

Long Term Monitoring of the Coral Reef Organisms of Biscayne National Park

Final Report: 1989-1990 Field Seasons

Amendment no. 1,
Subagreement no. 25,
Cooperative Agreement No. CA-5000-4-8005

Between USDI, NPS, & UGA Research Foundation Inc.

Volume 8 (of 8)

Deliverable: Sampling Protocol Handbook 2:
Photographic and Digitizer Methods & Software Analysis

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METHODS FOR THE ANALYSIS OF CORAL REEF COMMUNITY STRUCTURE

II. THE PHOTOSTATION METHOD

Manual by:
James W. Porter
Institute of Ecology
University of Georgia
Athens, GA 30602

III. Data File

Only temporary files created during execution. After execution, all these temporary files are deleted from the hard disk.

Introduction

These two manuals describe two methods for quantifying change on coral reefs: the line transect method (Part I) developed with Dr. Caroline Rogers, NPS, and the Photostation Method (Part II). The study was conceived to detect change in marine benthic communities. Therefore, while these methods can be used for one-time-only surveys, the methods are most powerful when used to compare between censuses taken in the same location but on different dates.

Section A of Parts I and II describes the field techniques for establishing the "permanent" surveys; Section B of both parts describes the computer software available for analyzing the data acquired by these methods.

These manuals, and the computer programs accompanying them, are not copy written. They can be obtained at cost from the following address. They will be supplied on 3 1/2" HD discs. This manual and the associated programs will be updated periodically. Any corrections or suggestions will be helpful.

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Coral Image Analysis (C.I.A.)
Version 1.2, Copyright(C) 1991
J.W. Porter/Linda Chiang, Zoology, UGA, Athens, Ga. 30602

Enter Photo Station ID : ? bp01
Enter Year of the Photo : ? 90
Enter the Beginning Frame Number for this region (e.g. 01) : 01
Enter the Ending Frame Number for this region : 36

Screen 4.13

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Enter Photo Station ID : ? bp01
Enter Year of the Photo : ? 90
Enter the Beginning Frame Number for this region (e.g. 01) : 01
Enter the Ending Frame Number for this region : 36
Drive (Path) for data : ? c:

Screen 4.14

Figure Legends

- Figure 1. Map of the Biscayne National Park, showing the location of Ball Buoy Reef and Triumph Reef.
- Figure 2. Survey of the Ball Buoy Reef area showing locations of the line transects and the photostation.
- Figure 3. Photo-montage of Ball Buoy Reef (BP01) showing the concatenation of the 36 individual photographs that make up the survey.
- Figure 4. Survey of the Triumph Reef area showing locations of the line transects and the photostations.
- Figure 5. Photo-montage of Triumph Reef (BP01) showing the concatenation of the 36 individual photographs that make up the survey.
- Figure 6. The rectangular grid system of the photostation is shown in this diagram. This representation shows in detail the frame numbers and coordinates for each frame.
- Figure 7. The 0.75 x 0.50 photographic framer is lowered over the large PVC framer and pictures (Figure 10) are taken of the sea floor below.
- Figure 8. Practice sheet for aligning the photographic tracing on the digitizer tablet.
- Figure 9. Cutlines are used to reduce (but not eliminate) overlap between photographs due to parallax. The parallax problem results from the need, when shooting through water, of keeping the camera as close to the reef as possible, necessitating the use of a wide angle lens. Compensation for parallax is one of the primary reasons why the digitized image is of the coral's projected surface area, not its actual biological surface area.
- Figure 10. Frame 8, of the Biscayne National Park Photostation BP01 on 27-April-1989.
- Figure 11. Photocopy of the mylar tracing (Figure 11a) of Frame 8, of the Biscayne National Park Photostation BP01 on 27-April-1989 and its digitized image (Figure 11b).
- Figure 12. Enlargement of digitized line showing the need to smooth the figure so as to reduce the number of point coordinates stored in each file.
- Figure 13. A digitized montage map of Ball Buoy Reef in the Biscayne National Park created by our mapping program (Figure 13a). Colonies of the dominant species have been silhouetted to show growth of the coral *Acropora palmata* from 1989 (Figure 13b1) to 1991 (Figure 13b2).

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Enter Photo Station ID : ? bp01
Enter Year of the Photo : ? 90

Screen 4.11

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Enter Photo Station ID : ? bp01
Enter Year of the Photo : ? 90
Enter the Beginning Frame Number for this region (e.g. 01) : 01

Screen 4.12

METHODS FOR THE ANALYSIS OF CORAL REEF COMMUNITY STRUCTURE

II. THE PHOTOSTATION METHOD

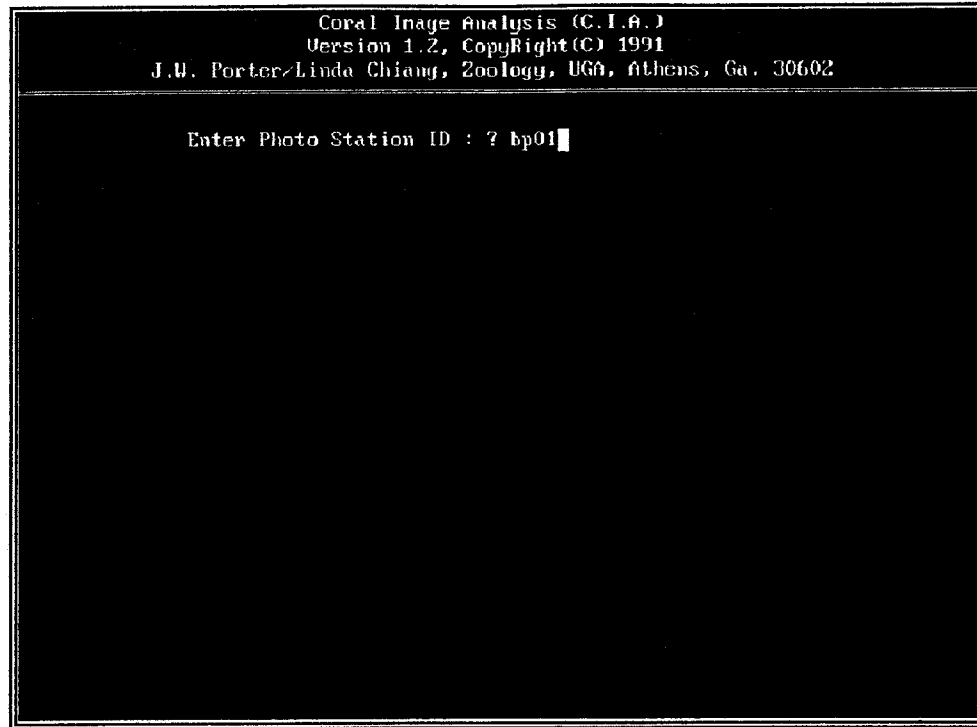
PART A. FIELD METHODS AND DATA ACQUISITION

In order to determine changes in community structure, base line surveys are needed against which to measure change. Repeat surveys at some later time interval can tell you if changes have occurred. This kind of information is useful to both research scientists trying to understand the population dynamics of the community, as well as environmental managers wishing to know the long term health of the environment. In either case, accurate information on the resource through time is needed.

Repeat surveys can be of two kinds: repeat surveys of exactly the same location, or repeat surveys of random samples taken from the same general location. Although these two methods may achieve the same goal, the assessment of change, the statistics applied to these two methods, and the number of samples required for statistical confidence, are different. Ludwig and Reynolds (1988) point out that the random sample method requires many more samples to detect the same amount of change as repeat samples of the same population. Repeat sampling of the same population will always give a higher level of statistical confidence with fewer samples than repeat random surveys. On the other hand, the representativeness of a specific locality chosen for repeat surveys can be questioned, whereas random samples are inherently less biased.

Underwood (1989) points out that ecological studies require experimental manipulations and controlled experiments to elucidate the causes for environmental change. Such experimental methods, however, may be inappropriate in the context of environmental management where a rapid assessment of the status quo of a resource may be critical to its preservation. Further, experimental manipulations may require environmental modifications that are incompatible with the preservation goals of a park or preserve.

In order to assess the health of coral reef communities (Porter *et al.*, 1981; Porter *et al.*, 1982), we set up a photographic monitoring system in the Biscayne National Park (Porter and Meier, 1992) (Figure 1). The system chosen involved the least amount of environmental modification possible, by establishing photostations that could be relocated precisely and rephotographed easily. This monitoring system relies on repeat surveys in precisely the same location, thereby taking advantage of the reduced number of samples needed to detect small changes with a high degree of accuracy. This system, therefore, was designed to act as an early warning signal of environmental change.



Screen 4.10

At Screen 4.10, enter the reef name (make it consist with previous names). Screen 4.11 asks for the year (for example, 90).

Screen 4.12 and Screen 4.13 ask for the start frame number and the stop frame number for this photostation.

Screen 4.14 directs the computer to the data for these frames (for example, on the c: drive in the current directory).

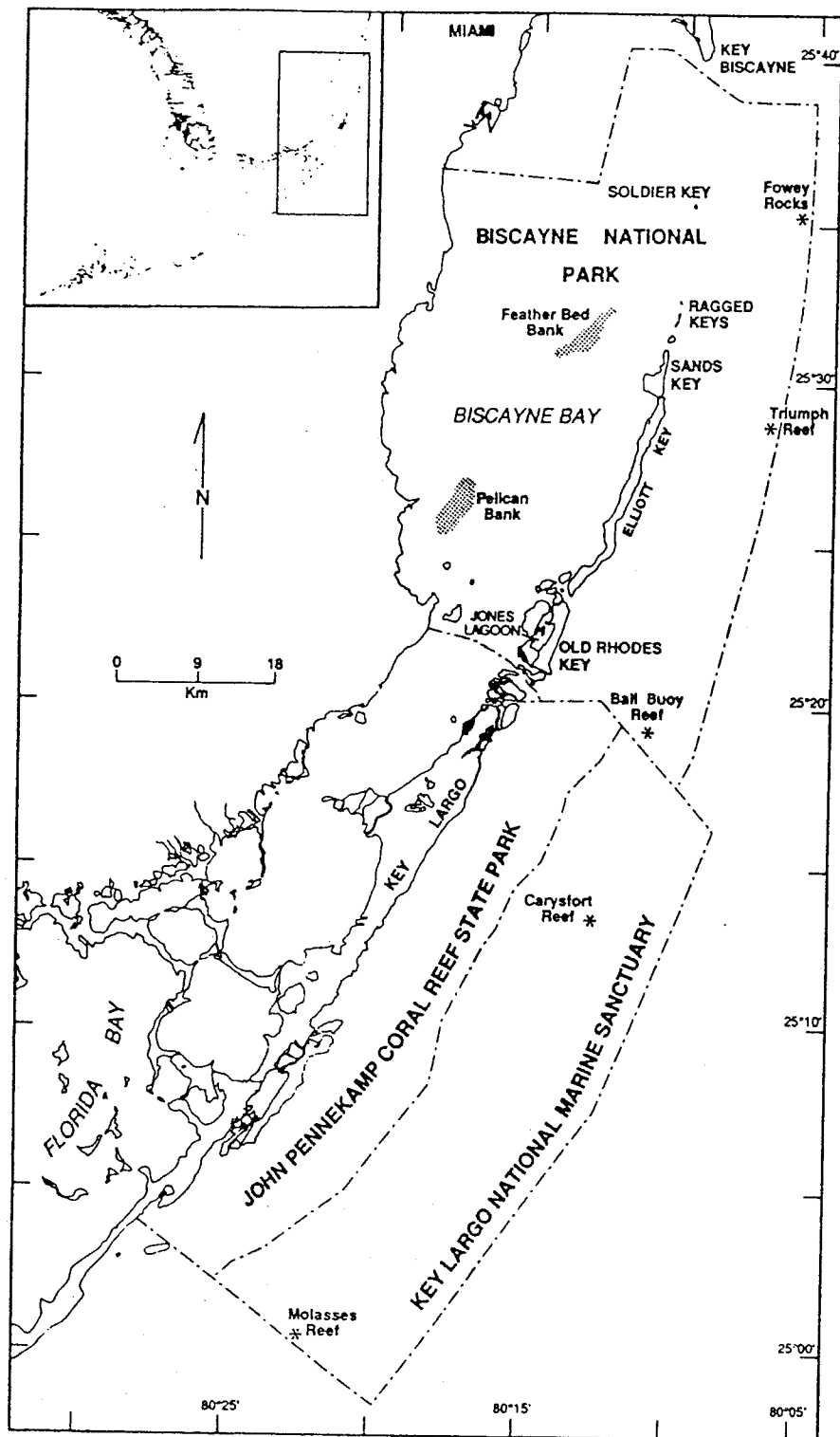
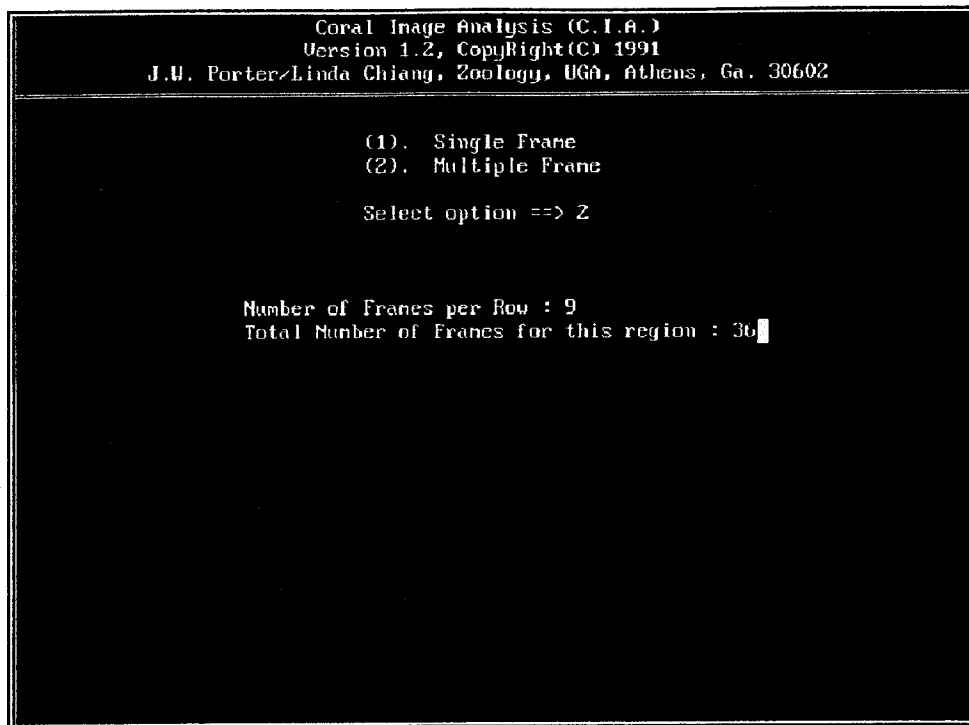
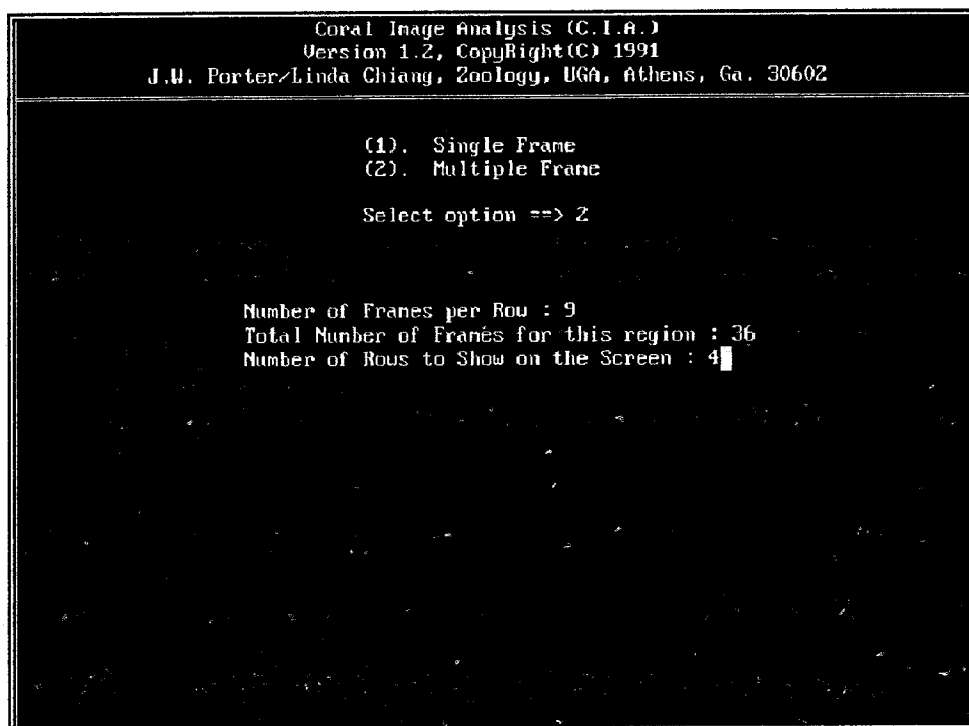


Figure 1



Screen 4.8



Screen 4.9

Photostations were chosen to include the two commonest coral reef types in the park: (1) a shallow water (4 m) reef dominated by elkhorn coral (Ball Buoy Reef; Figures 2 and 3) and (2) a slightly deeper reef (7 m) dominated by head corals (Triumph Reef; Figures 4 and 5). Photostations were marked so that they could be relocated, and line transects were run at the same location in order to compare between photostation and line transect methods.

An underwater hydraulic drill with a 2.5 inch core-bit was used to drill eight holes 2.25 m x 2.00 m apart in a rectangular grid (Figure 6). Stainless steel stakes (1 inch square pipe) are set two feet into the drilled holes with sufficient height above the bottom to serve as guide posts for a large PVC grid that is lowered over these stakes. The stainless steel stakes are cemented into place using hydraulic cement brought down through the water in zip-lock bags and squeezed into the holes through funnels.

A PVC grid is constructed of 1 inch diameter PVC pipe with dimensions of 2.25 m x 2.00 m. For the photographic survey, this grid is lowered over the vertical stainless steel stakes. A file mark part way down on the side of each stake designates how far down the stake the grid sits. Considering the three dimensional surface of the reef in the X, Y, and Z axes, then the stainless steel stakes position the grid in the X-Y plain, and the file marks on the stakes position it on the Z axis. The large grid must be moved three times to cover the region designated by the eight stakes (Figure 6). Total coverage under the three grid placements is therefore 13.5 square meters.

