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AN INVESTIGATION TO IMPROVE THE MENHADEN FISHERY PREDICTION AND DETECTION MODEL THROUGH THE APPLICATION OF ERTS-A DATA

Paul M. Maughan
Earth Satellite Corporation
1771 N Street, N.W.
Washington, D.C. 20036

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16. Abstract

This investigation represents a joint effort between EarthSat and the National Fish Meal and Oil Association, representing the Menhaden Industry. The primary objective was to demonstrate the utility of ERTS-1 imagery as a source of fishery-significant oceanographic data. The project was conducted in Mississippi Sound, in the north central Gulf of Mexico. It was undertaken in conjunction with NASA's Earth Resources Laboratory and NMFS's Fisheries Engineering Laboratory. The project utilized conventional surface data, obtained from fishing and other vessels, as well as aircraft and spacecraft remote data. Preliminary results indicate a relationship between commercial fish-stock availability and turbidity features recognizable both from surface and remote platforms.

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Figure 2. Technical Report Standard Title Page

Preface

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Introduction

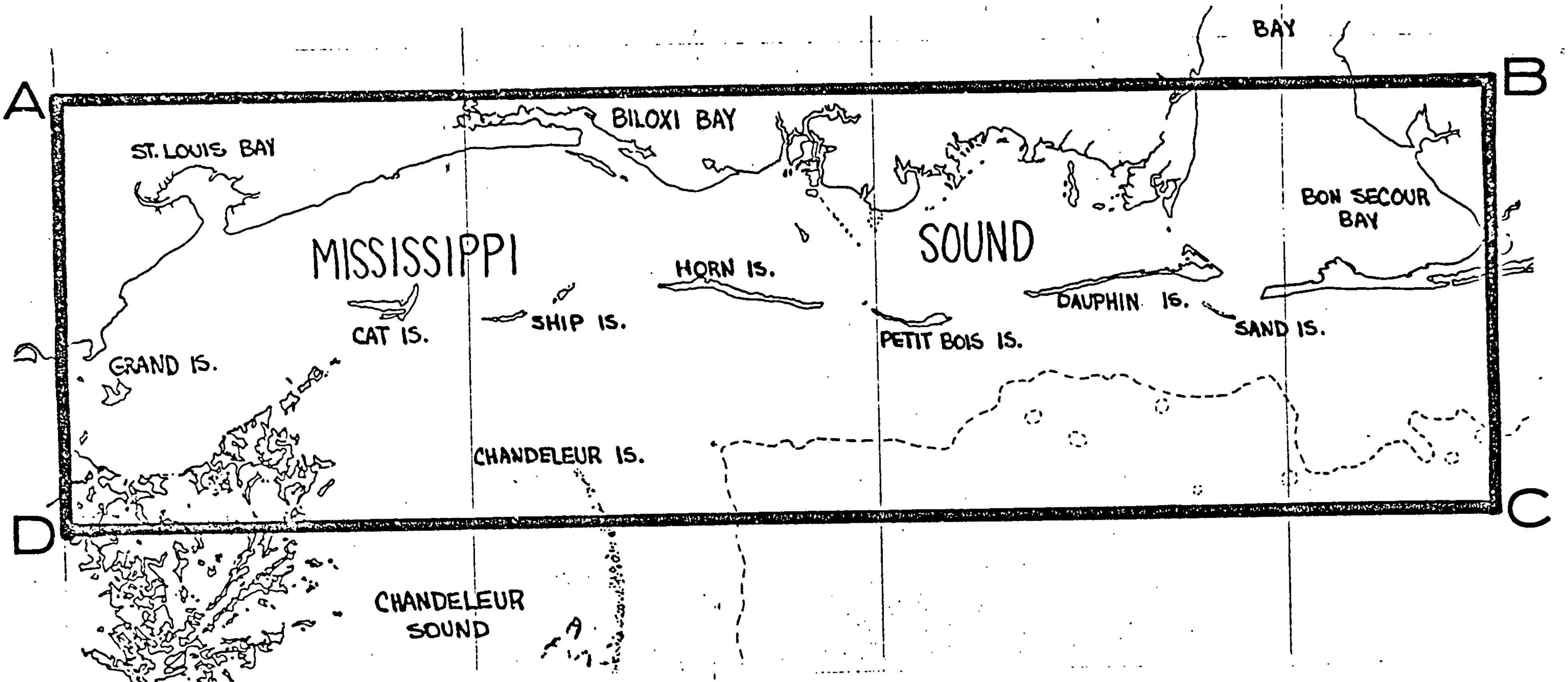
The principle objective of this study was to demonstrate the utility of ERTS-1 imagery as a source of fishery-significant oceanographic data in order to provide the menhaden industry with an improved fisheries intelligence model. The experiment was undertaken as a joint venture between Earth Satellite Corporation (EarthSat) and the National Fish Meal and Oil Association (NFMOA),which represents the majority of the commercial menhaden interests in the United States .

Menhaden are a surface schooling pelagic species which are fished in shallow coastal waters. The fishing process is initiated from large vessels (on the order of 200 feet) designed to carry smaller capture boats and store the catch. Fishing activities proceed from the two smaller (approximately 40 foot) boats which carry between them a very large net called a purse seine.

The fish are located by a pilot in a fixed wing aircraft (operating at approximately 800 to 1000 feet) who is in direct radio communication with both the carrier vessel and the smaller net boats. Upon sighting a school to be captured, the pilot directs the vessel captain to release the net boats and then, circling the school, guides the net boats to the school and directs their enclosure of the fish. Thus, for a period during the fishing activity, the majority of the crew has left the carrier vessel and under normal circumstances, the carrier vessel stands to in the immediate vicinity of the school to be captured.

