoplankton densities. This information should relate closely to productivity values. The relationship between areas of specific chlorophyll values to upwelling regions, the influence of currents and seasonal changes, and fisheries benefits would be the next logical step to develop.

5. Results to date were reported by the principal investigator on May 4, 1973 at the Virginia Academy of Science annual meetings. The title of the report was "Application of the Earths Resources Technological Satellite for Mapping Phytoplankton population densities in Atlantic Coastal Stations". An abstract of this talk will be published in the Virginia Journal of Science.

6. It has become evident that due to the large number of collections certain priorities have to be established.

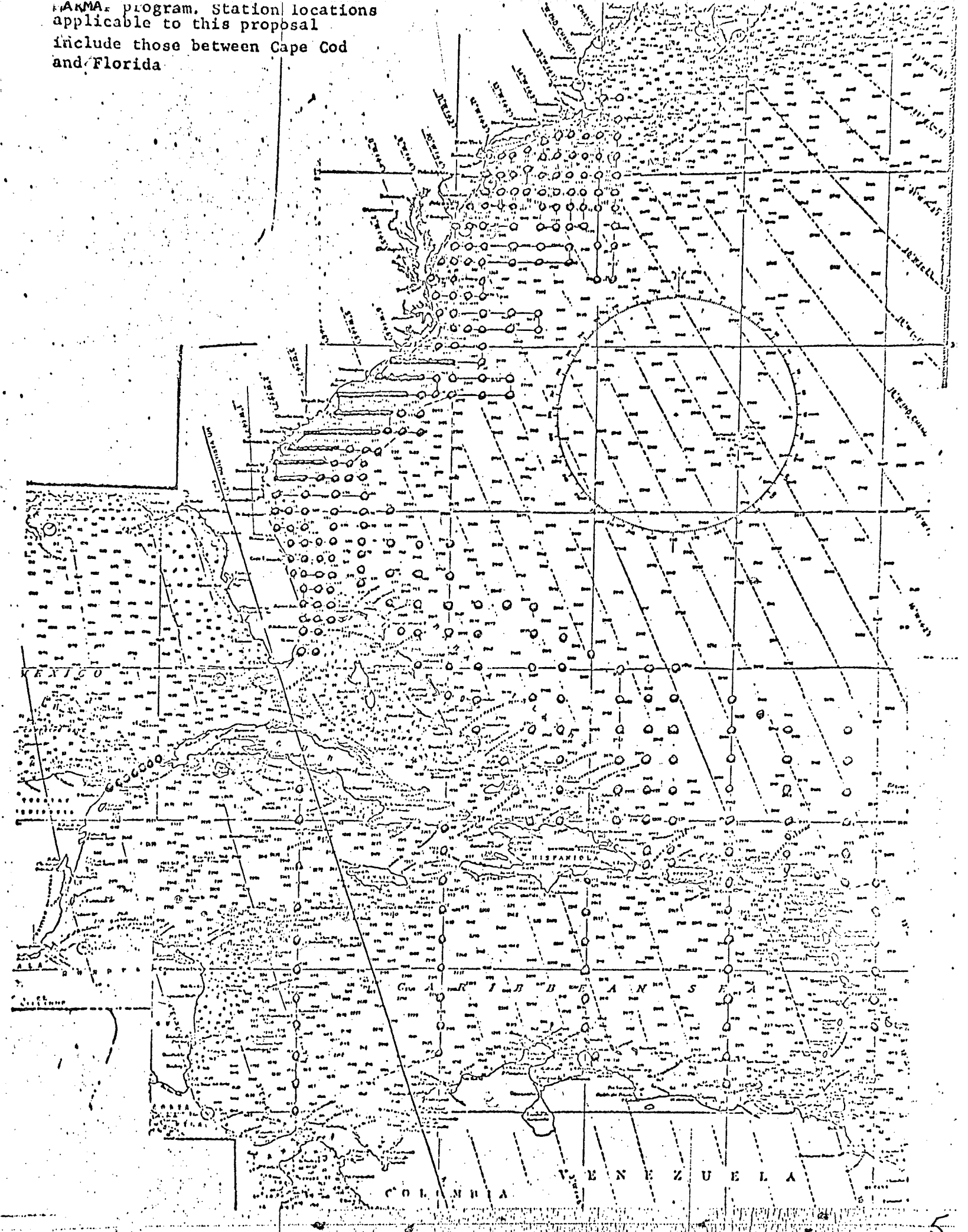
a) The MARMAP program provided a broad series of collections along the east coast that will be worked directly for phytoplankton concentrations and relationships to physical parameters and chlorophyll data.

b) Continual effort will be directed to collections along two transects off the east coast. This information plus what has been collected from the mouth of the Chesapeake Bay will provide a concentrated effort of analysis over a smaller section of the project site area.

c) Data from the summer 1973 collections, other ship data and plankton samples will be worked to offer comparative data for seasonal relationships.