This large grid serves as a guide for a Nikonos camera attached to a quadrapod photoframer with dimensions at its base of 0.75 m x 0.50 m (Figure 7). A Nikonos fitted with a 28 mm underwater lens needs to be placed 1.0 m above this frame to include the whole 0.75 m x 0.50 m area in the picture. The camera framer has, in view of the camera, a velcro-backed frame number plus a small placard with date and place information.

The camera and attached framer are moved across the large PVC grid (Figure 7) in the pattern shown in Figure 6. Each time the camera and its framer move, the velcro frame number is changed before the picture is taken. Therefore, each photograph includes both its view of the reef as well as the date and place the picture was taken. Thirty-six individual pictures must be taken to survey the whole photostation (Figures 3, 5, and 6).

Surveys are taken in both black and white negative film Tri-X, ASA 400) and color slide film (Ektachrome, ASA 200). Tri-X film allows both a rapid shutter speed and a small aperture, giving sharp images with a large depth of field. Back and white negatives are printed at an enlargement of 8" x 10" on Kodak polycontrast paper.

The photographic prints are taped to a light table and covered by a sheet of mylar tracing paper. All coral colonies in view are identified to species and traced around their perimeter. Species labelling involves a four letter designation that includes the first letter of the genus name (upper case) and the first three letters of the species name (lower case). In this fashion, all Caribbean corals can be uniquely identified. Pacific coral species would require a five letter

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- (1). Single Frame
- (2). Multiple Frame

Select option ==> 2

Screen 4.6

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- (1). Single Frame
- (2). Multiple Frame

Select option ==> 2

Number of Frames per Row : 9

Screen 4.7

Biscayne National Park

Ball Buoy Reef

Photostation 1 Line Transects 1-5

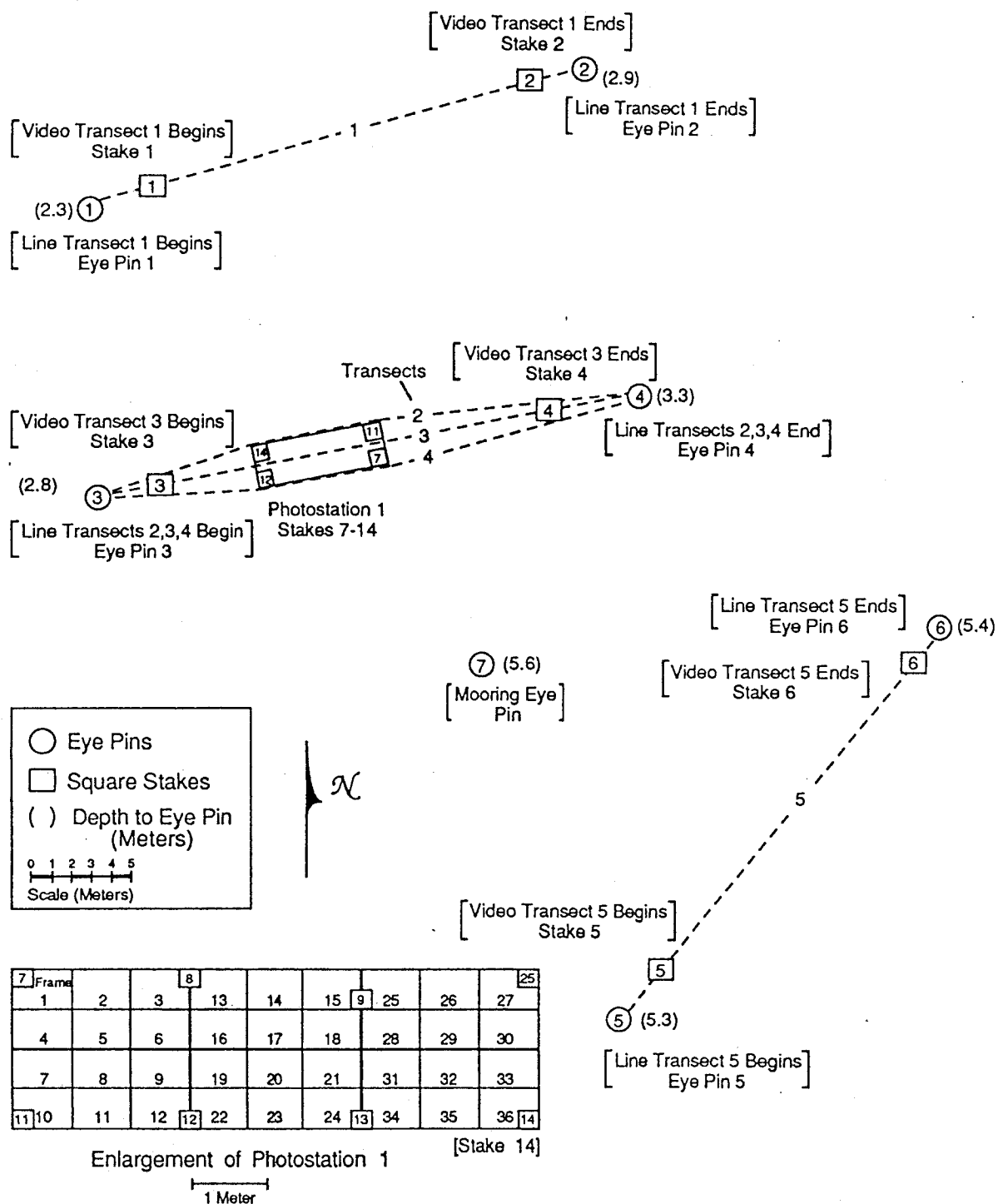
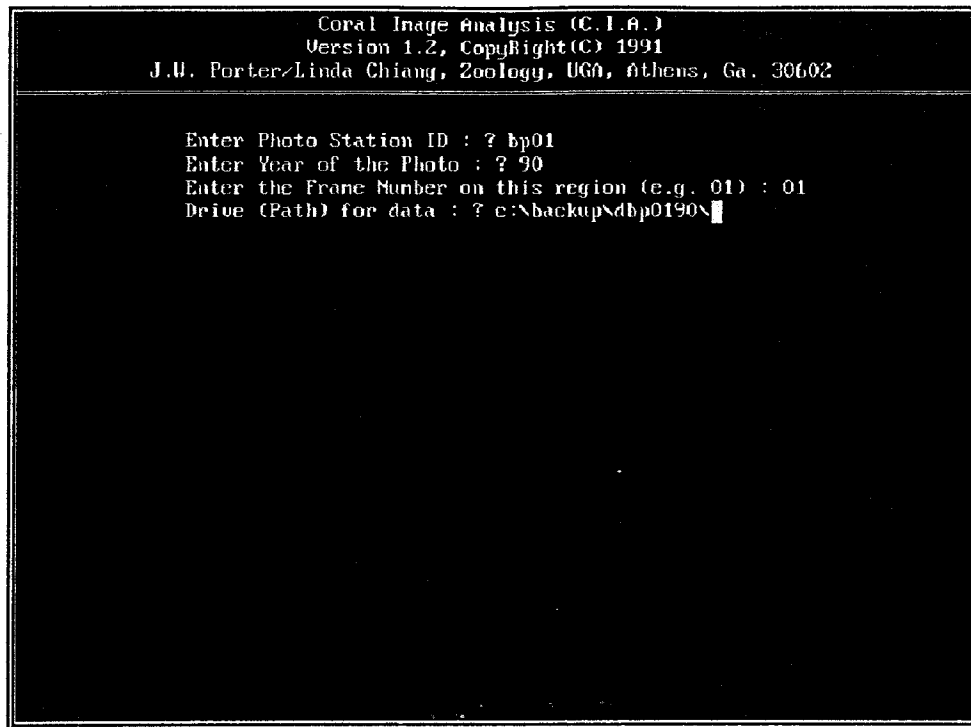


Figure 2.



Screen 4.5

Now the system will generate the specific frame image on the screen with no cut lines. If user wants to generate multiple frames, choose Option 2 from Screen 4.6.

Then, specify how many frames will show on each row, how many frames total are in this photostation, and how many columns are in the photostation (Screen 4.7, Screen 4.8, and Screen 4.9). The system will automatically count up and place the frames on the screen from left to right and top to bottom.

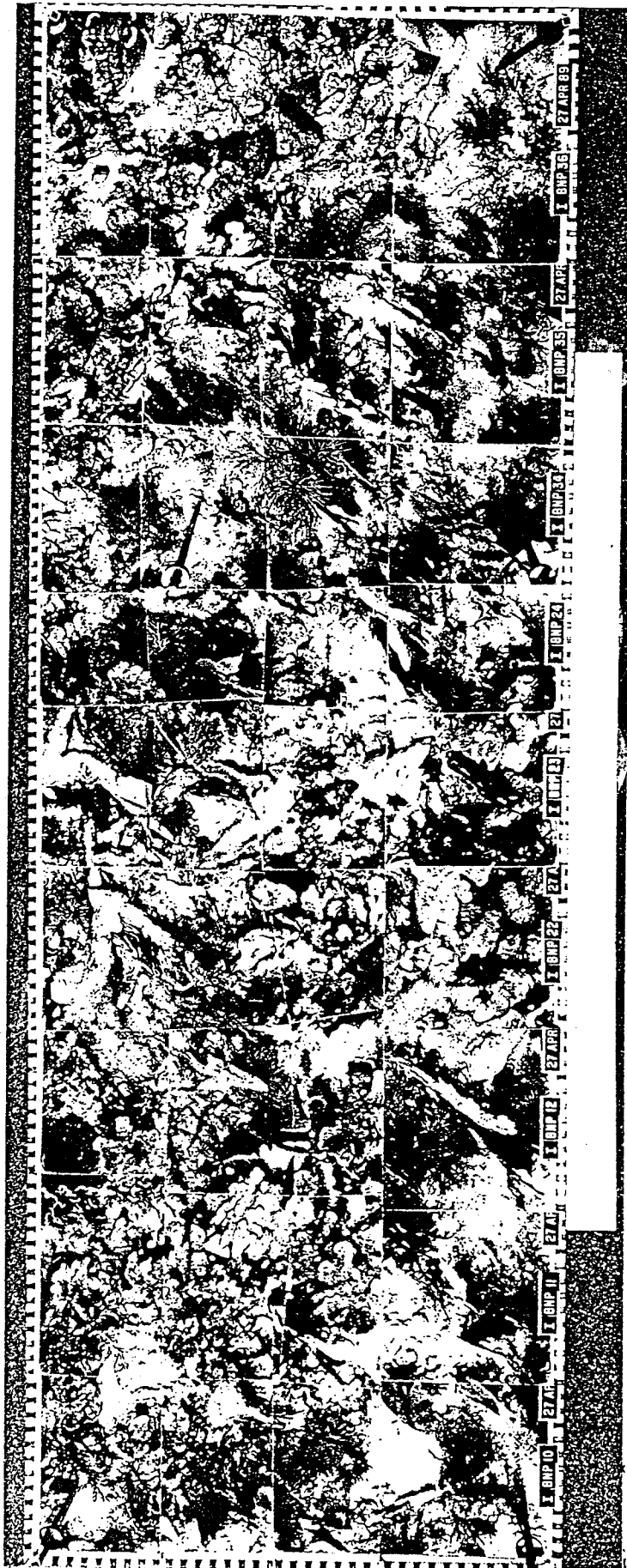


Figure 3. Ball Buoy Reef

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Enter Photo Station ID : ? bp01
Enter Year of the Photo : ? 90

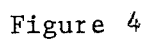
Screen 4.3

Coral Image Analysis (C.I.A.)
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Enter Photo Station ID : ? bp01
Enter Year of the Photo : ? 90
Enter the Frame Number on this region (e.g. 01) : 01

Screen 4.4

Photostation 2
Line Transects 6-10





If you choose 1, then Screen 4.2 appears. Enter the reef station name. This name should be consistent with the name assigned during digitizing.

```
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Enter Photo Station ID : ? bp01
```

Screen 4.2

Screen 4.3 asks for the year (for example 90). Screen 4.4 requests the beginning frame number (for example frame number 01). Finally, Screen 4.5 directs the system as to where to locate the files (for example c:\backup\dbp0190\).

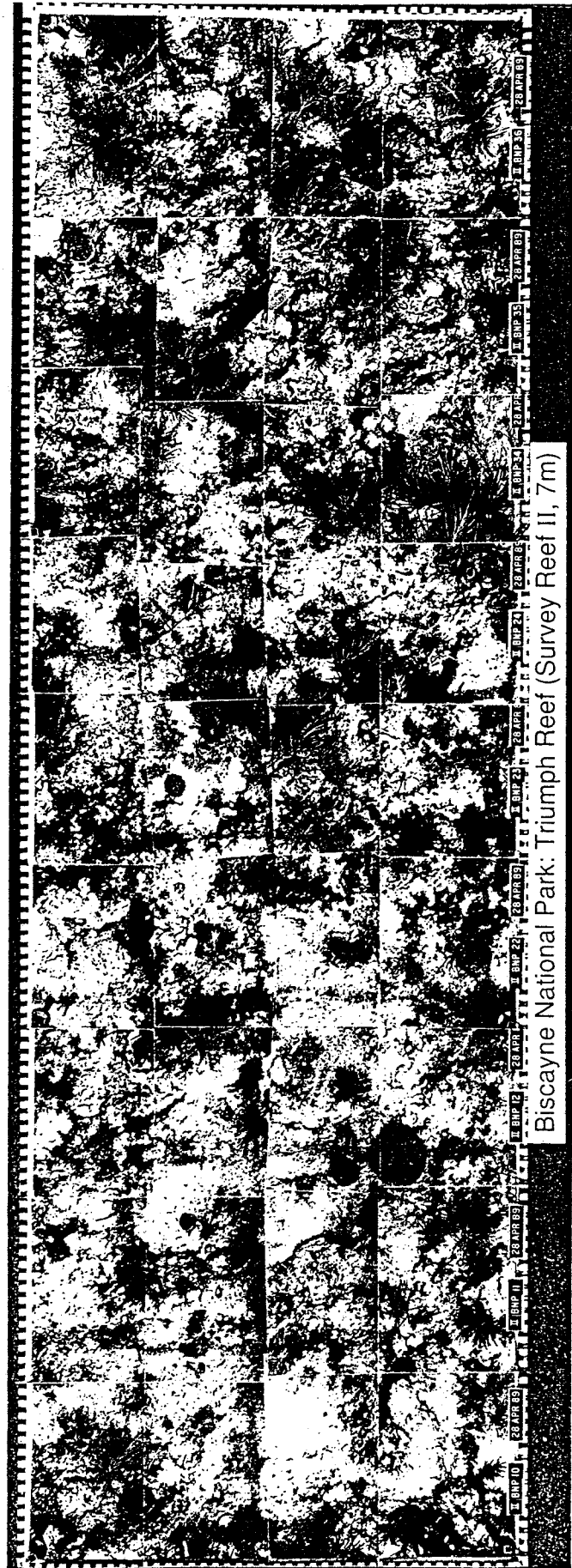
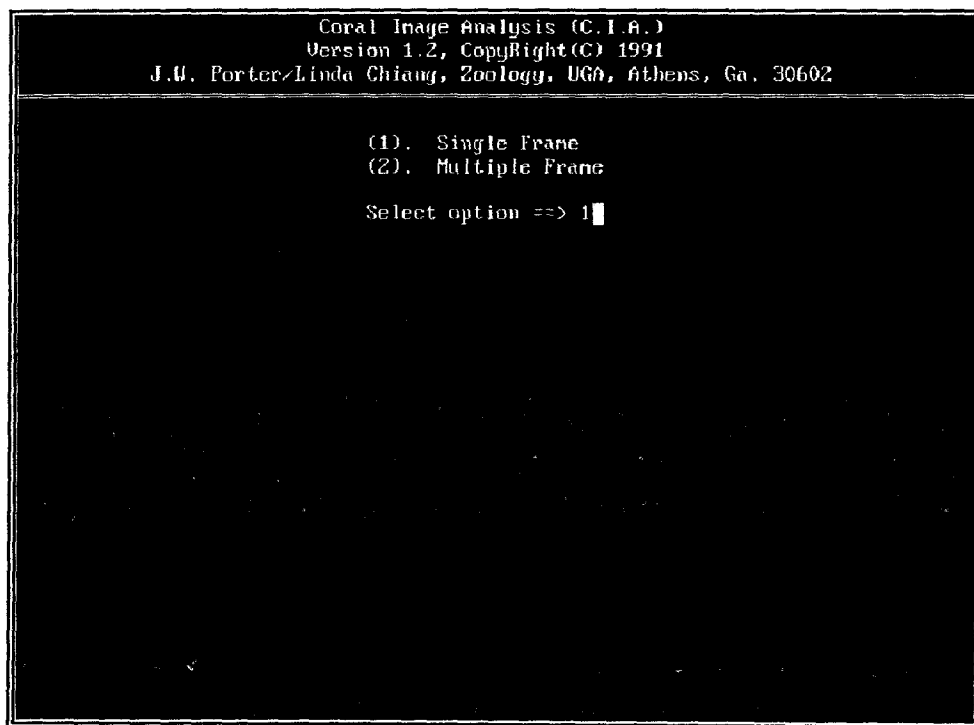


Figure 5. Triumph Reef

II. Running the Module

4.1 Starting up

Type CIA at the DOS prompt to get the system menu screen. At the menu screen (Screen 1.0) type 4 <Enter>. The frame mapping module screen (Screen 4.1) will now appear. The first question asks whether individual frames or multiple frames will be drawn.