The commercial fishery for menhaden presently exists in two geographically isolated coastal areas, one extending from the southern Chesapeake Bay to northern North Carolina, the other operating in the coastal waters of the Gulf of Mexico east and west of the Mississippi Delta. Both fisheries are seasonal, with activity extending from approximately May to November. The eastern fishery has been in a state of eratic decline for more than a decade, whereas the Gulf has been an expanding fishery since its inception in the early fifties. This fact, plus the prior existence of a NASA test site covering a portion of the Gulf menhaden fishery, provided the impetus for selecting the Gulf of Mexico (Mississippi Sound) fishery as the test case (Figure 1). This decision proved fortuitous in that two federal agencies were found to be preparing closely related experimental activities as part of the ERTS-A Program. Subsequently, EarthSat and NFMOA joined cooperatively with the National Marine Fishery Service's Fisheries Engineering Laboratory (FEL), and the National Aeronautics and Space Administration's Earth Resources Laboratory (ERL), both located at Mississippi Test Facility in southwestern Mississippi. The NMFS's Laboratory at Pascagoula, Mississippi also participated.

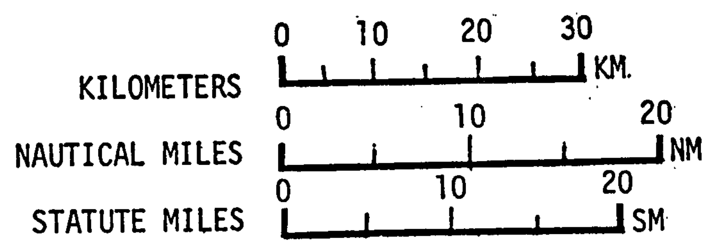
The overall experiment was designed in four parts with overlapping responsibility of the participants. These parts included the "Space Experiment," "Oceanic Experiment," "Living Marine Resources Experiment," and the "Utilization Experiment." EarthSat and NFMOA had principle responsibility for the Utilization Experiment and provided input data for use in the remaining three experiments. Similarly, the other cooperants and



AREA COORDINATES

LATITUDE (N)	LONGITUDE (W)
A. 30° 27'	89° 50'
B. 30° 27'	87° 45'
C. 30° 00'	87° 45'
D. 30° 00'	89° 50'

SCALE



AREA
AREA
DIMENSIONS

LINE	KM
A-B:	170.3
B-C:	51.0
C-D:	170.3
A-D:	51.0

TOTAL AREA: 8,685.3 KM^2

Figure 1. ERTS-A Experiment Test Site

participants provided data under each of their experimental programs which were also made available to the EarthSat/NFMOA team.

Reference is made to the ERTS-A Project Plan produced by the Fishery Engineering Laboratory under the direction of William H. Stevenson (July 21, 1972), for a complete discussion of the overall experiment. The EarthSat/NFMOA portion, funded as a separate entity by NASA, is all that will be considered in detail herein, with reference to the other experiments as required for continuity and clarity.

The data acquisition phase of this experiment was designed on the basis of two assumptions:

- °Remotely acquired data can be used to assist the fishing industry to deploy the harvesting fleet;
- °Satellite and aircraft imagery can be compared and integrated with simultaneously acquired sea truth fishery information to provide correlations regarding the ecology of the resource, and useful as a predictive tool.

With this reference, the program was executed so as to provide environmental information which was correlatable with both the fishery and the remote acquisition systems. Since the primary emphasis was on remote systems, the sea truth program was designed to coincide with the availability of remotely acquired data from one or more of the platforms utilized. Thus sea truth and fisheries information was acquired discontinuously through the fisheries season beginning approximately the first week in June and continuing until the end of September (at which time the fishery underwent a rapid decline). As will become evident in the following paragraphs, all cooperants provided sea truth under various schedules. However, primary sea truth for the overall experiment was provided by EarthSat and timing as well as deviations were constructed so as to provide this data not only for our own analysis, but for those of the other participants as well.

Main Text

Experimental Design

Each of the four sub-experiments previously described was designed as a separate entity with the capability to function entirely on its own. However, it was recognized that each would benefit from the coordination of data acquisition and subsequent free exchange of such data. For example, for this experiment it was only necessary to measure selected parameters at the site of fishing activity and utilize ERTS as an extrapolation tool. However, if quasi-synoptic surface data were also available, then the validity of the extrapolation could be verified. Similarly, the data base from which ERL made its analysis was increased by the addition of oceanographic data obtained from fishing vessels. Further, information obtained from fishing vessels was used to deploy the ERL weekly overflight, and the information so derived was of use in the fisheries experiment for adding a degree of synopticity otherwise unobtainable on a weekly basis.

Based on an understanding of the methods employed in the menhaden fishery, it was determined that basic fishery-environmental data would be obtained from selected fishing vessels during their activities. The number of vessels operating in the test area varied during the field operations period, but a minimum of two, and usually three, were always available. EarthSat personnel were placed on each of three vessels and instructed to obtain data (to be described below) during the interval when the net boats were deployed and the carrier vessel was idle. Thus the data so obtained was designed to sample the mesoscale environment, rather than the microscale conditions extant at any instant within a school. Such data was deemed more nearly representative of conditions viewed by the remote platforms to be utilized.

A field operations center was established in Moss Point, Mississippi, in the vicinity of the processing plants from which the fishing vessels operated. This center occupied a converted instrumentation trailer provided for that purpose by NASA/MTF. It was manned by Mr. O. Ray Temple of EarthSat, who relocated to Moss Point for the period of the field operations. Mr. Temple's primary responsibilities were to coordinate day to day activities of the personnel aboard the carrier vessels, coordinate the intermittant use of the industry spotter aircraft, and provide an operational interface between EarthSat field activities and those of the other cooperants.