Problems:

Delay in receiving additional ERTS data products has prevented further comparison to sea truth information. Hopefully this will be furnished so more complete data analysis can follow.



AKMA program. Station locations applicable to this proposal include those between Cape Cod and Florida

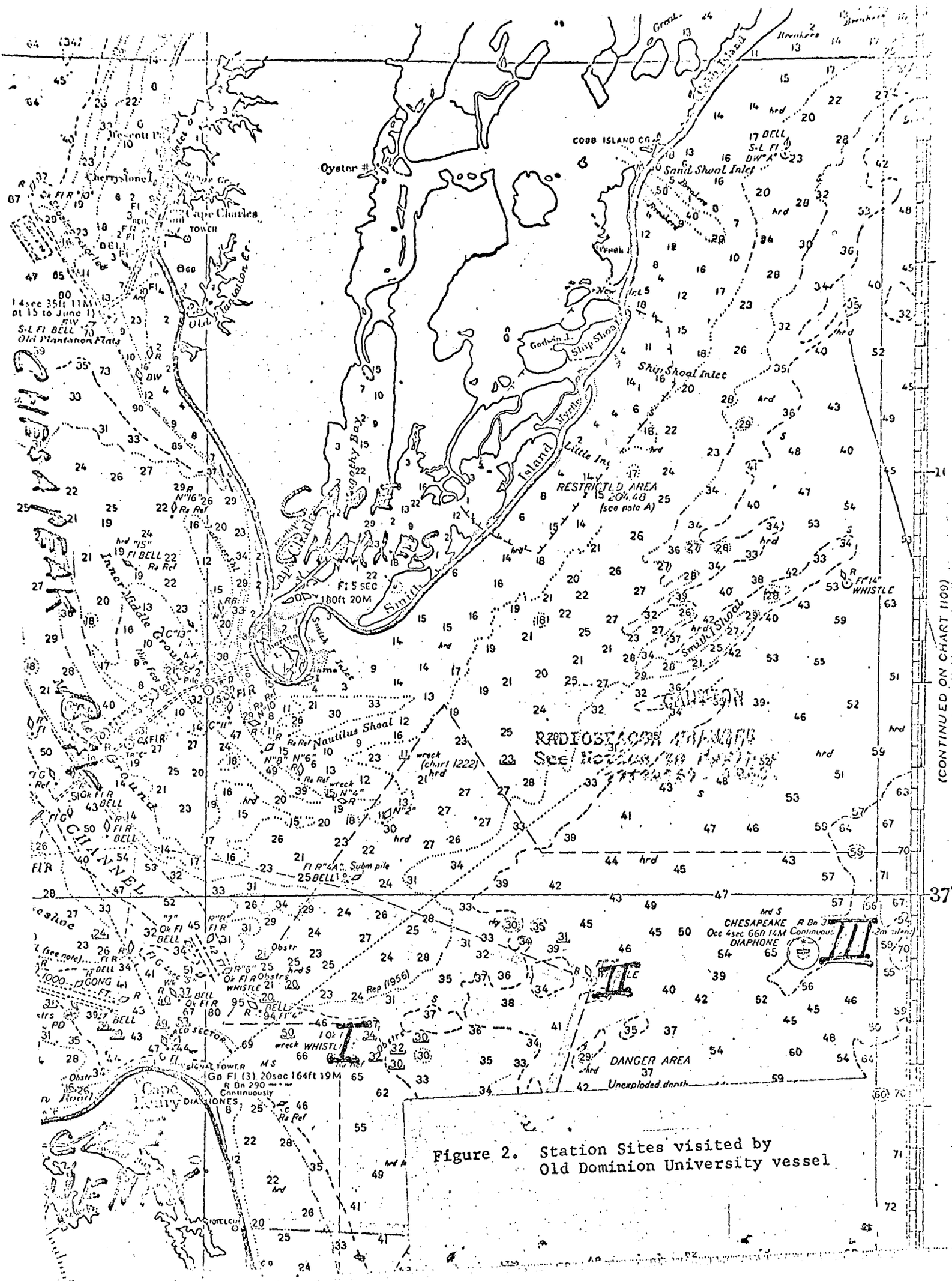


Figure 2. Station Sites visited by Old Dominion University vessel

	STATIONS		
	I	II	III
DIATOMS:	THALASSIONEMA NITZSCHIOIDES	THALASSIONEMA NITZSCHIOIDES	MELOSIRA SULCATA
	THALASSIOSIRA NORDENSKOLDII	MELOSIRA SULCATA	MELOSIRA GRANULATA
	THALASSIOSIRA ROTULA	MELOSIRA GRANULATA	
	MELOSIRA SULCATA		
	MELOSIRA GRANULATA		
	PLEUROSIGMA SP.		
DINOFLAGELLATES:			
	EXUVIELLA COMPRESSA	EXUVIELLA COMPRESSA	PROROCENTRUM MICANS
	PROROCENTRUM MICANS	PROROCENTRUM MICANS	PERIDINIUM PELLUCIDUM
	PROROCENTRUM SCUTELLUM	PERIDINIUM PELLUCIDUM	

Figure 3. Results of major phytoplankton constituents from 3 station locations at the mouth of the Chesapeake Bay on 26 January 1973.

	PHYTOPLANKTON (CELLS/L)		CHLOROPHYLL
STATION	DIATOMS	DINOFLAGELLATES	MG/L
1	33,600	42,600	9.07
2	27,840	14,400	1.01
3	10,900	10,080	0.35

Figure 4. Results of quantitative counts for phytoplankton concentrations and chlorophyll values from surface samples taken 26 January 1973 at 3 stations at the mouth of the Chesapeake Bay.