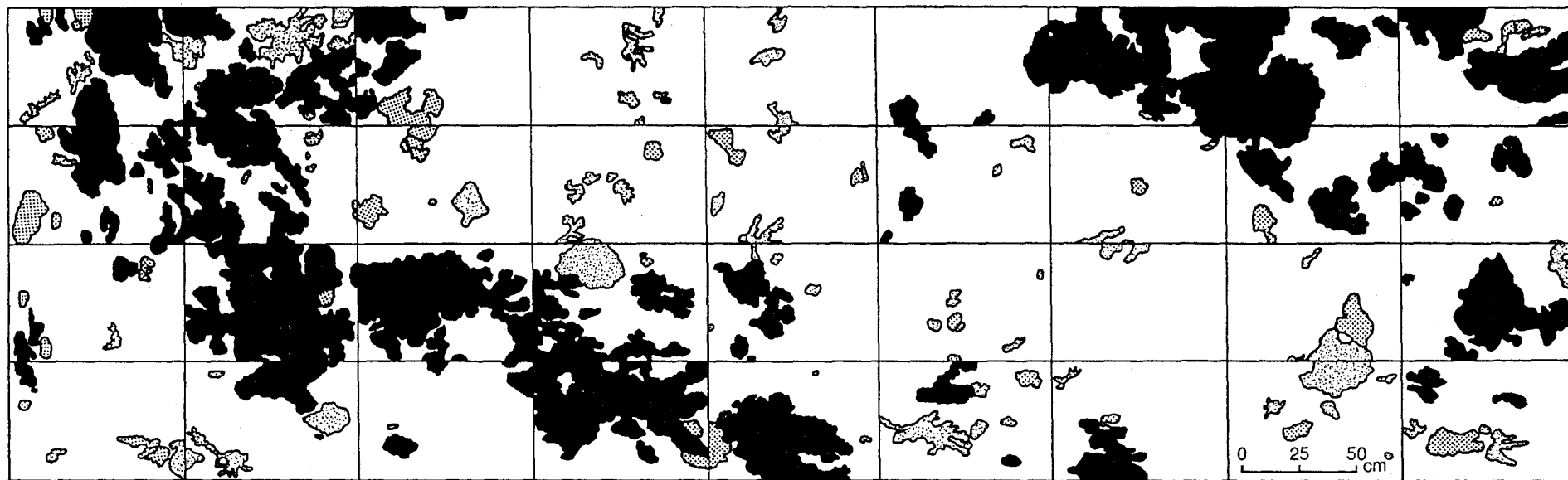
Screen 4.1

1 0,150	2 75,150	3 150,150	13 225,150	14 300,150	15 375,150	25 450,150	26 525,150	27 600,150
4 0,100	5 75,100	6 150,100	16 225,100	17 300,100	18 375,100	28 450,100	29 525,100	30 600,100
7 0,50	8 75,50	9 150,50	19 225,50	20 300,50	21 375,50	31 450,50	32 525,50	33 600,50
10 0,0	11 75,0	12 150,0	22 225,0	23 300,0	24 375,0	34 450,0	35 525,0	36 600,0

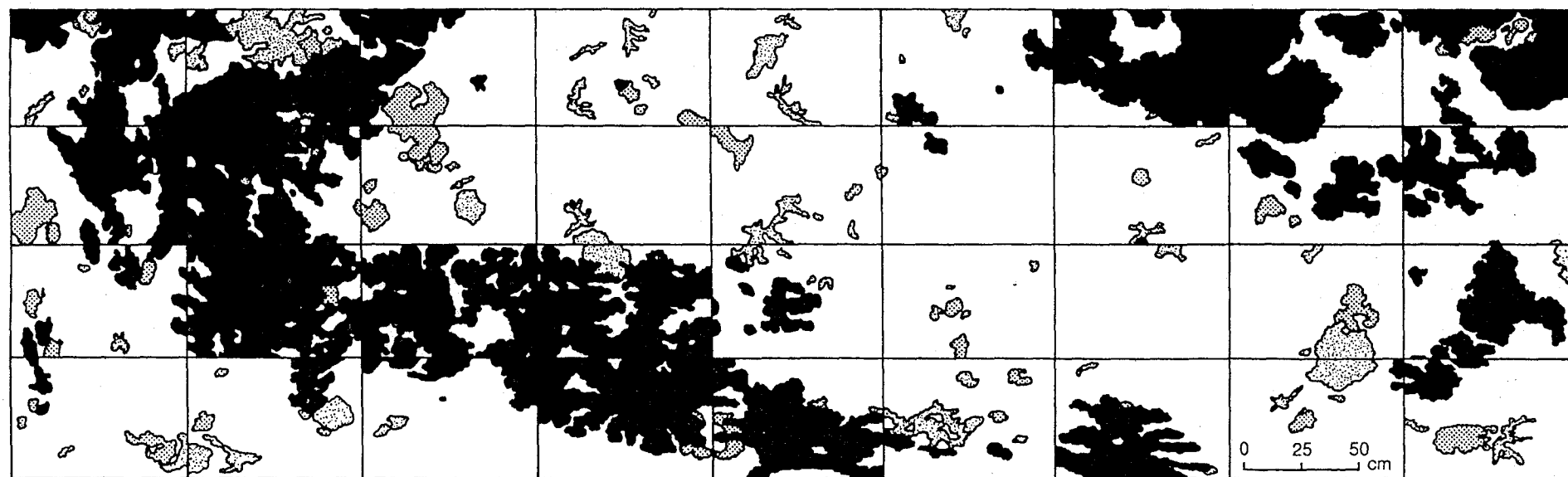
Figure 6

Underwater photostation. Black dots indicate the position of eight stainless steel stakes arranged in a rectangular pattern 2.25m apart along the horizontal axes and 2.00m apart on the vertical axes. The stakes are inserted into holes drilled into the reef and cemented into place. A large PVC grid with dimensions of 2.25m x 2.00m is lowered three times consecutively over these stakes from left to right. This large PVC grid is subdivided into 12 rectangles, each 0.75m x 0.50m in length and width. An underwater camera mounted to a quadrapod with a rectangular base of these same dimensions (75cm x 50cm) is lowered into place sequentially as indicated by the ascending frame numbers. After all 36 pictures are taken, a reef area of 13.5 m² has been photographed.





1989



1991



Acropora palmata



Porites astreoides



All other coral species

Figure 13b.

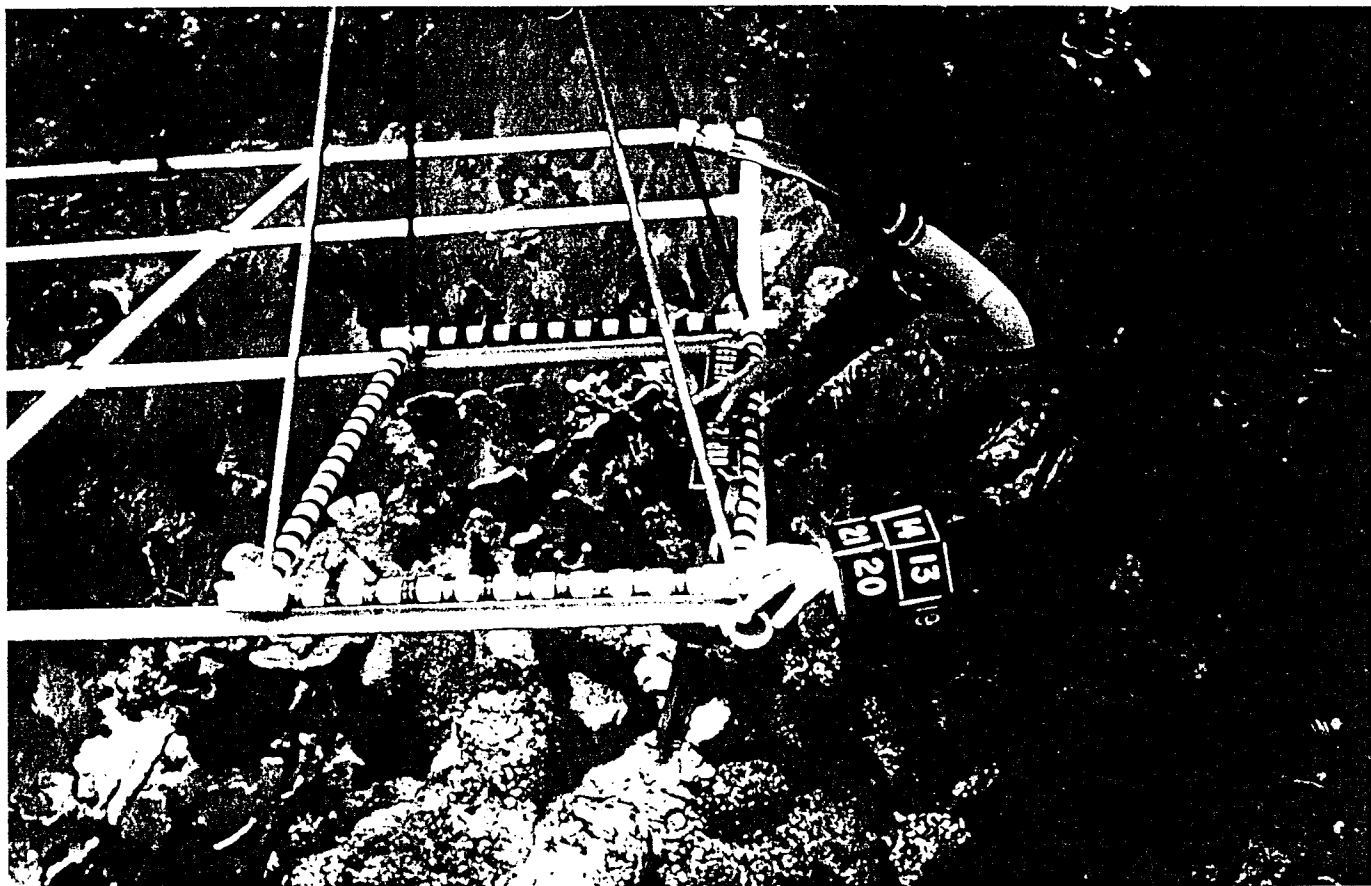


Figure 7

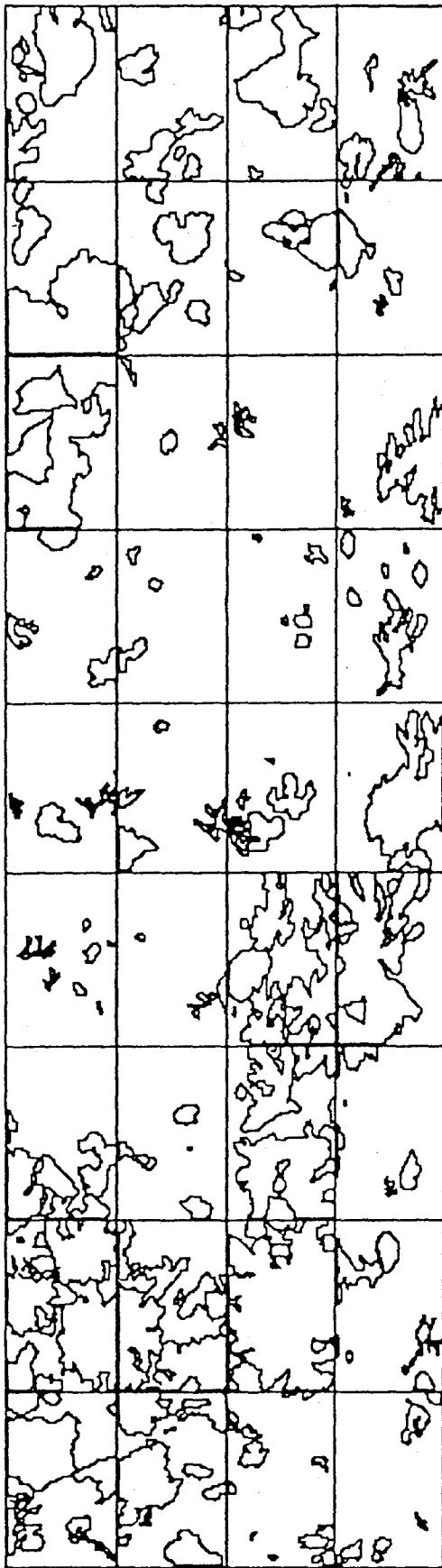


Figure 13a.

(Y/N): ■

appellation. In addition, each colony of each species is given a unique number.

Because a coral reef is a three dimensional community, the surface area traced for each coral colony is PROJECTED SURFACE AREA, NOT BIOLOGICAL SURFACE AREA (Middleditch, 1988). Obviously, the undersides of colonies in view are not surveyed, nor even are vertical surfaces. Done (1981) has tested a stereophotographic system, but also demonstrated the high degree of difficulty inherent in analyzing data from such techniques.

Overlap between frames is caused by parallax. When the camera is well above the bottom, as when placing the large PVC grid over an elkhorn reef, parallax can be substantial. We use "cut lines" drawn vertically and/or horizontally across the frame to remove overlap between adjacent frames. Vertical cut lines are by convention placed to the left of the frame; horizontal cut line at the bottom of the frame. So long as the PVC grid is properly aligned on the stainless steel stakes each time the reef is resurveyed, these cut lines remain in the same position. The surface area contained in the photographs is normalized to the 13.5 m² area bounded by the survey stakes.

REFERENCES

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Frame Mapping Module

I. Introduction

With this module, you can print either individual frames or a montage of the whole reef (Figure 13). The output is to the screen. Using any commercial "screen grabber" software (for example Pizazz Plus), one can the print this graphic. This module accesses only files digitized according to our digitizer module.

Frame mapping requires a recalculation after removing cut lines of each frame. The system deposits the new raw data points in a temporary file. After the image appears on the monitor, these temporary files are deleted. Depending on the number of individual frames to be mapped, we suggest that your hard disc have at least 5 - 10 MB free for temporary use.

The multiple frame concatenation option assumes all that all of the frames to be plotted together are in a strict sequential order, starting with one in the upper left hand corner and numbered from left to right and top to bottom. If the frames are in any other order, then the files must be renumbered for the purposes of the making the map. For instance, Figure 6 shows our frame numbering scheme. This order does not match the left-to-right, top-to-bottom rule. We recommend that you temporarily rename all the files involved to conform to the correct order. This process is described step by step in the next paragraph.

Three different type of files need to be renamed:

- 1) xxxxFRxx.Yyy
- 2) xxxxFRxx.Pyy
- 3) xxxxFRxx.Fyy

Use the DOS command - RENAME - to do it. First backup all the files (!) and use only these backups for the mapping exercise. Rename all the original files to another name. Then copy these files, one by one, into the correct order for the mapping module. After finishing, remember to rename these map files back to their original name.

For example, type `rename ???fr?.y?? ???fr?.ytt <Enter>`, type `???fr?.p?? ???fr?.ptt <Enter>` and type `???fr?.f?? ???fr?.fft <Enter>`. Next, type `copy ???fr01.ytt ???fr01.y90 <Enter>`, type `copy ???fr02.ytt ???fr02.y90 <Enter>`, type `copy ???fr03.ytt ???fr03.y90 <Enter>`, type `copy ???fr13.ytt ???fr04.y90 <Enter>`, type `copy ???fr14.ytt ???fr05.y90 <Enter>`, type `copy ???fr15.ytt ???fr06.y90 <Enter>`, type `copy ???fr25.ytt ???fr07.y90 <Enter>`, type `copy ???fr26.ytt ???fr08.y90 <Enter>`, type `copy ???fr27.ytt ???fr09.y90 <Enter>` and so on for all 3 different type of files.

After finishing this module, type `copy ???fr?.ytt ???fr?.y90 <Enter>`, type `copy ???fr?.ptt ???fr?.p90 <Enter>` and type `copy ???fr?.fft ???fr?.f90 <Enter>`. The original order has been restored.

METHODS FOR THE ANALYSIS OF CORAL REEF COMMUNITY STRUCTURE

II. PHOTOSTATION

B. SOFTWARE ANALYSIS

The coral Image Analysis (C.I.A.) software system includes four different modules. They are (1): the Digitizing Program, (2) the Statistical Analysis Program, (3) the Year to Year Comparison Program, and (4) the Mapping Program.

This system can be executed from either a floppy disk drive or a hard disk drive. You will need a computer with at least 64K RAM. Due the large data files and complex calculating tasks, we recommend that you install the CIA program on your hard disk. Also, depending on the frame complexity and the total number of frames, you will need a large amount of space (at least 5 Megabytes) on the hard disk.

This system is written in MicroSoft Quick Basic (v. 4.0) and has been compiled as an execution file. If you want to modify our system, you must have this commercially available product (approximately \$100; Microsoft Corporation / 16011 N.E. 36th Way / Box 97017 / Redmond / WA / 98073).

During the next few chapters, we will introduce each program, list the data files created, and describe the data format.

III. Data File

3.1 File Name

Three different year-to-year comparisons are created by this module. They are the difference between the:

- 1) Cumulative Percent Coral Cover. This file is stored as xxxxy1y2.DPC.
- 2) Cumulative Species Diversity (H' In Area). This file is stored as xxxxy1y2.DHA
- 3) Cumulative # of Coral Species. This file is stored as xxxxy1y2.DNC.

This program also creates and stores a series of .TTT files, which can be deleted after running the module.

3.2 File Format

- | | | |
|-----|--------------------|-----------------|
| (1) | xxxxy1y2.DPC | |
| | Field name | Ending position |
| | Frame # | 2 |
| | 95 % C.I.(lower) | 14 |
| | 95 % C.I.(upper) | 6 |
| | Mean of difference | 38 |
| (2) | xxxxy1y2.DHA | |
| | Field name | Ending position |
| | Frame # | 2 |
| | 95 % C.I.(lower) | 14 |
| | 5 % C.I.(upper) | 26 |
| | Mean of difference | 38 |
| (3) | xxxxy1y2.DNC | |
| | Field name | Ending position |
| | Frame # | 2 |
| | 95 % C.I.(lower) | 14 |
| | 95 % C.I.(upper) | 26 |
| | Mean of difference | 38 |

Digitizing Program

I. Introduction

Once the photographs are printed and the corals traced, they need to be digitized. This program quantifies the projected surface area of each colony and stores the information on a disk.

This program uses a Jandel Digitizer Tablet. We used a Jandel because it was the least expensive digitizer tablet on the market at the time (approximately \$600; Jandel Scientific / 65 Koch Road / Corte Madera / CA / 94925). Any digitizer tablet will work, but if you are not using Jandel, you may have to change the default parameters inside our program to accept data from your particular tablet. You will need to get your tablet's source code to modify it.

Before you use this program to collect photographic data, practice with the digitizer tablet. We attach a practice sheet on the last page. When your area and perimeter match the values shown, you are ready to collect real data. Because the tablet is very sensitive, a rough digitizing will give an inaccurate result. The more familiar you are with the tablet, the more accurate your data will be.

The following paragraphs explain the Jandel tablet's sensitivity; or you can skip to next page to continue.