The menhaden fishery operates on a weekly basis. No fishing occurs on Sunday; however spotter aircraft fly patrols on Sunday to locate concentrations of fish. This information is used in deploying the fleet for the fishing which begins on Monday. Fishing proceeds until Friday, unless weather intervenes, and if fishing is good, may continue until early afternoon Saturday. Operations are strictly during daylight hours. Generally, fishing is best early in the week and tapers off towards the end of the week, possibly due to school disruption by fishing activity. To obtain data most representative of optimum fishing, EarthSat confined its "sea truth" program to the first three days of each fishing week, with the exception of those weeks when satellite overflight or a major field exercise involving all cooperants was scheduled to occur later in the week.

Two days were required to image the entire test area, but only selected overpass sequences were utilized for major field exercises. On ERTS overflight days occurring during the week but not scheduled as an exercise period, field activities were continued to include those days. Due to the uncertainty of Saturday data and lack of Sunday data, no major field events were scheduled on weekends.

The data obtained from the fishing vessels is shown in Table 1. Two categories of data were obtained. The first included fishery data and environmental data likely to be related to fish availability. Such data included water temperature, salinity, turbidity and water color. Other data was obtained as part of the cooperative agreement to augment observations undertaken by other cooperants, and to provide ancillary environmental information.

Although EarthSat surface data was acquired throughout the season as described, data acquisition by FEL, Pascagoula, and ERL occurred at specified intervals designated "Main" and "Secondary" days. With the exception of the first Main Day, which was used as a system test, Main Days were scheduled coincidental with, or as near as possible to, days of ERTS overflight of the test area. On Main Days, ERL /FEL chartered surface vessels occupied descrete stations in the test area (Figure 2) and aircraft overflights were accomplished utilizing light aircraft from ERL and Pascagoula, as well as the NASA NP3A from Houston. During Main Days, the number of fishing vessels utilized was increased to as many as six, depending on availability. This was accomplished by coordinating site visits by the PI and Test Site coordinator (P.M. Maughan and A.D. Marmelstein, respectively) with such planned activities, so that they and Mr. Temple might also participate in data collection.

Secondary Days were scheduled for each Tuesday from mid-July until mid-October, except for weeks when Main Days were scheduled. On Secondary Days one charter vessel was utilized, but primary sea truth was obtained from fishery vessels. Only a portion of Main Day flight lines were utilized and these were selected to coincide as nearly as possible with fishing vessel activity. Thus ERL aircraft deployment decisions were made jointly by ERL personnel and O.R. Temple of EarthSat.

As indicated, another aircraft program acting cooperatively with this experiment involved a weekly overflight of the test area conducted by an aircraft chartered by NMFS Pascagoula. This program involved photographic inventory of all surface schooling species in the test area. These flights were nominally scheduled coincident with Main and Secondary Day activities. Weather constraints or equipment problems frequently caused rescheduling of both weekly aircraft overflights to days other than the nominal Tuesday date.

PARAMETER	ACCURACY
Date	-
Location	0.1° Lat., Long.
Time	5 mins.
Catch	1000 Fish
Water Temperature	0.1°C
Air Temperature	0.1°C
Salinity	0.1 o/oo
Secchi Depth	0.5 ft.
Forel Color	(to scale)
Wind Speed & Direction	5 knts.
Sea State	1 ft.

Table 1 EarthSat/NFMOA Surface Truth Data.