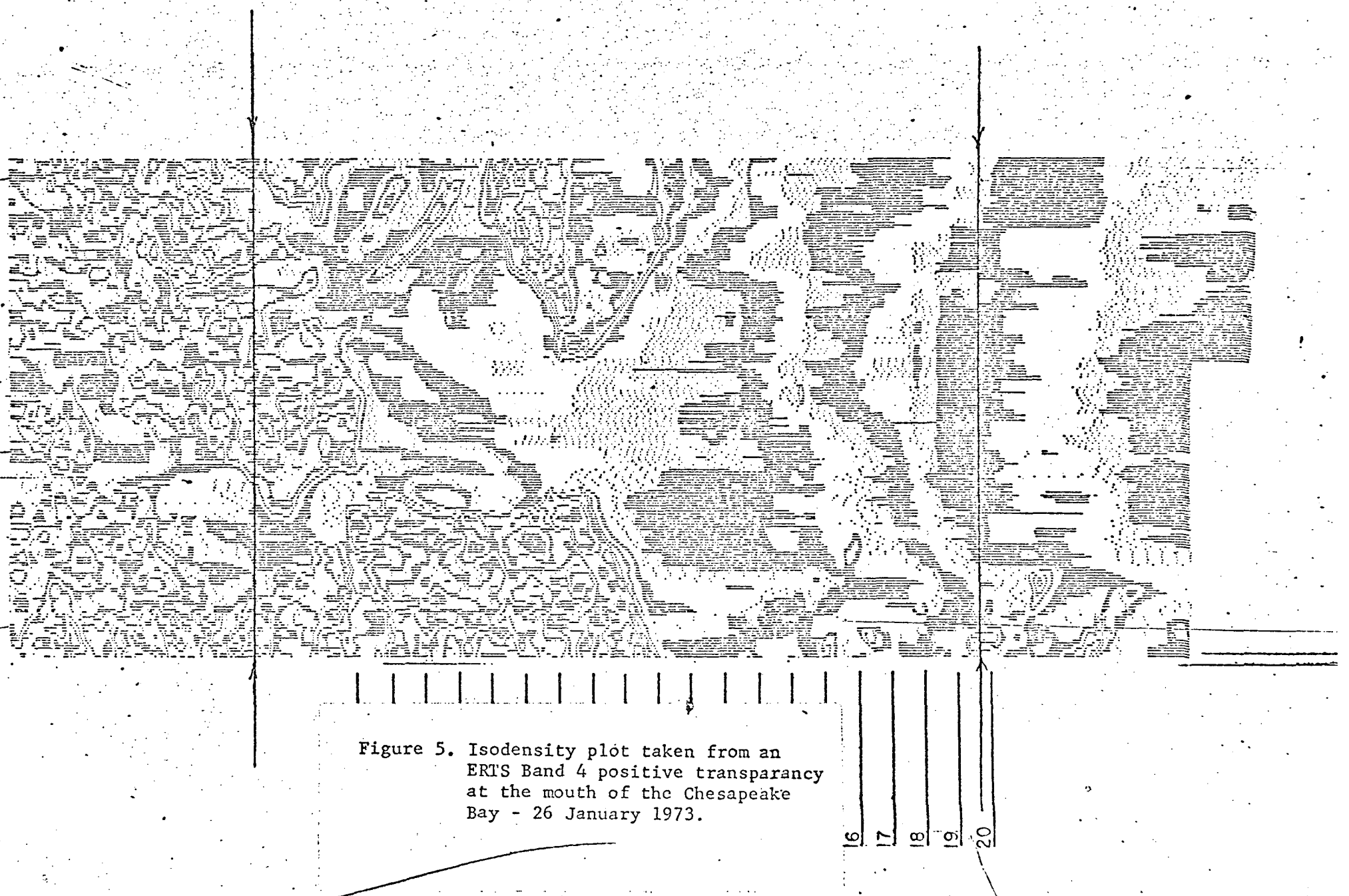
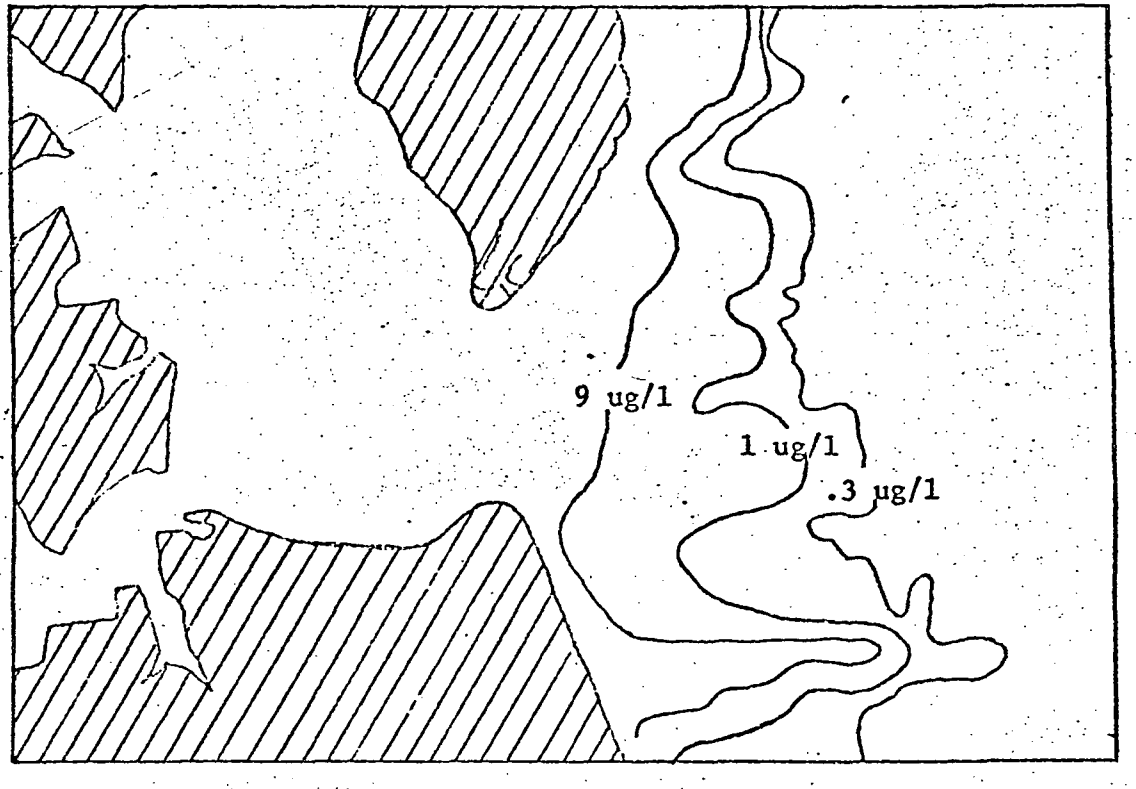


Figure 5. Isodensity plot taken from an ERTS Band 4 positive transparancy at the mouth of the Chesapeake Bay - 26 January 1973.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