Digitizer data is passed to the computer through a communication port. The COM1 port operates at 9600 bits/sec. When the Jandel digitizer is put in ASCII mode, each point from the Jandel tablet is equal to 16 bytes. Each byte consists of 1 start bit, 1 parity bit, 7 character bits, and 1 stop bit. The total is 10 bits. Therefore, the fastest speed that the COM1 port can transmit is 960 bytes/sec for a maximum of 60 data points/sec. In stream mode, however, the Jandel tablet generates data points at a speed of 200 points/sec, too fast for the COM1 port. To slow down the Jandel Tablet, use the Jandel Tablet set up menu designation ":INmm" to control the speed (":INmm", where 0 = mm = 99). After several tests, we set it up as ":IN2" (mm = 2). We suggest 2 mm / sec as the maximum speed an operator should move the cursor to produce an accurate digitizing. If you use another digitizer tablet, you must read their documentation carefully and reinitialize this parameter for that particular tablet.


```
Please enter the 1st year for comparision (e.g. 89) : ? 89
Please enter the 2nd year for comparision (e.g. 90) : ? 90
Please enter the station id for comparision (e.g. BP01) : ? bp01
Please enter the tottal frame number (e.g. 36) : ? 36
Please enter the drive (path) from which the data are retrieved
(e.g. c:) : ? c:\dbp01\
```

Screen 3.5

```
Please enter the 1st year for comparision (e.g. 89) : ? 89
Please enter the 2nd year for comparision (e.g. 90) : ? 90
Please enter the station id for comparision (e.g. BP01) : ? bp01
Please enter the tottal frame number (e.g. 36) : ? 36
Please enter the drive (path) from which the data are retrieved
(e.g. c:) : ? c:\dbp01\
Please enter the drive (path) on which the data are to be stored
(e.g. c:) : ? c:\dbp01\ana\
```

Screen 3.6

II. Running the Module

1.1 Starting up

Connect the Jandel digitizer to the computer and turn both the computer and tablet on. Type **CIA** at the DOS prompt to get the system menu screen. At the menu screen (Screen 0.1), type **1** <Enter>. The digitizing module screen (Screen 1.1) will now appear. The first information requested is the name of the locality of your study. When asked for the locality name, you may respond with both upper and lower case letters for a total of 30 characters. This name will head all output tables.

```
Coral Image Analysis (C.I.A.)
Version 1.2, Copyright(C) 1991
J.W. Porter/Linda Chiang, Zoology, UGA, Athens, Ga. 30602

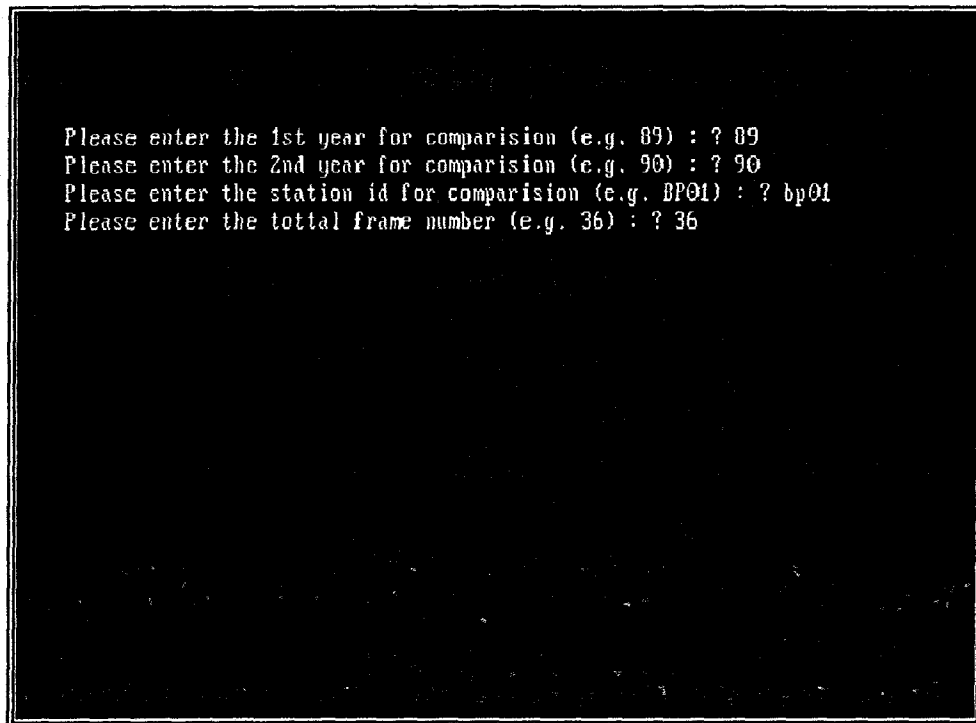
*****
*                                     *
*               Main Menu           *
*                                     *
*****

1. Run Digitizing Module.
2. Run Statistic Analysis Module.
3. Run Year Comparison Module.
4. Run Frame Mapping Module.
5. Back to DOS.

--> 1
```

Screen 0.1

Screen 3.4 requests the total number of frames in this photostation (for example 36 frames in our survey).

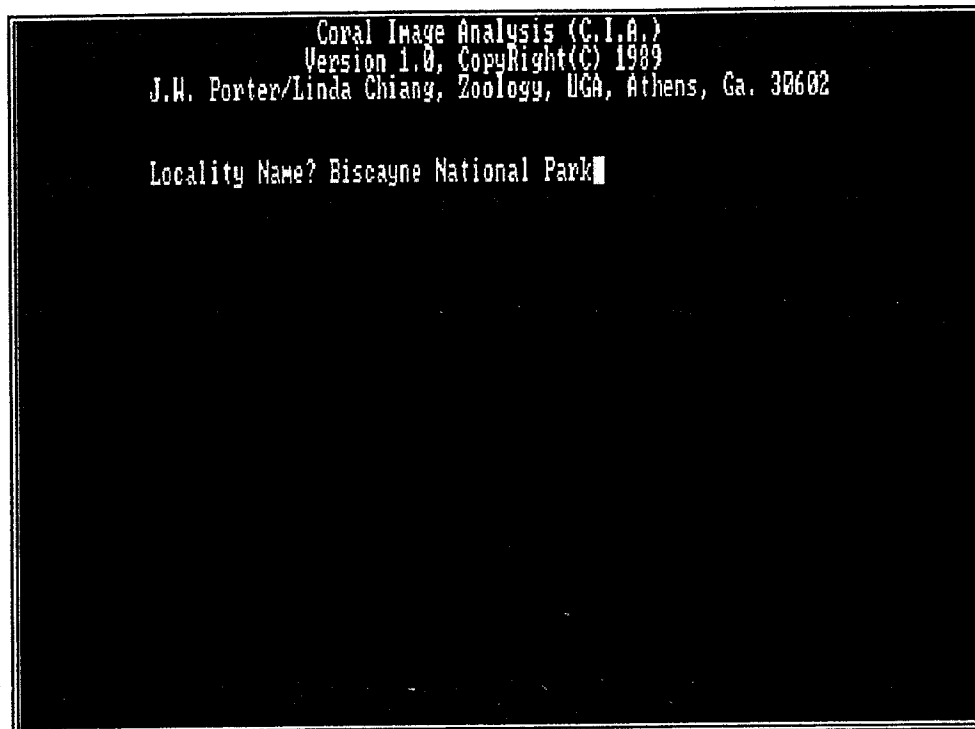


```
Please enter the 1st year for comparision (e.g. 89) : ? 89
Please enter the 2nd year for comparision (e.g. 90) : ? 90
Please enter the station id for comparision (e.g. BP01) : ? bp01
Please enter the tottal frame number (e.g. 36) : ? 36
```

Screen 3.4

Screen 3.5 asks where to retrieve the data from. Copy all the pertinent files into the same subdirectory or drive, and then retrieve them all from that one place during this step. In our example, data are retrieved from drive C under the DBP01 subdirectory.

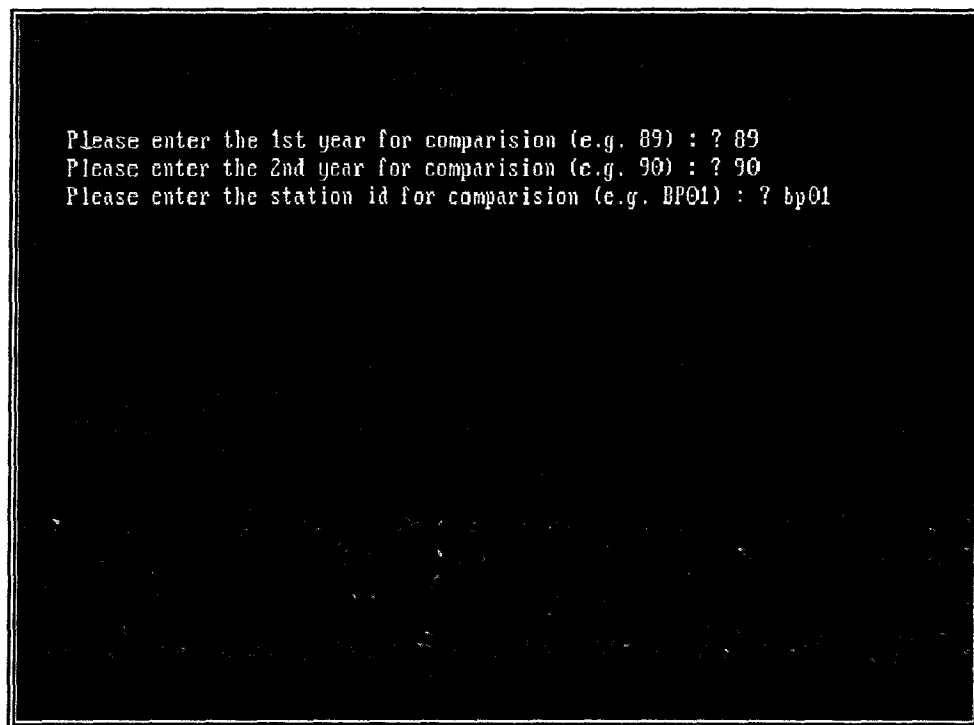
Screen 3.6 asks where to save the result. In this example, sample data can be saved in an ANA subdirectory under the DBP01 subdirectory through drive C.



Screen 1.1

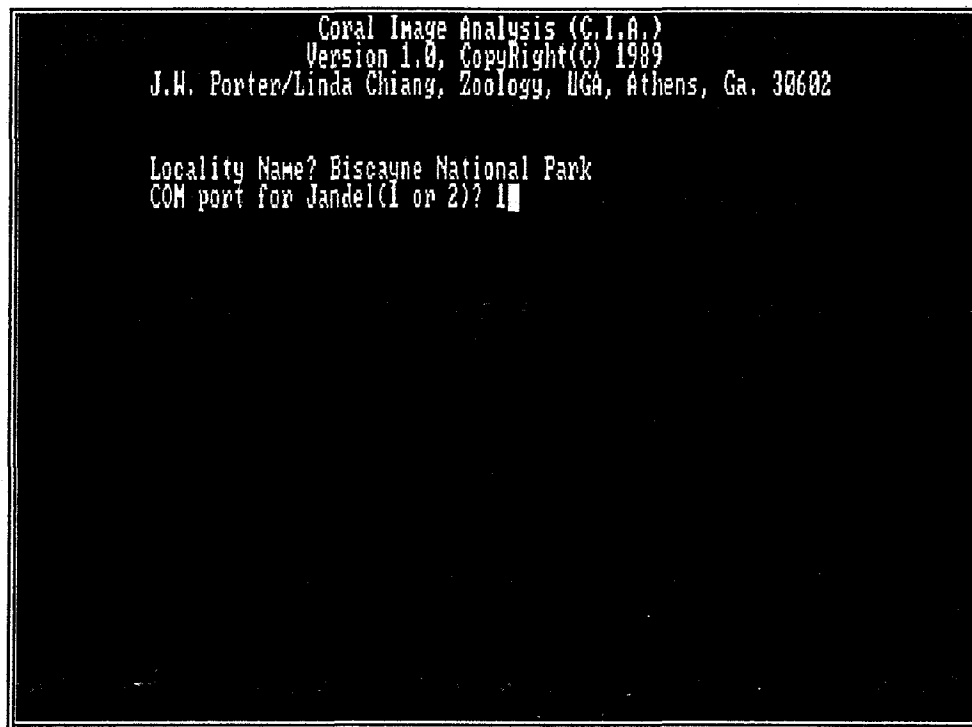
When the locality name has been entered, Screen 1.2 appears asking for the communication port number to which the digitizer tablet has been connected; 1 means COM1 and 2 means COM2. Our default convention is set up for COM1.

Screen 3.3 requests the reef name. This name has already been assigned during digitizing and you should repeat this same name here (for example BP01 on this screen). Consult your *.ANA files. The first 4 characters on the filename designate the reef name.

A screenshot of a computer screen with a black background and white text. The text consists of three lines of prompts for user input. The first line asks for the 1st year for comparison, with an example of 89. The second line asks for the 2nd year for comparison, with an example of 90. The third line asks for the station id for comparison, with an example of BP01. Each prompt is followed by a colon and a space, then a question mark, and then a space before the example. The text is left-aligned.

```
Please enter the 1st year for comparision (e.g. 89) : ? 89
Please enter the 2nd year for comparision (e.g. 90) : ? 90
Please enter the station id for comparision (e.g. BP01) : ? bp01
```

Screen 3.3

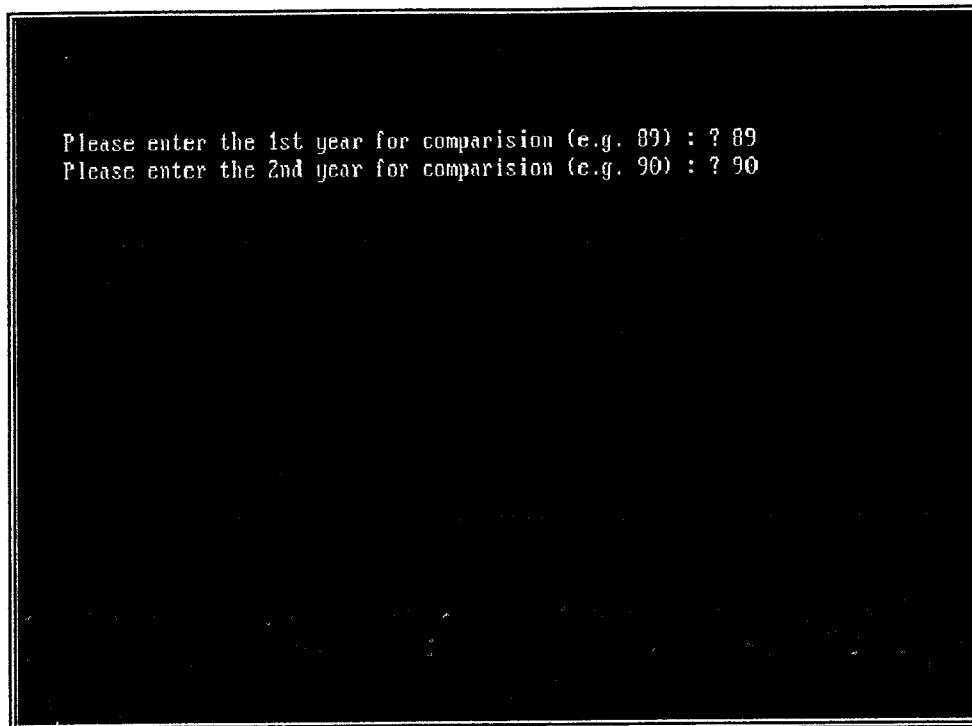


Screen 1.2

1.2 Aligning the Frame

Screen 1.3 appears prompting you to set up the digitizer tablet so that you can digitize your traced photographs. To do this, place a piece of ruled graph paper in the middle of the digitizer tablet and tape down one of its corners (Figure 8). Now put the cursor on one of the horizontal lines over the graph paper and move the cursor cross hairs along the line to the extreme left hand point on that line. Tap cursor button #1. Note that the values for both the X and Y axis are now displayed on the screen. Now slide the cursor along the line to its extreme right hand point. Tap cursor button #1 again, and observe the new X, Y axis value. Compare the two Y axis values. The idea is to align the graph paper squarely on the digitizer tablet. Adjust the graph paper until the left and right ends of the horizontal line give you the same Y axis values, plus or minus 3 digitizer units. When the ruled paper is on squarely, tape down all four corners securely. The graph paper is now aligned and helps to align a phototracing.

Screen 3.2 requests the second year (for example type 90 on this screen).

A screenshot of a computer screen with a black background and white text. The text consists of two lines of prompts. The first line is "Please enter the 1st year for comparision (e.g. 89) : ? 89". The second line is "Please enter the 2nd year for comparision (e.g. 90) : ? 90". The word "comparision" is misspelled as "comparision". The screen is framed by a thin white border.