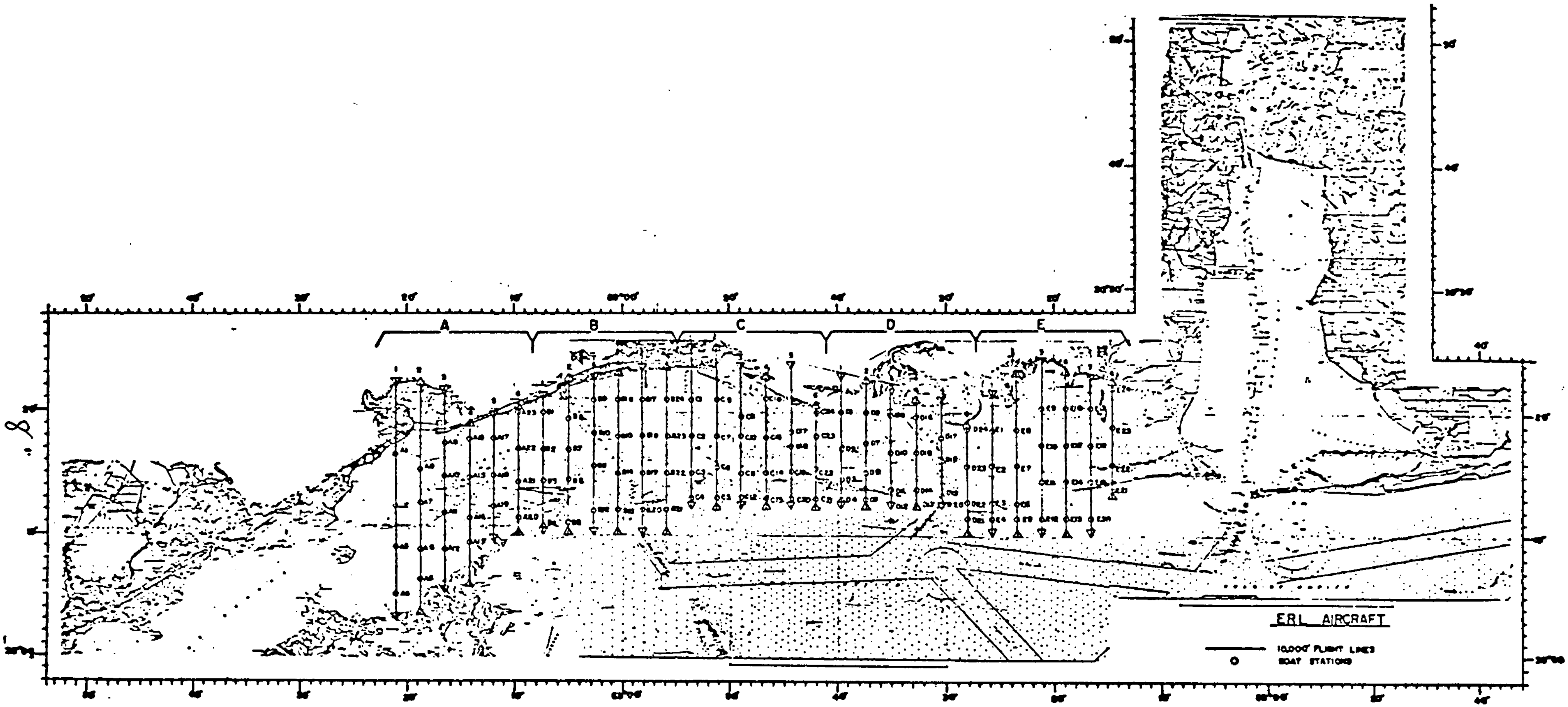


Figure 2. ERL Flight Lines and Surface Vessel Stations.

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The weekly patrols flown on Sunday by industry spotter pilots were utilized as a further inventory of surface schooling species, in that the pilot reported both menhaden and non-menhaden schools and an estimated of school size. Data were retrieved from these flights either by placing an EarthSat observer aboard or, where that was not possible, by monitoring the pilot's observations by radio. Thus school positioning could be accomplished on the occasion of a Sunday ERTS overflight, such as occurred on August 6, but ancillary environmental data was lacking. During the period 18 July to 1 August, the Pascagoula aircraft was unavailable, and spotter pilot patrols were substituted for those missions.

Field activities for this experiment extended from June through September and spanned the most active portion of the fishing season. Table 2 lists the dates during which field data was acquired, as well as dates of Main and Secondary Days and dates of ERTS overflight. This table shows the actual acquisition dates of EarthSat field data. In many cases, such as 12 September, the field program was in effect, but no data was collected due to a lack of fishing success.

Fishing by industry vessels was reduced to two vessels in early October and terminated entirely in early November. During the period October to November fishing was very poor.

Data Analysis

Data Management System

In the initial meetings held in May at MTF and attended by all participants in the joint ERTS experiment, it was agreed that all data would be archived in a common data bank. The system to be utilized, then under developement, would be computerized and dynamic. It would allow continual updating while maintaining the versatility necessary to allow the individual cooperants' to manipulate their own data, or any combination of their own or other cooperants' data, as they saw fit.

The system utilized, called "ENVIR", was developed for NASA by the Gulf Universities Research Consortium (GURC). In order to fully utilize this system, Dr. Marmelstein relocated to MTF for approximately three months from September through November. During this time he attempted the first exercises of the ENVIR system which precipitated an extended system shakedown period. By late November, the basic system was functioning. The "end to end" structure of ENVIR is shown in Figure 3.

The ENVIR system is so designed that data acquired by each of the participants can be entered through punch cards and exposed to an editing routine which converts all parameters to standard units. Each experiment file is then stored separately on tape in reformatted form. These separate storage files are individually read into the ENVIR system which codes and compresses all the data into a common file called the ENVIR ERTS-A Data File. With simple English language requests an investigator can retrieve any subset of data, structured or restricted in any manner he chooses, and identified as to its source as well as its content. These retrieved subsets are available either in routine printout or as a tape file for further analysis using available statistical, analytical, and display routines. An example of a query printout is shown in Figure 4.

EarthSat Field Acquisition	Main Day	Secondary Day	ERTS Overpass
7 June			
9-12 June			
15 June			
18 June			
21-29 June			
2-8 July	6 July		
10-13 July		11 July	
16-19 July			
		20 July	
21 July			
23-26 July		25 July	
31 July			
1-2 August		1 August	
6-9 August	7 August		6-7 August
13-16 August		15 August	
20-25 August	25 August		24-25 August
28-30 August			
3 September			
5-6 September		6 September	
			11-12 September
13-14 September		13 September	
18-19 September		19 September	
26-29 September	28 September		29-30 September

TABLE 2: Summary of Data Acquisition Dates.