Please enter the 1st year for comparision (e.g. 89) : ? 89
Please enter the 2nd year for comparision (e.g. 90) : ? 90

Screen 3.2

Practice Sheet

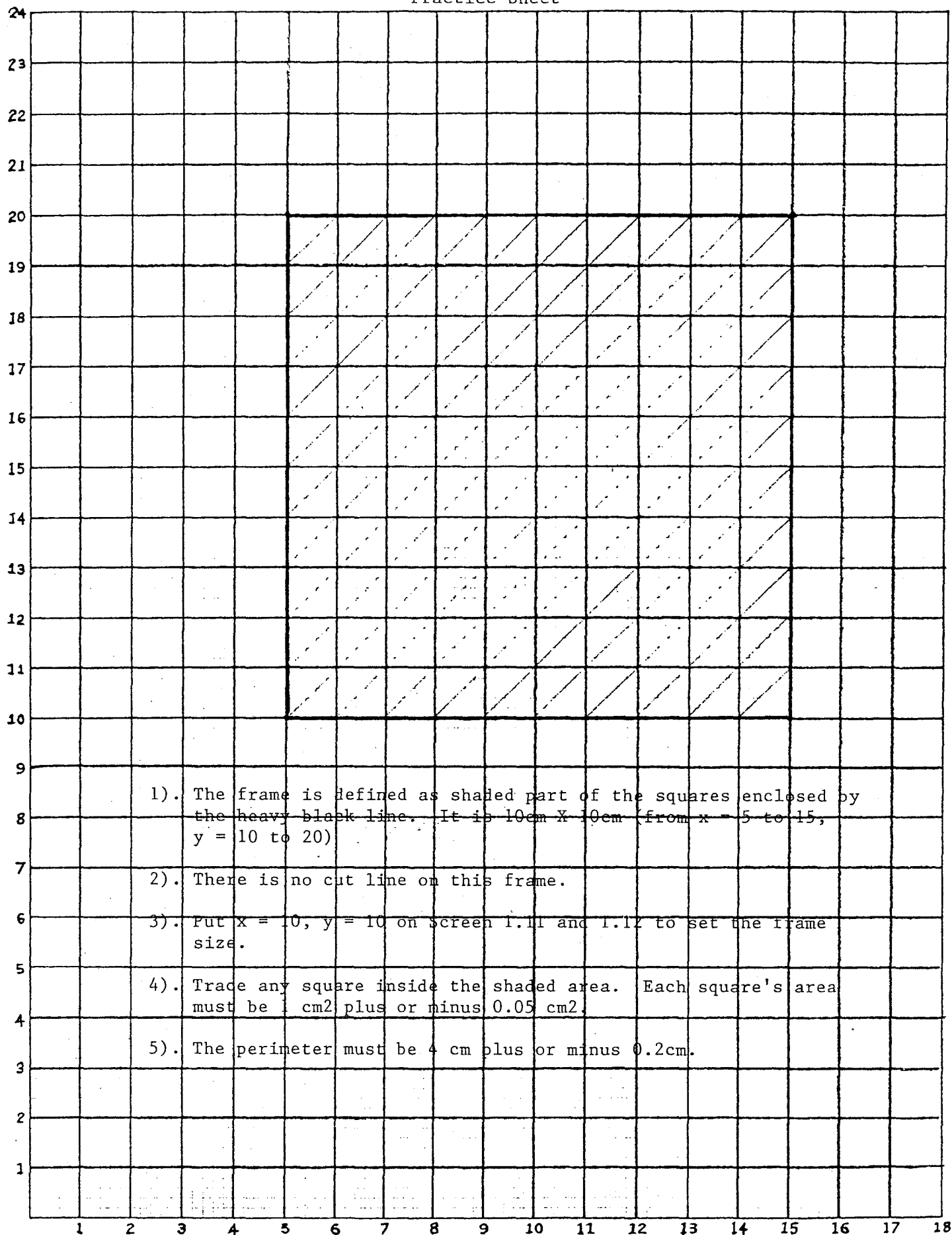
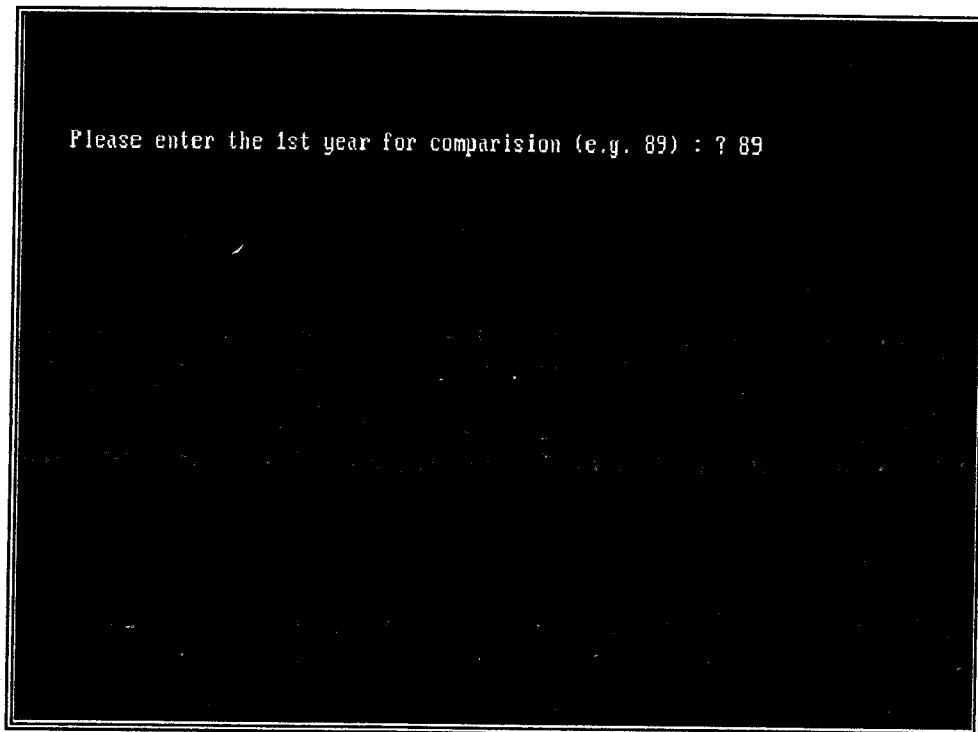


Figure 8.

II. Running the module

3.1 *Starting up*

Type **CIA** at the DOS prompt to get the system menu screen. At the menu screen (Screen 1.0) type **3 <Enter>**. The year comparison module screen (Screen 3.1) will now appear. The first question requests the first year number. Enter only a two digit number (for example 89 on Screen 3.1).



Screen 3.1

Coral Image Analysis (C.I.A.)
Version 1.0, Copyright(C) 1989
J.W. Porter/Linda Chiang, Zoology, UGA, Athens, Ga. 30602

Read Instructions on how to center tracing.
Loosely tape the tracing to the digitizer tablet. Do a 2-point
alignment, either Horizontally (y1=y2), or Vertically (x1=x2). A
difference of ≤ 3 is tolerable. Press cursor button #1 to establish
the two x or two y positions. Adjust paper repeatedly. After
aligning the tracing, tape it securely to the digitizer tablet.
Press cursor button #2 to Proceed!

x y

Screen 1.3

Coral Image Analysis (C.I.A.)
Version 1.0, Copyright(C) 1989
J.W. Porter/Linda Chiang, Zoology, UGA, Athens, Ga. 30602

Read Instructions on how to center tracing.
Loosely tape the tracing to the digitizer tablet. Do a 2-point
alignment, either Horizontally (y1=y2), or Vertically (x1=x2). A
difference of ≤ 3 is tolerable. Press cursor button #1 to establish
the two x or two y positions. Adjust paper repeatedly. After
aligning the tracing, tape it securely to the digitizer tablet.
Press cursor button #2 to Proceed!

x y
1024 1776

Screen 1.4

Year Comparison Module

I. Introduction

This module can be used only when the user has two years of information on the same photostation. You must finish the statistical analyses on both years first. This module will generate the mean difference between the two years, and calculate the upper and lower 95% confidence interval (C.I.) between them on the parameters listed below.

Not all the statistical analysis files can be treated in this fashion. This module generates differences between years for:

- 1) Cumulative Percent of Coral Cover. This file is saved as xxxxy1y2.DPC
- 2) Cumulative Species Diversity (H' ln Area). This file is saved as xxxxy1y2.DHA
- 3) Cumulative # of Coral Species. This file is saved as xxxxy1y2.DNC.

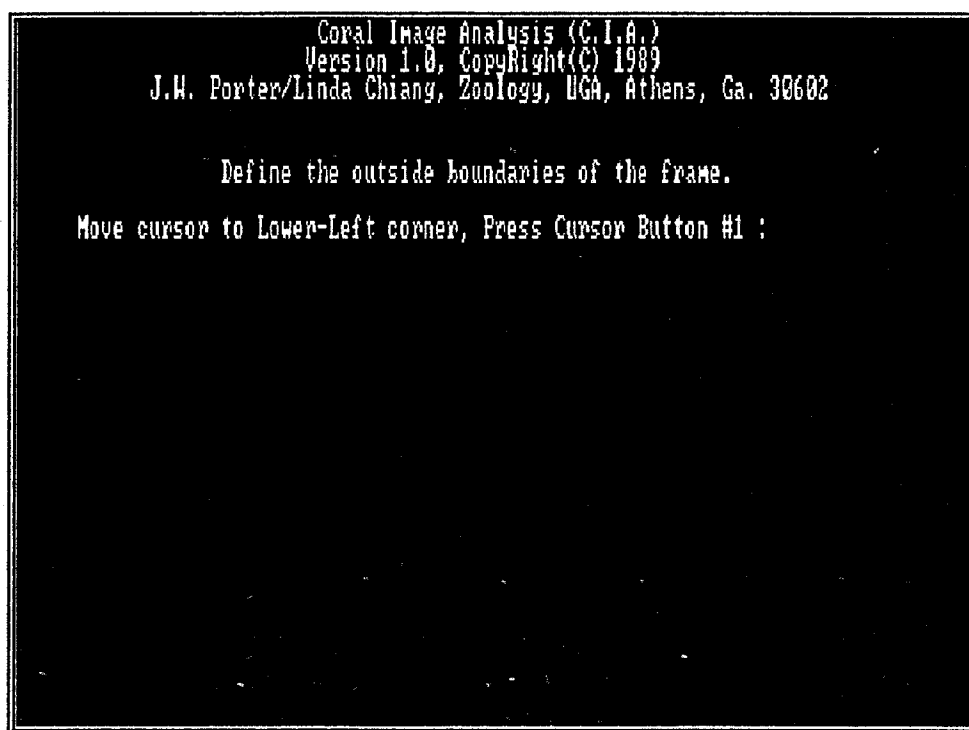
All these files are saved as ASCII (text) files. You can import these data into any graphic software package to display or graph the data. The files which are created in this module do not label or name the imported variables. The file format is presented at the end of this module.

Put the photo tracing on the top of this graph paper, and align the bottom of the frame parallel to a horizontal line on the graph paper. Loosely tape the tracing paper to the digitizer tablet. Using the same method described above for testing the proper orientation of the graph paper, square the tracing paper on the digitizer tablet (Screen 1.3). Pick two points, either vertical points (X1, X2) or horizontal points (Y1, Y2). Align them such that $X1 = X2$ for vertical points, or $Y1 = Y2$ for horizontal points. Tapping cursor button #1 displays the X, Y coordinates of whichever point the cross hairs are over (Screen 1.4). Continuously adjust the paper; use cursor button #1 to test it repeatedly. When you are satisfied that the frame is squarely centered, tape the tracing paper securely to the digitizer tablet. Press cursor button #2 to continue.

1.3 *Defining the Frame Boundaries*

Selection of frame boundaries is illustrated in Figures 10 and 11). After aligning the phototracing, Screen 1.5 appears. This next step requires you to define the **outside** boundaries of each frame. Move the cursor cross hairs to the **lower-left** corner of the frame; press cursor button #1. The X and Y coordinates of this point will show on the screen. Repeat this process for the **upper-right** corner (Screen 1.6).

The next screen appears (Screen 1.7). This next step prompts you to set the parallax cut lines that are **inside** the frame boundaries established in the previous steps.



Screen 1.5

III. Data File

3.1 File Name

- There are five different statistical files created by this statistic analysis. They are
- 1) Cumulative Species Diversity (H' ln Area). This file is stored as xxxxHAYy.ANA.
 - 2) Cumulative Species Diversity (H' ln number of colonies). This file is stored as xxxxHCyy.ANA
 - 3) Relative Abundance (%). This file is stored as xxxxRAYy.ANA
 - 4) Cumulative Coral Cover (%). This file is stored as xxxxCPyy.ANA
 - 5) Cumulative # of Coral Species (S). This file is stored as xxxxCSyy.ANA.

3.2 File Format

(1) xxxxHAYy.ANA

Field name	Ending position
Frame #	2
Diversity (based on area)	8
Cumulative area	21

(2) xxxxHCyy.ANA

Field name	Ending position
Frame #	2
Diversity (based on colony #)	8

(3) xxxxRAYy.ANA

Field name	Ending position
Species name	4
% cover	10

(4) xxxxCSyy.ANA

Field name	Ending position
Frame #	2
Cumulative Species #	5

(5) xxxxCPyy.ANA

Field name	Ending position
Frame #	2
Cumulative % coral cover	8

Coral Image Analysis (C.I.A.)
Version 1.0, Copyright(C) 1989
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Define the outside boundaries of the frame.

Move cursor to Lower-Left corner, Press Cursor Button #1 :[1,011 1791]
Move cursor to Upper-Right corner, Press Cursor Button #1:

Screen 1.6

Coral Image Analysis (C.I.A.)
Version 1.0, Copyright(C) 1989
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Move cursor to Lower-Left corner, Press Cursor Button #1 :[1,011 1791]
Move cursor to Upper-Right corner, Press Cursor Button #1:[9,975 7594]

Define the Photo Station Parallax Cut Lines

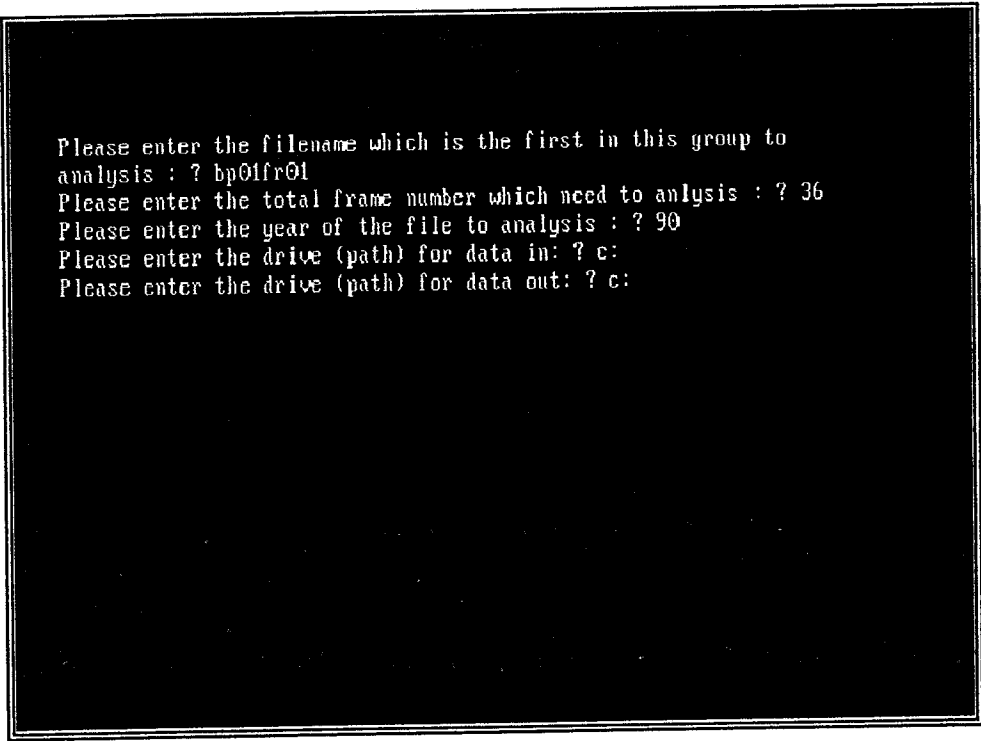
Read instructions on defining the parallax cut lines.

Move cursor to proper point, Press Cursor Button #1.

- (1) No cut line : move cursor beyond LL corner
- (2) Vertical cut line : move cursor on line below frame
- (3) Horizontal cut line : move cursor on line to left of frame
- (4) Vert. Hor. cut line : move cursor to the intersection of two lines

Screen 1.7

Because the statistical analysis module creates output files, we need to direct the system to send the output files to the proper path. Screen 2.5 prompts for the output path. In this example, the output information will go to the same path (C:) as the input information.



```
Please enter the filename which is the first in this group to  
analysis : ? bp01fr01  
Please enter the total frame number which need to anlysis : ? 36  
Please enter the year of the file to analysis : ? 90  
Please enter the drive (path) for data in: ? c:  
Please enter the drive (path) for data out: ? c:
```

Screen 2.5

After these parameters have been specified, the module will begin to access the required data files to calculate the proper results. The length of time to complete this analysis depends on how many frames are used. This module takes a few minutes to complete.

There are four possible combinations of cut lines in a frame:

- (1) No cut lines.
- (2) One horizontal cut line.
- (3) One vertical cut line.
- (4) Both a horizontal and a vertical cut line.

Horizontal cut lines are always placed on the **bottom** of a frame; vertical cut lines are always placed to the **left** of the frame.

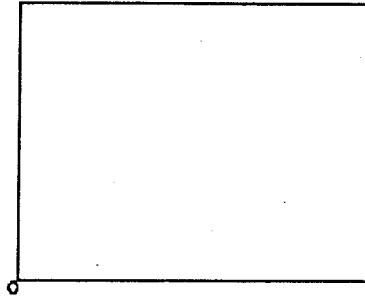


Figure 9a

With no cut lines on the frame, move the cursor cross hairs into the zone below and to the **left** of the lower left corner of the frame (Figure 9a). Tap cursor button #1.

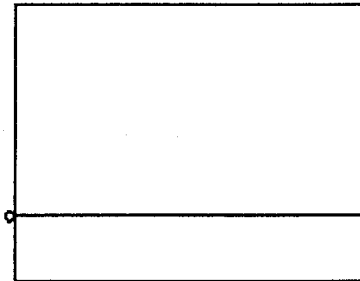


Figure 9b

The screen now requests the input data path (Screen 2.4). Input data can come either from a floppy diskette or from the hard disk. This directory chosen must contain all the files from the photostation. The user can also put a subdirectory name in the path. It all depends on how the user manages the data. In this example, type **C:** This means that the data are in the current directory/subdirectory. If the user types **C:**, this means input data are in the main directory of the c: drive. Check your DOS command reference book for questions concerning directory paths. If you use a subdirectory, be sure to specify the complete path, *e.g.*, **C:\subdir**.

```
Please enter the filename which is the first in this group to
analysis : ? bp01fr01
Please enter the total frame number which need to anlysis : ? 36
Please enter the gear of the file to analysis : ? 90
Please enter the drive (path) for data in: ? c:
```

Screen 2.4

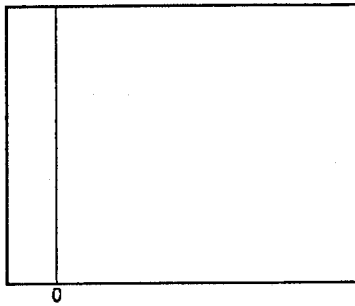


Figure 9c

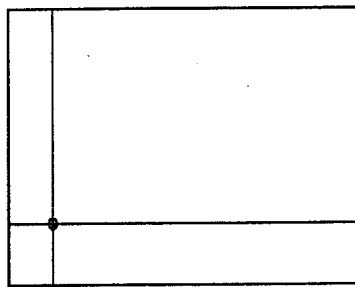


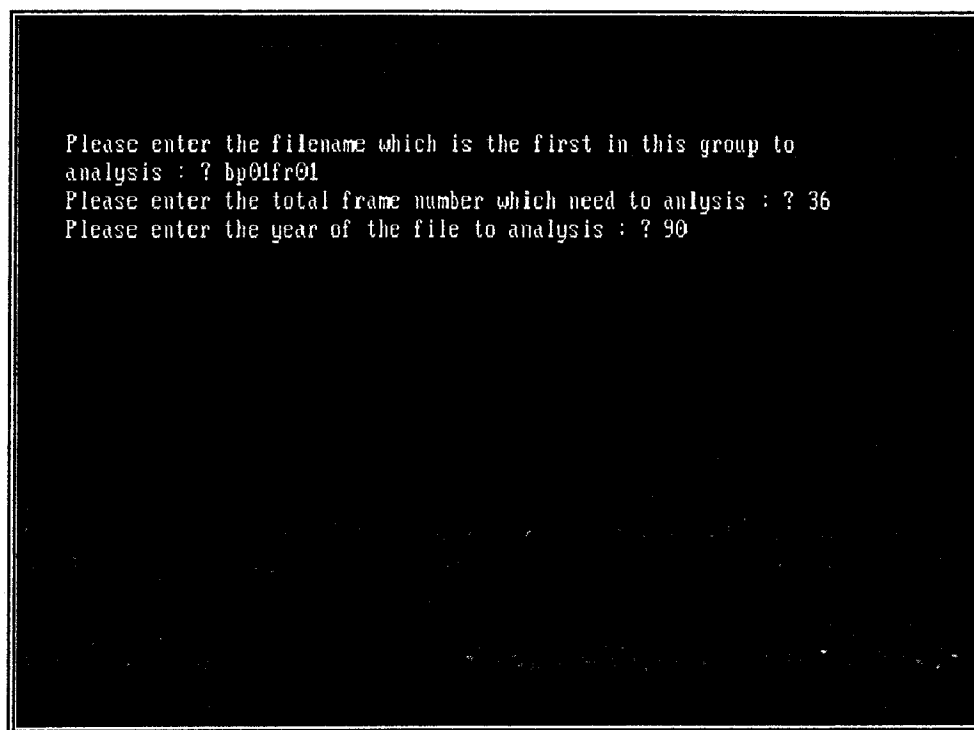
Figure 9d

For a horizontal cut line, put the cursor cross hairs on the same level as the horizontal cut line, but to the **left of the frame boundary** (Figure 9b). Tap cursor button #1.