ERTS-A

INFORMATION FILE GENERATOR

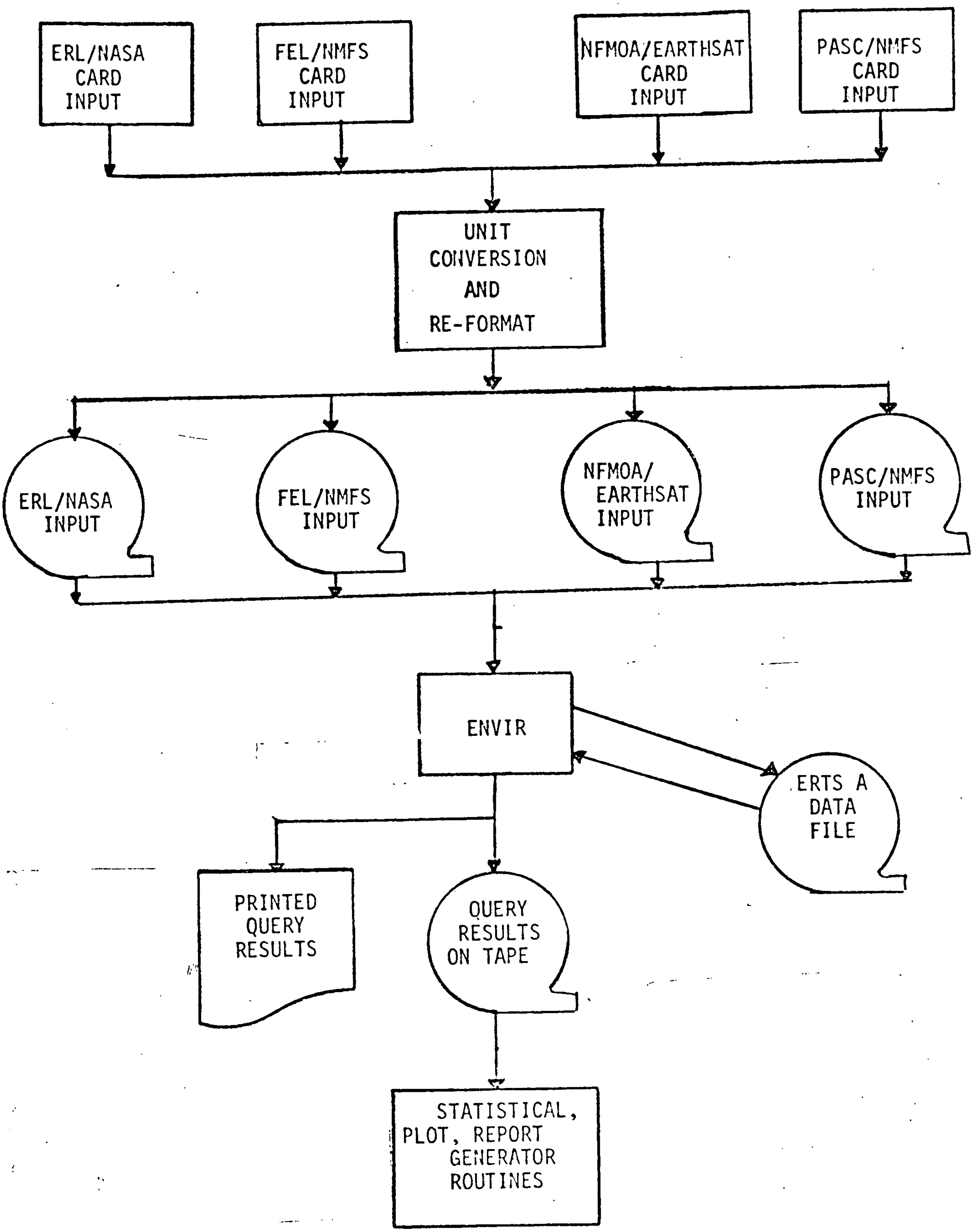

Figure 3. An overview of GURC-NMFS interface for generating an ERTS-A Information File using the GURC EDMPAS Data Management System.

ID (TIME,LAT,LONG,SECCHI VISB.,HOH DEPTH,DATA SOURCE)
PRINT:(TIME,LAT,LONG,SECCHI VISB.,HOH DEPTH,DATA SOURCE)
FOR ALL ITEMS IN THE ERTS-A DATA BANK AS OF NOV. 27 1972 WITH DATE,080772

NO. OF ITEMS IN QUERY RESPONSE = 1228
NO. OF ITEMS IN THE DATA BANK = 4766
PERCENTAGE OF RESPONSE/TOTAL DATA BANK = 25.77

645	30.32	DEG.N.	88.54	DEG.W.	1.1 METERS	---	NFMOA
755	30.32	DEG.N.	88.52	DEG.W.	1.2 METERS	---	NFMOA
819	30.37	DEG.N.	88.23	DEG.W.	---	---	PASC
819	30.37	DEG.N.	88.25	DEG.W.	---	---	PASC
819	30.39	DEG.N.	88.23	DEG.W.	---	---	PASC
819	30.39	DEG.N.	88.25	DEG.W.	---	---	PASC
820	30.37	DEG.N.	88.27	DEG.W.	---	---	PASC
820	30.37	DEG.N.	88.29	DEG.W.	---	---	PASC
820	30.38	DEG.N.	88.27	DEG.W.	---	---	PASC
820	30.38	DEG.N.	88.29	DEG.W.	---	---	PASC
821	30.37	DEG.N.	88.33	DEG.W.	---	---	PASC
821	30.38	DEG.N.	88.31	DEG.W.	---	---	PASC
821	30.38	DEG.N.	88.33	DEG.W.	---	---	PASC
822	30.37	DEG.N.	88.35	DEG.W.	---	---	PASC
822	30.37	DEG.N.	88.37	DEG.W.	---	---	PASC
822	30.38	DEG.N.	88.35	DEG.W.	---	---	PASC
822	30.38	DEG.N.	88.37	DEG.W.	---	---	PASC
823	30.37	DEG.N.	88.40	DEG.W.	---	---	PASC
823	30.37	DEG.N.	88.41	DEG.W.	---	---	PASC
823	30.38	DEG.N.	88.40	DEG.W.	---	---	PASC
823	30.38	DEG.N.	88.41	DEG.W.	---	---	PASC
824	30.37	DEG.N.	88.44	DEG.W.	---	---	PASC
824	30.37	DEG.N.	88.46	DEG.W.	---	---	PASC
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824	30.37	DEG.N.	88.50	DEG.W.	---	---	PASC
824	30.38	DEG.N.	88.44	DEG.W.	---	---	PASC
824	30.38	DEG.N.	88.46	DEG.W.	---	---	PASC
824	30.38	DEG.N.	88.48	DEG.W.	---	---	PASC
824	30.38	DEG.N.	88.50	DEG.W.	---	---	PASC
825	30.33	DEG.N.	88.54	DEG.W.	1.1 METERS	2.1 METERS	ERL
825	30.37	DEG.N.	88.52	DEG.W.	---	---	PASC
825	30.37	DEG.N.	88.54	DEG.W.	---	---	PASC
825	30.38	DEG.N.	88.52	DEG.W.	---	---	PASC
825	30.38	DEG.N.	88.54	DEG.W.	---	---	PASC
826	30.37	DEG.N.	88.56	DEG.W.	---	---	PASC
826	30.37	DEG.N.	88.58	DEG.W.	---	---	PASC
826	30.38	DEG.N.	88.56	DEG.W.	---	---	PASC
826	30.38	DEG.N.	88.58	DEG.W.	---	---	PASC
827	30.36	DEG.N.	88.60	DEG.W.	---	---	PASC
827	30.36	DEG.N.	88.62	DEG.W.	---	---	PASC
827	30.38	DEG.N.	88.60	DEG.W.	---	---	PASC
827	30.38	DEG.N.	88.62	DEG.W.	---	---	PASC
828	30.36	DEG.N.	88.65	DEG.W.	---	---	PASC
828	30.36	DEG.N.	88.67	DEG.W.	---	---	PASC
828	30.38	DEG.N.	88.65	DEG.W.	---	---	PASC
828	30.38	DEG.N.	88.67	DEG.W.	---	---	PASC