For a vertical cut line, put the cursor cross hairs directly on the cut line, but just **below the frame boundary** (Figure 9c).

For two cut lines (both vertical and horizontal), set the cursor cross hairs **at the intersection of the two cut lines** inside the frame (Figure 9d), and tap cursor button #1.

Screen 2.3 asks for the year, to be provided as a two-digit number (*e.g.* enter 90 for 1990). Having received this information, the software package can now find the proper extension.

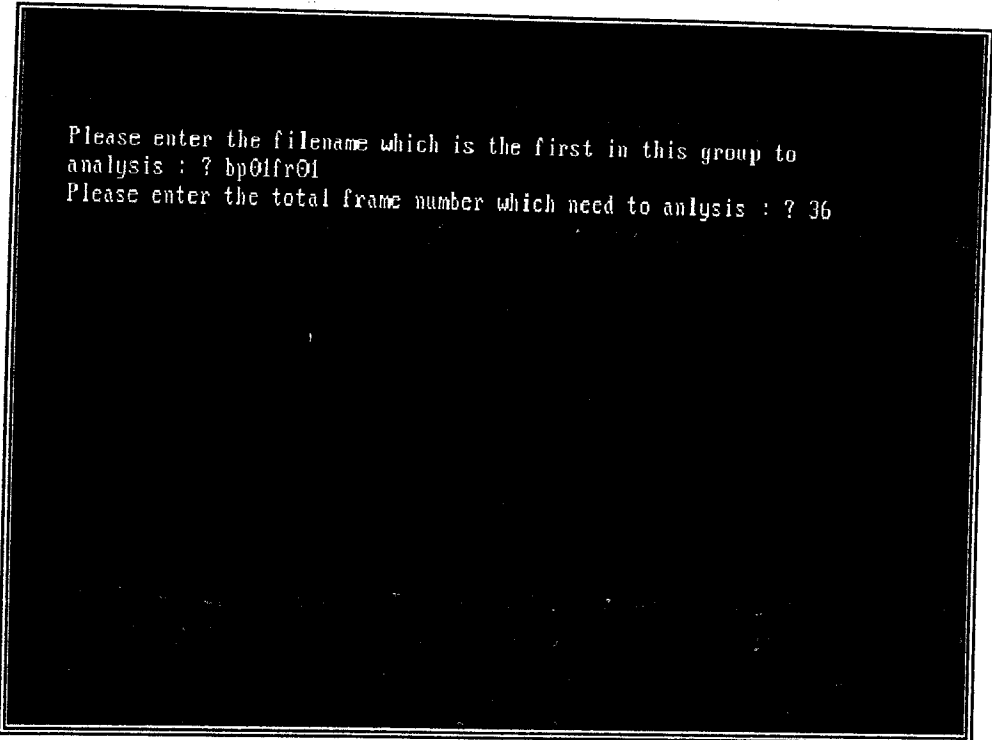


Screen 2.3



Figure 10.

Screen 2.2 requests the total number of frames in the photostation to be analyzed.



```
Please enter the filename which is the first in this group to  
analysis : ? bp01fr01  
Please enter the total frame number which need to anlysis : ? 36
```

Screen 2.2

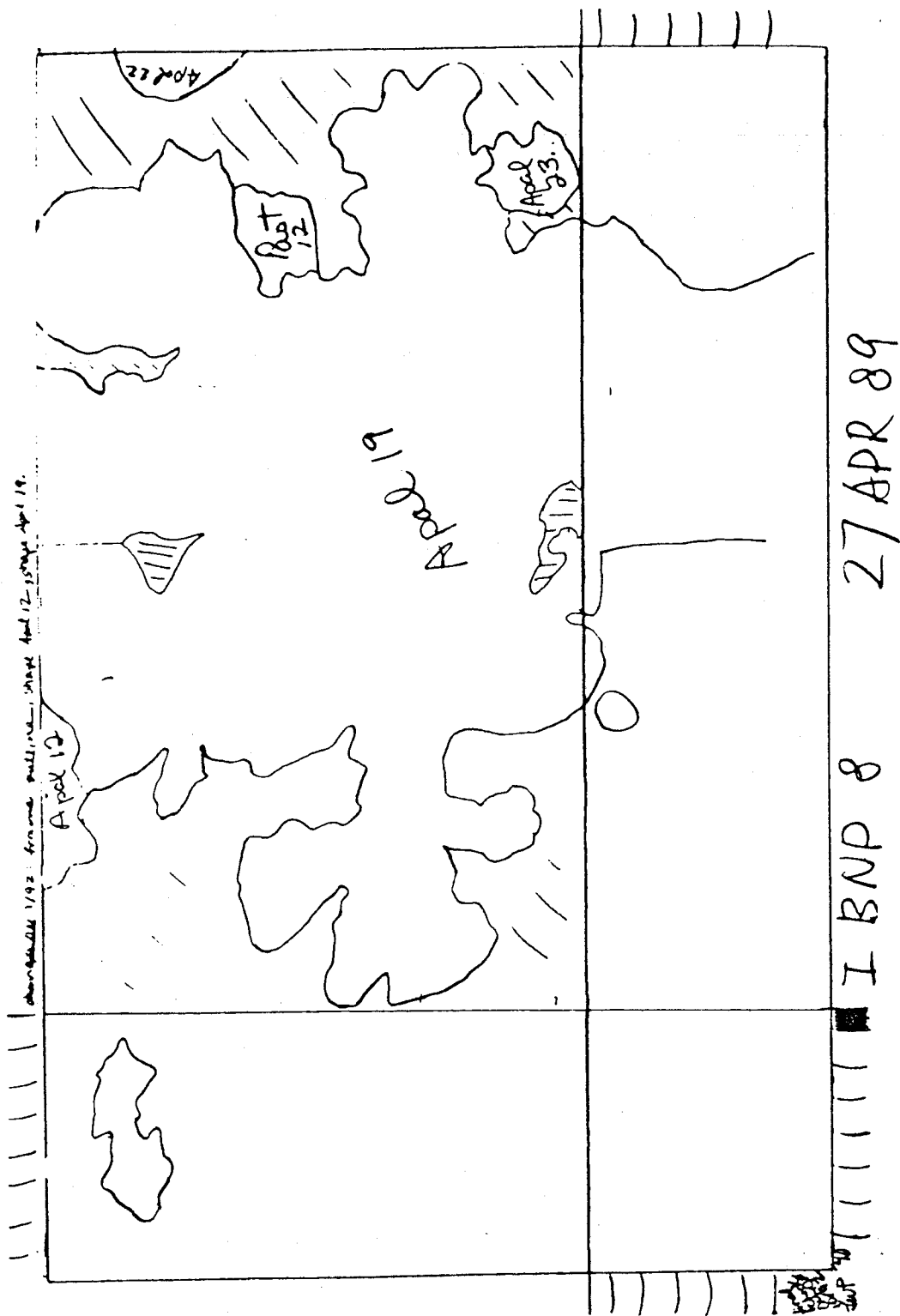
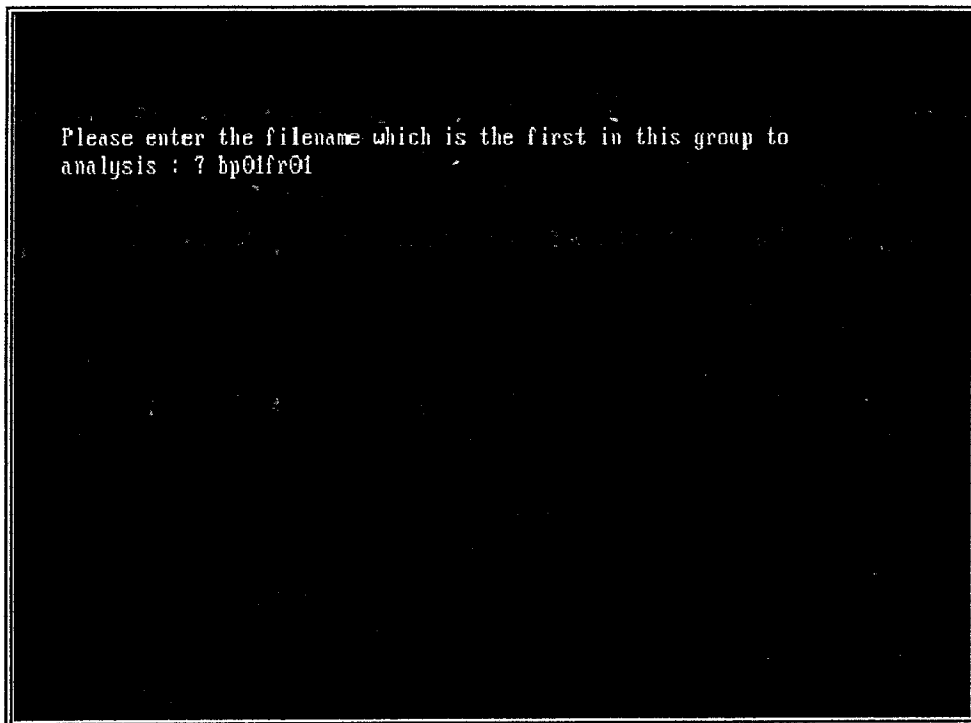


Figure 11a

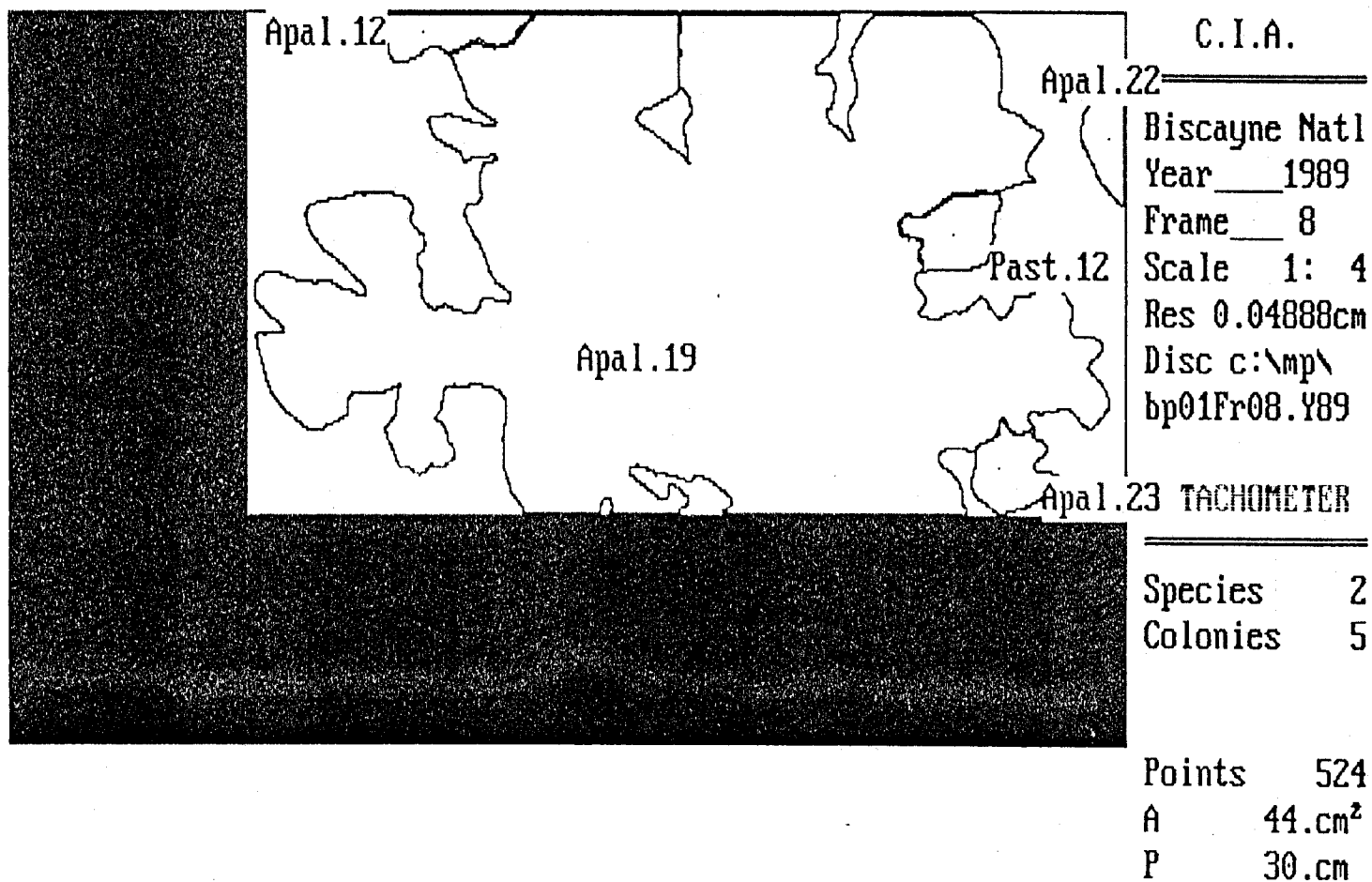
II. Running the Module

2.1 *Starting up*

Type CIA at the DOS prompt to get the system menu screen. At the menu screen (Screen 0.1) type 2 <Enter>. The statistical analysis screen (Screen 2.1) will then appear. The first information requested is the filename of the first frame in this photostation. This filename was created while using the digitizing module. Check the storage disk/diskette directory if you need prompting for the correct file name. Key in the filename without extension (.xxx). The program will find the proper file and automatically create a new extension using the rules mentioned above. (This module assumes that the frame numbers from the photostation are in sequential order. This means that when the first frame filename and the last frame number have been given, that the module will automatically load all frames between these numbers.)



Screen 2.1



More Photo Frames (Y/N): ☐

Figure 11b.

Statistical Analysis Module

I. Introduction

When all the frames of a photostation have been digitized (*i.e.* one site and one year), this module can be run to generate a photostation summary.

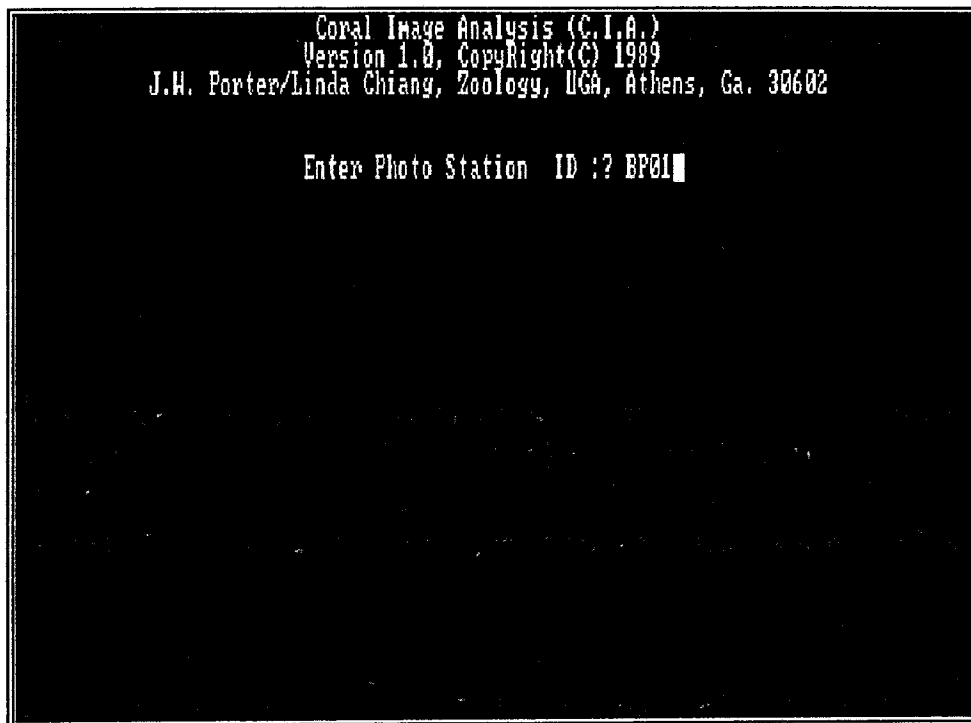
This module generates five different statistical output files. They are:

- 1) Cumulative Species Diversity (H' in area occupied by each species). This file is stored as xxxxHAYy.ANA.
- 2) Cumulative Species Diversity (H' in number of colonies belonging to each species). This file is stored as xxxxHCyy.ANA.
- 3) Relative Abundance (as a percent) of each coral species. This file is stored as xxxxRAYy.ANA.
- 4) Cumulative Coral Cover (as a percent of total area). This file is stored as xxxxCPyy.ANA.
- 5) Cumulative # of Coral Species (S). This file is stored as xxxxCSyy.ANA.

All these files are saved as **ASCII** text files. The user can apply all kinds of graphic software to import these files and create graphs. No file can have a variable name in its title. Files format is listed at the end of this module.