Figure 4. An example of an ENVIR Query Printout.

The ability of ENVIR to rapidly retrieve any data subset and expose it to preselected analytical routines has greatly facilitated statistical and display manipulations required for this experiment. The availability of compatible data from sources other than the fishing vessels is expected to contribute to the identification of major environmental features, such as turbidity, also observable from ERTS data. Reliable analyses are currently being produced. Products received until recently were subject to doubt due to systems errors which occurred whenever a new modification was attempted. Analyses discussed in the results section must be considered preliminary in that they are based on computer runs attempted during the period when such errors were still common. Recent "end to end" runs have produced error free results, but these latter results are not completely analyzed.

Surface Data

In an attempt to extend qualitative relationships developed from familiarity with adult menhaden behavior, analyses of the key parameters salinity, water temperature, water color, and turbidity are proceeding to relate these graphically and analytically to availability of the resources as measured by number of fish captured per attempt and number of attempts. This is being accomplished by visual comparison of geographic plots of catch distribution with contoured displays of the above parameters. In addition, linear regression and other numeric analyses are being routinely employed due to the ease with which the computerized data management systems allow such manipulation. Particular attention is being given to color/turbidity, as these parametric distributions are most readily obtained from ERTS imagery. Relationships developed around temperature and salinity are also of interest, as distributions of these parameters are suspected to be driven by tidal action, as are color/turbidity features. It is hoped that cooperatively supplied aircraft remote temperature and color/turbidity data will be useful in extrapolating relationships to ERTS.

Remote Data

Two types of remote data analyses are underway. The first involves survey data such as school inventory, as provided by NMFS, Pascagoula. Such data is directly entered into ENVIR after photographic interpretation by NMFS staff, and can be utilized in the same manner as surface data in ENVIR. The second analysis technique employs standard methods for comparing surface observed parametric distributions and derived relationships with remote observations. In the latter case, ERTS imagery and available aerial photography were helpful, and are being interpreted visually and with enhancement by color combination or density slicing in order to relate surface observations to those obtained by remote platforms. Of most benefit to date has been the preparation of overlay maps depicting catch locations at time of ERTS overflight and comparison of these geographic overlays with water structure features (some combination of color/turbidity) depicted in ERTS imagery. Unfortunately, few cloud free overpass days have coincided with periods of successful fishing.

Results

Significant Results

Preliminary analyses accomplished to date indicate that several important relationships have been observed utilizing ERTS-1 imagery. Of most signifance is that in Mississippi Sound, as elsewhere, considerable detail exists as to turbidity patterns in the water column. Simple analysis of this information is complicated however by the apparent interaction between actual turbidity, turbidity induced by shoal water, and actual imaging of the bottom in extreme shoal water. A statistical approach is being explored which shows promise of at least partially separating these effects so that partitioning of true turbid plumes can be accomplished. This partitioning is of great importance to this program in that supportive data seem to indicate that menhaden occur more frequently in turbid areas. In this connection we have been able to associate four individual captures with a major turbid feature imaged on 6 August. An enhanced portion of this image (a black and white reproduction of a color enhanced, density sliced presentation of MSS Band 5) with capture positions annotated, appears as Figure 5. The corresponding portion of the actual image, similarly annotated, is shown in Figure 6. If a significant relationship between imaged turbid features and catch distribution can be established, for example by graphic and/or numeric analysis, it will represent a major advancement for short term prediction of commercially accessible menhaden.

Other Results

Surface Data - Preliminary correlations have been performed to determine the relationship, if any, between number of fish captured per set and number of sets attempted; and the environmental variables of water color, water visibility, water temperature, and salinity. These correlations have been attempted for the season's data, as well as the data lumped by month and week. Software errors preclude definitive statements at this time, but indications are that some consistent relationships exist, whereas other relationships are nonexistent or seasonally affected. Figure 7 shows the results of a linear correlation of secchi depth (a measure of turbidity) with fish catch. For this example, using data from the week of July 2, a correlation coefficient of 0.44 was obtained. However, anomalous values do appear due to software errors. These errors are being removed and is is expected that software system corrections plus availability of other numeric analysis techniques to be interfaced with ENVIR will shortly provide clarification of these findings. Graphic and geographic displays of both EarthSat/NFMOA and other cooperants data are also becoming available, but as yet not enough products exist to permit meaningful analysis beyond the impression that, as with ERTS observable turbidity, some relationship appears to exist between turbidity/visibility parameters and commercially available menhaden schools. For example, Figure 8 is a plot of average catch versus secchi visibility for the same period as Figure 7 above. Note the positive relationship. Relationships between school availability and temperature and salinity for the data acquired are less clear.

Figure 5. An Enhanced Portion of ERTS-1 Image 1015-16013-5, Showing Association of Menhaden Capture Sites with a Turbidity Feature.

Figure 6. Reproduction of a Portion of the Original Image 1015-16013-5 with Overlay Showing Association of Menhaden Capture with a Turbid Feature.

```
RESTEM CASE =    9 EFIN =     .01000 EFOUT = -20.00000

MULTI-STEP REGRESSION ANALYSIS OF      2 VARIABLES

FLEVEL =      .00000

FLEVEL =   11.85183

REGRESSION COMPLETED NORMALLY ON STEP NO.       3

ARRAY OF MEANS -XBAR- FOLLOWS
   1.19800  59.42000

CORRELATION COEFF. ARRAY -A- FOLLOWS
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   -.44499     .80198

STANDARD DEV. ARRAY -SIG- FOLLOWS
   2.22032 386.26697

FLEVEL =   11.85183

CONSTANT =          -33.32354

NVAR =              1 NOIN =              1 IVAR =        1      0

STANDARD ERROR OF Y -SY- =   49.92854

REGRESSION COEFF. ARRAY -B- FOLLOWS
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STANDARD ERRORS OF COEFF. ARRAY -SB- FOLLOWS
  22.48714     .00000

PREDICTED Y PLUS RAW DATA ARRAY .X(I)+OX(N). FOLLOWS
    1 PRED. Y=,   13.12565     .60000  60.00000
    2 PRED. Y=,   28.60872     .80000   2.00000
    3 PRED. Y=,   28.60872     .80000  20.00000
    4 PRED. Y=,   28.60872     .80000  25.00000
    5 PRED. Y=,   28.60872     .80000  45.00000
    6 PRED. Y=,   36.35025     .90000   3.00000
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   13 PRED. Y=,   36.35025     .90000  40.00000
   14 PRED. Y=,   36.35025     .90000  75.00000
   15 PRED. Y=,   36.35025     .90000  75.00000
   16 PRED. Y=,   51.83331    1.10000    .00000
   17 PRED. Y=,   51.83331    1.10000    .00000
   18 PRED. Y=,   51.83331    1.10000  10.00000
   19 PRED. Y=,   51.83331    1.10000  25.00000
   20 PRED. Y=,   51.83331    1.10000  40.00000
   21 PRED. Y=,   51.83331    1.10000  75.00000
   22 PRED. Y=,   51.83331    1.10000  90.00000
```

Figure 7. Sample Linear Regression of Number of Fish Per Set Versus Secchi Visibility for 07/02/72 to 07/08/72