2.4 Labelling the File

Screen 1.8 allows you to create and label digitizer data files. Screen 1.8 requests the photostation ID number. No matter how many characters you enter, it only picks up the first four characters. For example, for our data from Biscayne National Park, Reef 1, we choose the photostation ID as **BP01**.



Screen 1.8

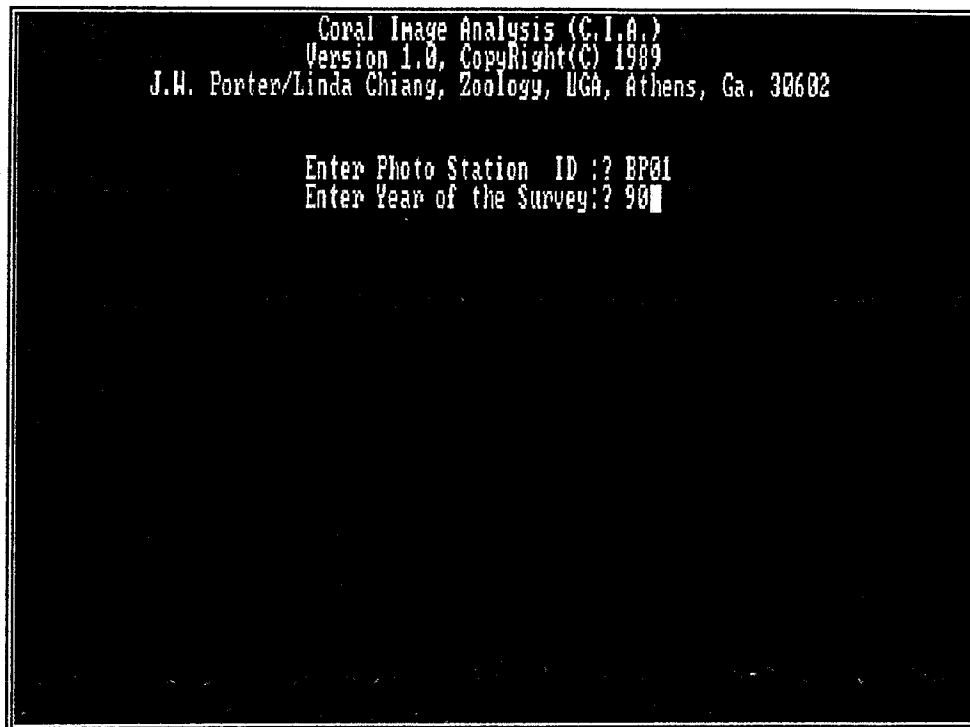
Next, enter the year of the survey (Screen 1.9). Only two numbers are accepted, so for 1989's data, key in 89. If you key in 1989, the program will only take **89** instead of "1989".

II. Calculation of Polygon Area

Our polygon area calculation algorithm is based on Green's theorem (Middleditch, 1988). This algorithm applies to any polygon, convex or concave. It is based on many small contiguous triangles with the polygon edge as their base and the polygon centroid as their apex. Since the digitizer resolution is about 0.00254 cm, this mathematical approximation of the area of the coral is considered highly satisfactory.

These stored data are then used to compute the following coral community parameters:

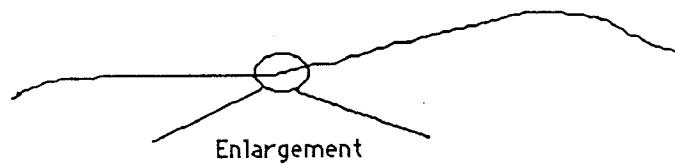
- (1) the number of coral species
- (2) the percent coral cover
- (3) the relative abundance of the different coral species (based on area)
- (4) the coral species diversity (natural log) based on either:
 - a) the number of colonies of each species, or
 - b) the area occupied by each species



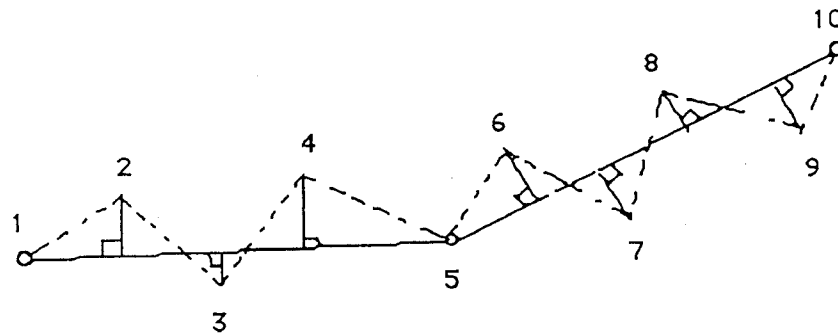
Screen 1.9

Each frame creates a separate file in our digitizing module, so enter the frame number to finish the file labelling process (Screen 1.10). The module will only take the first two characters. For instance, if we plan to digitize Frame 1, we key in 01, and press <Enter>.

a Line as seen by the naked eye



b Simple smoothing of enlargement



c Polygon smoothing of same line enlargement

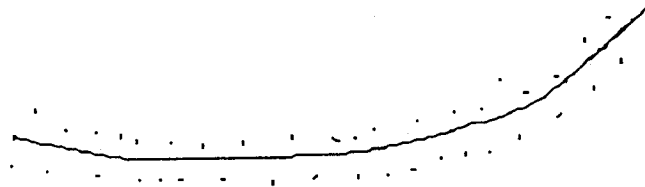
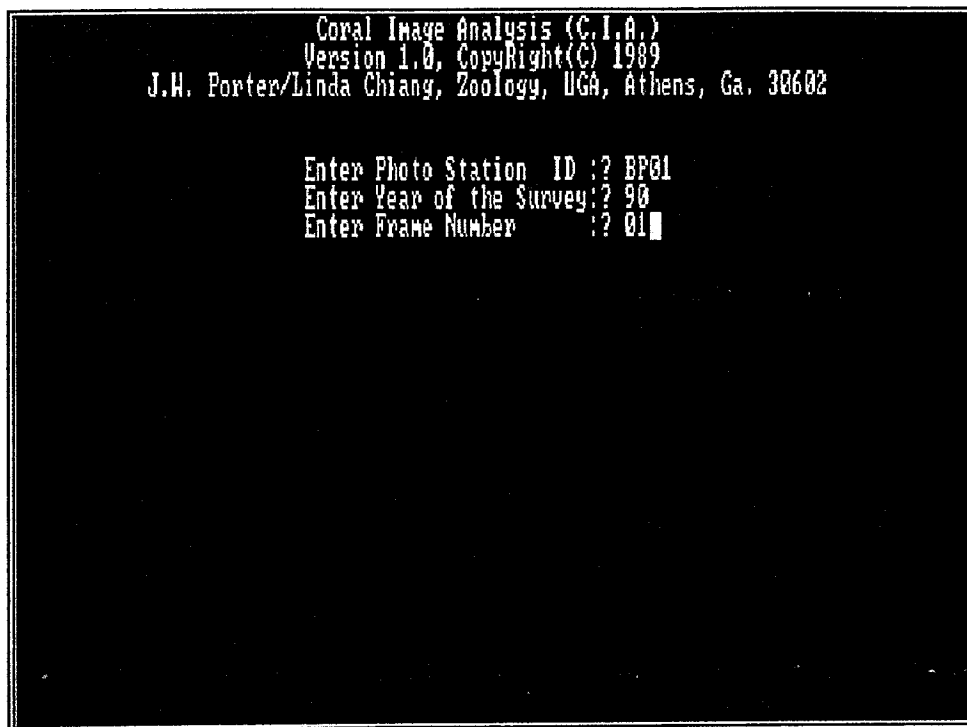


Figure 12.



Screen 1.10

Files are labelled according to the *photo station ID*, *year of the survey*, and *frame number*. Screen 1.10 illustrates this principle. The filename will appear as **BP01FR01.Y89** for example. The first four characters of the filename represent the photostation. "FR" means frame (this is automatically built in). "01" is the frame number. So, "FR01" represents frame 01. "89" is the year of the survey and therefore "89" designates 1989.

Appendix

I. Smoothing Points

A digitizer does not actually trace a line, it collects the X and Y coordinates of consecutive points along a line. Since the Jandel tablet is very sensitive to cursor movement, slight vibrations cause a large number of points off the line to be sent to the file. Most of these points are actually "noise". Experiments show that even table top vibrations, undetectable by the human hand, can still create a considerable amount of "data." Noise dramatically increases the number of unnecessary data points, uses up premium memory space, and makes consistent perimeter measurement almost impossible. Figures 12a - 12c illustrate a traced line and its blown up collection of points.

There are two alternative methods used to smooth the data. One is simple smoothing, the other is polygon smoothing. Neither of these methods have much effect on area, but both produce a much more accurate estimate of perimeter.

(1) *Simple Smoothing*

This method uses every fifth point. It calculates the distance of points 2, 3, 4 relative to the line between points 1 and 5. If the distance is less than twice the digitizer's resolution, it deletes them. The accepted points may be 1, 5, 10, 15 (Figure 12b). Only these points only are stored. This is similar to bandwise filtering.

(2) *Polygon Smoothing*

Figure 6c illustrates polygon smoothing. Hand shake, or even table vibration, causes the erratic scattering of points seen around the line. The polygon smoothing method compares every point, and from these generates a smooth line between them.

In this program, we have chosen to use the simple smoothing method. The reason is that while an average colony generates between 500 and 1000 points, really only a fifth of these points are significantly different from the last. The polygon smoothing method would save them all, involving a huge number of calculations for each colony, too many for most PC's to run efficiently. Simple smoothing discards most, saving only those that have X, Y coordinates significantly different from the last point.

2.5 *Setting the Scale*

The next step allows you to enter the frame size, in centimeters, for both the X and Y dimensions (Screens 1.11 and 1.12). This is an important step as it sets the scale on the screen and determines the projected surface area of objects digitized within the frame.

```
Coral Image Analysis (C.I.A.)  
Version 1.0, Copyright(C) 1989  
J.W. Porter/Linda Chiang, Zoology, UGA, Athens, Ga. 30602  
  
Enter Photo Station ID :? BP01  
Enter Year of the Survey: ? 90  
Enter Frame Number      :? 01  
Enter Frame Length(X,cm):? 75
```

Screen 1.11

(4) xxxxTEMP.Dyy

Field name	Ending position
Species name	4
Colony #	9
Frame #	12
Area	24
Perimeter	36

(5) PERCVRxx.Yyy

Field Name	Ending position
Frame #	2
% coral cover	8
diversity (based on the # of colonies of each species)	15
diversity (based on the area of each species)	22

(6) xxxxFRxx.Pyy

This file is a binary file. It consists of two different record types, Colony Type and Species Point Type. If you are interested in its detail and want to access this file, please check the source code (CIA.BAS) to make sure you are using the same sequence to read them out.

(7) xxxxFRxx.Fyy

This file is a binary file. It consists of one record type which is Species Type.

Coral Image Analysis (C.I.A.)
Version 1.0, Copyright(C) 1989
J.W. Porter/Linda Chiang, Zoology, UGA, Athens, Ga. 30602

Enter Photo Station ID :? BP01
Enter Year of the Survey: ? 90
Enter Frame Number :? 01
Enter Frame Length(X,cm): ? 75
Enter Frame Width(Y,cm): ? 50

Screen 1.12

III. Data File

3.1 File Name

Three kinds of files will be created after running the digitizing module. First, a file containing information on each individual frame (xxxxFRxx.Yyy) will be created. This is a general report for each individual frame. To get this output, just use the PRINT command in DOS prompt to get a hardcopy as Table 1.

Second, a table containing statistical calculations using this information (xxxxFRxx.Dyy, xxxx.Yyy, xxxxTEMP.Dyy and PERCVRxx.Yyy) will be created. Every time a new frame is added, these four cumulative summary files are updated. These four files are prepared for and used by the statistic analysis module only.

Third, graphic drawing files are created (xxxxFRxx.Pyy, xxxxFRxx.Fyy). These two files are saved as binary code to save disk space. File xxxxFRxx.Pyy collects all the points of the frame with each colony. File xxxxFRxx.Fyy collects all the frame sizes and cut line information.

3.2 File Format

(1) xxxxFRxx.Yyy

The format of this file is just like Table 1.

(2) xxxxFRxx.Dyy

Field name	Ending position
Species Name	4
Colony #	7
Perimeter	19
Area	32

(3) xxxx.Yyy

Field name	Ending position
Species name	4
Colony #	9
Frame #	12
Area	24
Perimeter	36

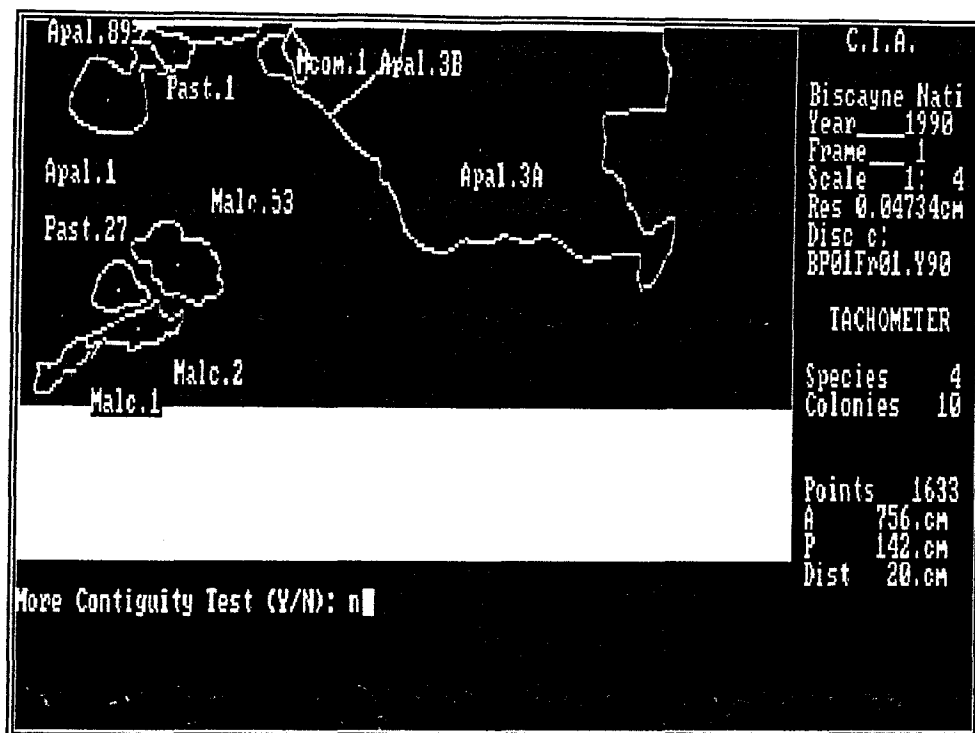
2.6 Routing the Data

Screen 1.13 routes the storage of your data. You can store the data on either a hard disk (e.g. C:) or on a floppy disk (e.g. A:). Remember to key in the semicolon ; after the drive letter designation. We strongly recommend placing data for a single site and year (which can include up to 100 individual frames) in a separate subdirectory from other sites and years. If you do this, you will need to create a subdirectory before you initiate the Coral Image Analysis program. Then, in screen 1.13 specify the drive path for data with the subdirectory name followed by a backslash (e.g. c:\BP0190\).

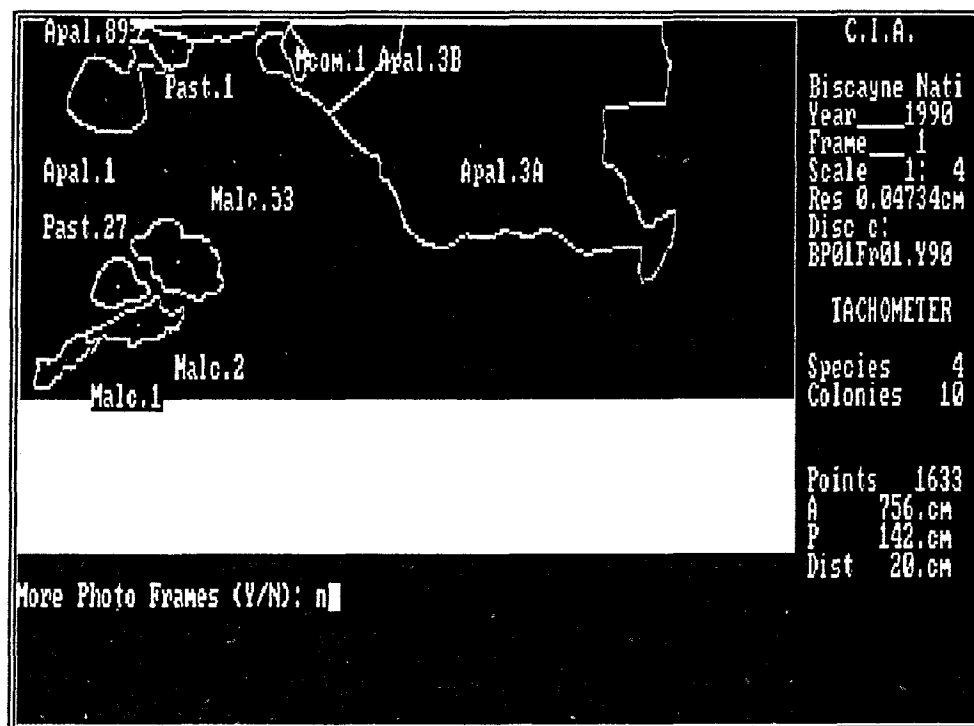
```
Coral Image Analysis (C.I.A.)
Version 1.0, Copyright(C) 1989
J.H. Porter/Linda Chiang, Zoology, UGA, Athens, Ga. 30602

Enter Photo Station ID :? BP01
Enter Year of the Survey :? 90
Enter Frame Number      :? 01
Enter Frame Length(X,cm):? 75
Enter Frame Width(Y,cm) :? 50
Drive (Path) for data   :? c:\
```

Screen 1.13



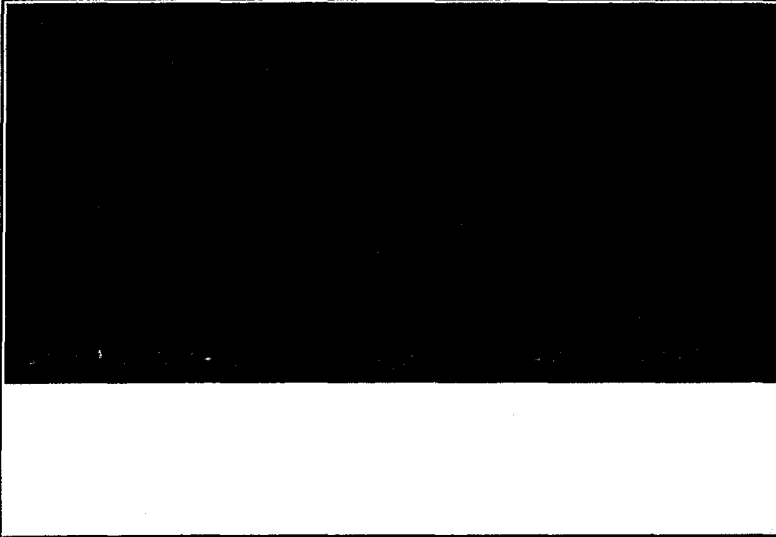
Screen 1.31



Screen 1.32

2.7 Tracing

Screen 1.14 is the image screen menu. The right hand side of the screen contains a brief summary of information about this frame from the data you just keyed in. Under the TACHOMETER label is a digitizing update, the number of species and colonies entered so far will be counted up as you digitize more colonies from the frame. "Points" tells you the number of data points collected around the perimeter of the current colony.