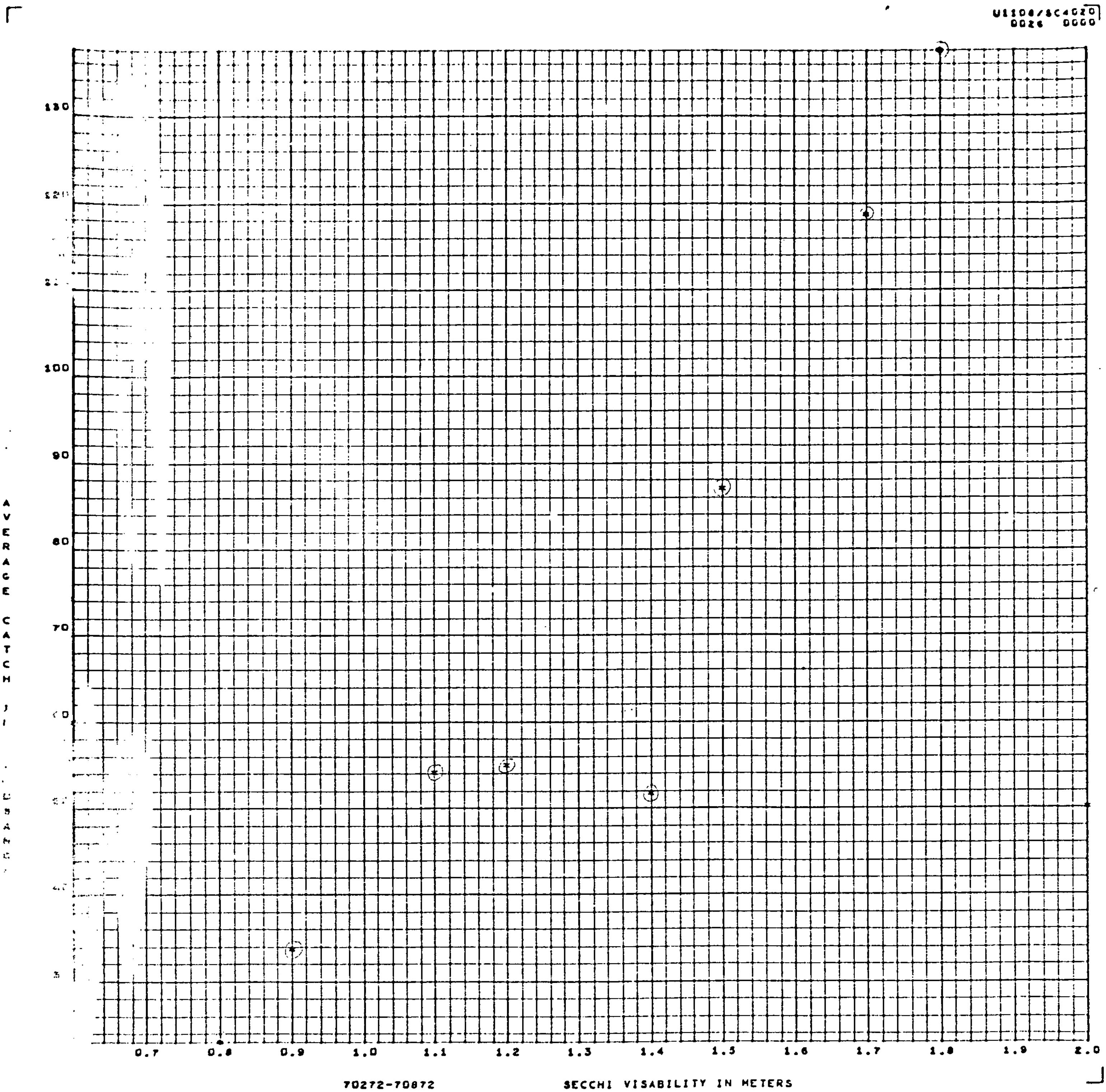

Figure 8. Machine Plots of Visability vs. Average Catch for 07/02/72 to 07/08/72

Remote Data - Analyses of aerial photography and aircraft multispectral data are proceeding to determine if turbid features identified from ERTS and/or ground truth can be further detailed utilizing these sources. Aircraft thermal imagery is being examined for its relationship to turbid features as it is hypothesized that major turbid and thermal features may be tidally induced or affected.

Visual comparison of ERTS identified turbid features and catch records for several days before and after overflight are being attempted to establish persistence of associations of schools with areas where such features are imaged. It is hoped that this will enable identification of the minimum ERTS return time necessary in order to maintain continuity of association predictions.

New Technology

As of this reporting period no new technology has resulted from this project.

Program for Next Reporting Interval

During the next reporting interval, completion of statistical and numerical analyses are expected, as well as further definition of relationships between ERTS imaged turbidity/color features and commercial fishing activity. The latter will be accomplished through continued analyis of imagery/sea truth interrelationships. This next interval will cover the completion of this project and production of the final report.

Conclusions and Recommendations

It is felt at this time that conclusions would be premature, other than to state that ERTS imagery does reveal considerable detail as regards turbidity in the coastal environment and that such features apparently bear some relevance to menhaden fishing effort.

Meetings and Papers

Three meetings of the cooperative ERTS-A experiment participants were convened at MTF. These were held on 24-26 May, 5-7 July and 25-27 October. The first and second, attended by Drs. Marmelstein and Maughan respectively, were to plan the cooperative approach and then review that approach after one month of operations. The third meeting, held during Dr. Marmelstein's TDY at MTF, was to review the current status of the field activities and to review and revise the data products being routinely supplied by ERL or available through ENVIR.

On September 19, Dr. Marmelstein and Mr. W.H. Stevenson of NMFS/FEL gave a brief project review to the Technology Committee of NFMOA at their annual meeting.

Dr. Maughan co-authored a paper entitled "Application of ERTS-A Data for Fishery Resource Assessment and Harvest" presented by Mr. Stevenson at the Eighth International Symposium on Remote Sensing of Environment. This conference was held in Ann Arbor, Michigan on 2-6 October. Third author of the paper was Dr. H.B. Atwell of NASA/ERL/MTF. Copies of the abstract and paper have been forwarded to cognizant NASA personnel by Mr. Stevenson.

Appendices

Appendix 1

ERTS Image Descriptor Forms

ERTS IMAGE DESCRIPTOR FORM

USER NAME Paul Maughan DATE December 29, 1972
USER ID P507
AGENCY Earth Satellite Corporation

PRODUCT ID (Include Band and Product)	Frequently Used Descriptors *				DESCRIPTORS
	Turbid Water	Shoal Water	Estu-aries	Coastal Marshes	
1032-15555-4	X	X	all	all	
" -5	X	X			
" -6	X	X			
" -7					
1033-16014-4	X	X			
" -5	X	X			
" -6	X	X			Marshes
" -7					Islands
1050-15560-4	X	X			Barrier Beach
" -5	X	X			
" -6	X	X			Bayou
" -7					Jetties
1051-16014-4	X	X			Barrier Isl.
" -5	X	X			Rivers

*For Descriptors which will occur frequently, write the descriptor terms in these column heading spaces now and use a check (✓) mark in the appropriate ID lines. (For other descriptors, write the term under the DESCRIPTORS column).

MAIL TO ERTS User Services
Code 563
Bldg 23 Room E203
NASA GSFC
Greenbelt, Md. 20771

ERTS IMAGE DESCRIPTOR FORM

USER NAME Paul Maughan

DATE December 29, 1972

USER ID (con't)

AGENCY Earth Satellite Corporation

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS *				DESCRIPTORS
1051-16014-6	X	X			
" " -7					Above Descriptors apply to all images but are judged to be of secondary importance.
1086-15562-4	X	X			
" -5	X	X			
" -6	X	X			
" -7	X	X			

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

MAIL TO ERTS USER SERVICES
CODE 563
BLDG 23 ROOM E203
NASA GSFC
GREENBELT, MD. 20771

Appendix 2

Changes To Standing Orders

Changes to Standing Orders

15Nov72	delete:	Chesapeake Bay - North Carolina Coast Test Site;
	delete:	Coverage East Texas Coast - Western Mississippi
	add :	Coastal Alabama, Gulf Coast Florida

Only 70mm black and white bulk images

Appendix 3

Changes To Data Request Forms

Changes to Data Request Forms

250ct72 Request for 70-m black and white images not delivered per standing order:

1015-16013 07Aug72
1014-15555 06Aug72

270ct72 Request for 9 track digital tapes of scenes as follows:

1015-16013 07Aug72
1014-15555 06Aug72
1032-15555 24Aug72
1033-16014 25Aug72