	C.I.A.
	Biscayne Nati Year 1990 Frame 1 Scale 1: 4 Res 0.04736cm Disc c: BP01Fr01.Y90
	TACHOMETER
	Species 0 Colonies 0
	Points
Place the cursor at a start point on the colony perimeter. Press cursor button #1 to BEGIN; trace back to the start point, then press cursor button #2 to STOP.	

Screen 1.14

To begin tracing a colony, choose a starting point on the perimeter of the colony, place the cursor cross hairs over this starting point, and tap cursor button #1 once (Screen 1.15). You may trace clockwise or counterclockwise around the polygon. After returning to the start point, tap cursor button #2 to stop. If the colony crosses outside the frame boundary, choose a starting point on the perimeter of the coral that is outside the frame boundary. Trace all the way around the colony, but stop at the point where the perimeter crosses the boundary beyond your starting point.

When you have finished tracing a colony, Screen 1.15 appears with an outline of the traced object displayed on the screen. If you are not satisfied with the digitizing, key in N (upper or lower case N) after the question "Trace OK?". The colony which you just digitized will disappear. If you are satisfied with the trace, press Y (upper or lower case Y), then <Enter> to continue.

		C.I.A.	
		Biscayne Nati	
		Year 1990	
		Frame 1	
		Scale 1: 4	
		Res 0.04736cm	
		Disc c:	
		BP01F01.Y90	
		TACHOMETER	
		Species 0	
Colonies 0			
Points 503			
Trace OK? (Y/N): y			

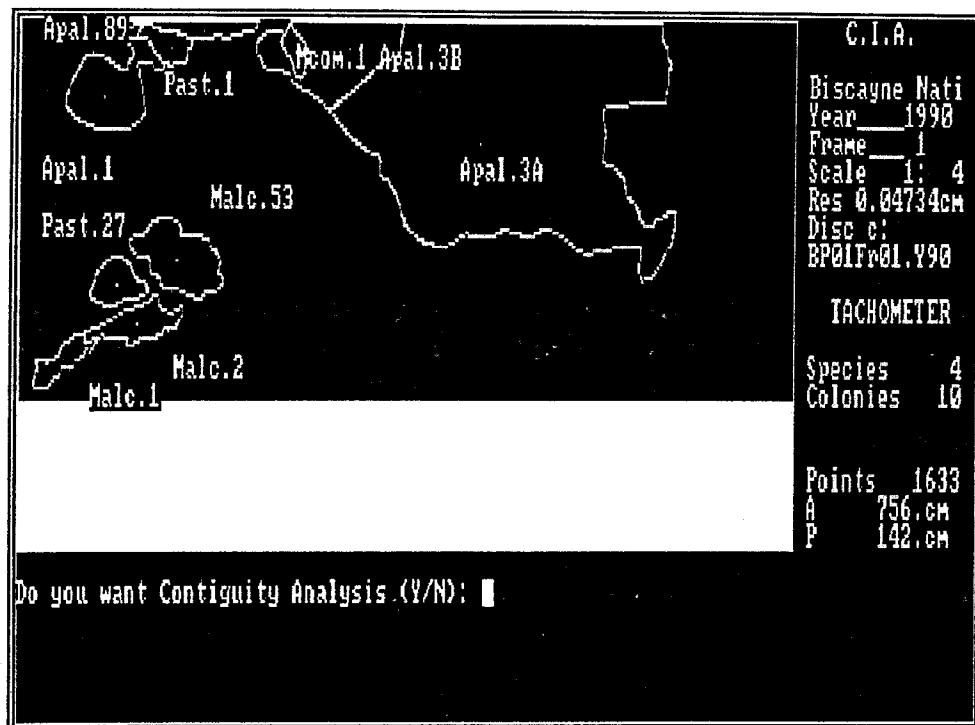
Screen 1.15

Screens 1.16, 1.17, 1.18 1.19 request (1) the number of segments, and (2) the positioning of one point inside each of these segment for the current colony. A colony will have more than one segment if the edge of the colony lies near or outside the frame boundary (Screens 1.20 - 1.23), or if the shape of the colony is tightly "pinched" at some point. If a colony has what looks like "hourglass" constrictions between the various sections of the same colony, then this colony has more than one "segment." This process is somewhat arbitrary, but any time there is a severe constriction between parts of a colony, designate these peninsulas as segments. There is no penalty or error of calculations involved in designating "too many" segments within a single colony.

Each segment needs its own point positioned somewhere inside each segment to help the graphics plotting package define the colony's shape. Even if the colony's perimeter only wanders close to the cut lines without actually crossing it, you must give each part a segment number and a central point (Screens 1.20 - 1.23).

Screen 1.28, the Contiguity Analysis, appears only when more than two colonies appear on the screen. This option allows you to measure the distance between any pair of colonies. According to the distance showing on the screen, you can decide whether you want to show this information on the report output (Screen 1.29 - 1.31).

At Screen 1.32, if you want to trace another frame, key in Y for "More Photo Frames". The program will now jump back to Screen 1.13 and wait for you to tape and center a new tracing on the digitizer tablet. If you don't want to trace more frames, and respond N to the question on the screen, the program will close and cycle you back to the DOS prompt.



Screen 1.28

	C.I.A.
	Biscayne Nati Year 1990 Frame 1 Scale 1: 4 Res 0.04736cm Disc c: BP01Fr01.Y90
	TACHOMETER
	Species 0
	Colonies 0
	Points 503
Number of segments on this colony:1	

Screen 1.16

	C.I.A.
	Biscayne Nati Year 1990 Frame 1 Scale 1: 4 Res 0.04736cm Disc c: BP01Fr01.Y90
	TACHOMETER
	Species 0
	Colonies 0
	Points 503
Number of segments on this colony:1 Do you need to change?(Y/N)? n	

Screen 1.17

Screen 1.27 appears, showing you the colony and its label. Also, the area (cm²) and perimeter (cm) of this colony are displayed on the right hand side of the screen. If you want to digitize the next colony in this frame, key in Y <Enter> after the question "More Colonies (Y/N)." The program will then cycle you back to Screen 1.14. If, however, you have entered all the colonies in this frame, key in N <Enter> after the question "More Colonies", and proceed to the next screen.

 Malc.1		C.I.A.
		Biscayne Nati
		Year 1990
		Frame 1
		Scale 1: 4
		Res 0.04734cm
		Disc c:
		BP01Fr01.V90
		TACHOMETER
		Species 1
Colonies 1		
Points 494		
A 17.cm		
P 24.cm		
More Colonies (Y/N): y		

Screen 1.27

	C.I.A.
	Biscayne Nati Year 1990 Frame 1 Scale 1: 4 Res 0.04736cm Disc c: BP01Fr01.Y90
	TACHOMETER
	Species 0
	Colonies 0
	Points 503
Number of segments on this colony:1 Do you need to change?(Y/N)? n Put cursor cross hairs to the center of # 1 Press Button #1.	

Screen 1.18

	C.I.A.
	Biscayne Nati Year 1990 Frame 1 Scale 1: 4 Res 0.04734cm Disc c: BP01Fr01.Y90
	TACHOMETER
	Species 0
	Colonies 0
	Points 494
Number of segments on this colony:1 Do you need to change?(Y/N)? n Put cursor cross hairs to the center of # 1 Press Button #1. Do you need to change?(Y/N)? n	

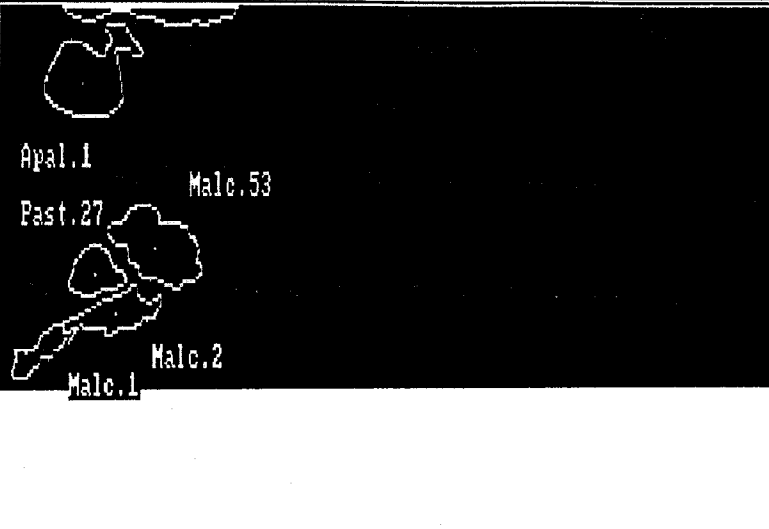
Screen 1.19

C.I.A.	
Biscayne Nati	
Year	1990
Frame	1
Scale	1: 4
Res	0.04734cm
Disc c:	BP01Fr01.Y90
TACHOMETER	
Species	0
Colonies	0
Points	494
Species ID(4 letters always):? Male	
Do you need to change?(Y/N)? n	

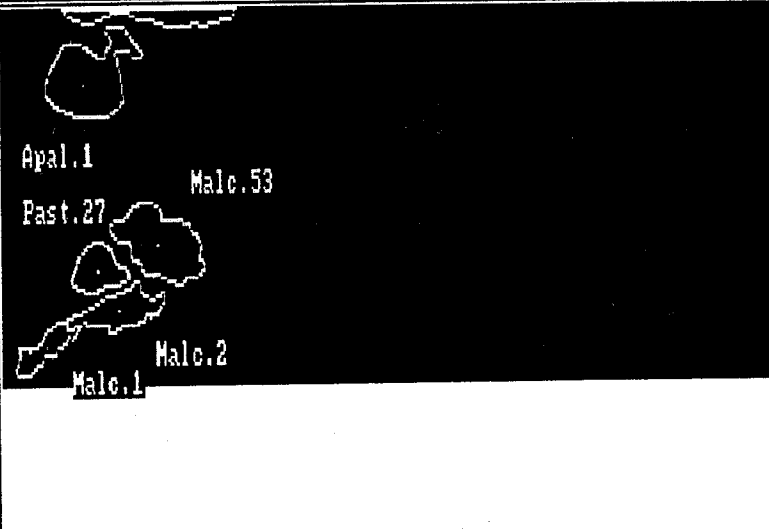
Screen 1.25

C.I.A.	
Biscayne Nati	
Year	1990
Frame	1
Scale	1: 4
Res	0.04734cm
Disc c:	BP01Fr01.Y90
TACHOMETER	
Species	0
Colonies	0
Points	494
Do you need to change?(Y/N)? n	
Coral ID (4 characters max.):? 1	
Do you need to change?(Y/N)? n	
Put cursor cross hairs to left of label position.	
Press Button #1.	

Screen 1.26

		C.I.A. Biscayne Nati Year 1990 Frame 1 Scale 1: 4 Res 0.04734cm Disc c: BP01Fr01.Y90 TACHOMETER Species 3 Colonies 5 Points 565 A 66.cm P 42.cm
Number of segments on this colony:2		

Screen 1.20

		C.I.A. Biscayne Nati Year 1990 Frame 1 Scale 1: 4 Res 0.04734cm Disc c: BP01Fr01.Y90 TACHOMETER Species 3 Colonies 5 Points 565 A 66.cm P 42.cm
Number of segments on this colony:2 Do you need to change?(Y/N)? n Put cursor cross hairs to the center of # 1 Press Button #1.		

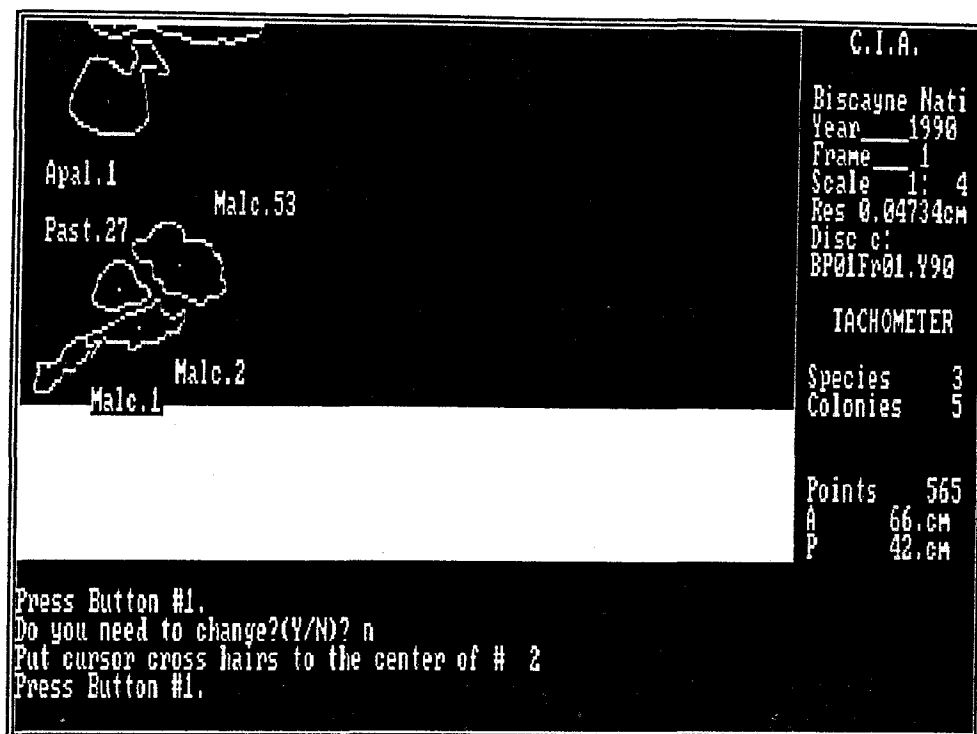
Screen 1.21

Screens 1.24, and 1.25 request the digitized colony's species name and colony number. You can correct these entries immediately if you enter them incorrectly. Species identifiers are the *first letter of the genus name (capitalized)* and the *first three letters of the species name (all lower case)*. Colony numbers range from 1-9999. If a colony splits apart in a subsequent survey, you may designate the parts by a letter, as in 1A, 1B, *etc.* Be sure not to give separate colonies of the same species the same colony number. Also be sure, however, that if a colony is viewed in more than one frame, that it receives the same colony number in all frames in which it appears.

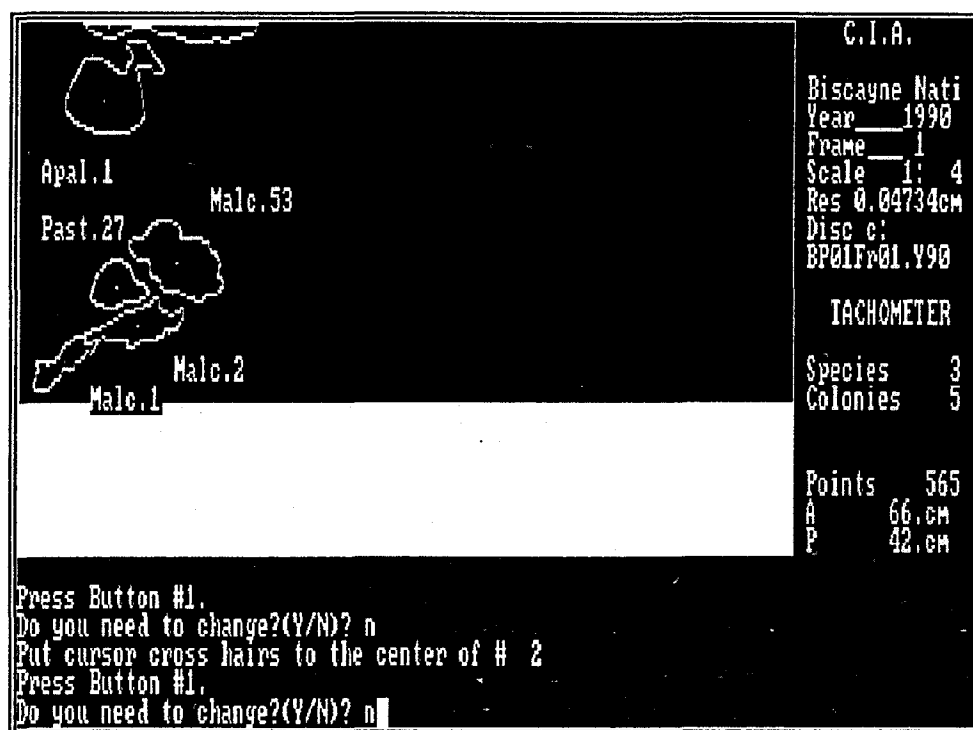
After you key in this colony identifier information, the next screen appears to let you choose where to place its label (Screen 1.26). For large colonies, put the label in the middle of the traced colony; for small colonies, put the label outside the colony, but not on top of another colony. Put the cursor cross hairs over the point on the tracing where the left edge of the label should be, and tap cursor button #1. (This label only helps you to identify colonies on the screen while digitizing. If the image of the frame is called up or mapped later, the colony labels will not appear. If you wish to retain a labelled image of the frame, you will need to either print the screen immediately after you have finished digitizing, or send and save the screen as a graphic into some other software program (*e.g.*, save as a TIF file). if you request to redraw the frame later, the label will not be visible. So, if you want to get the label printed with the graph on a hardcopy printout, you mus print screen now before leaving the current frame.)

		G.I.A.	
		Biscayne Nati	
		Year 1998	
		Frame 1	
		Scale 1: 4	
		Res 0:04734cm	
		Disc c:	
		BP01Fr01.Y98	
		TACHOMETER	
		Species 0	
Colonies 0			
Points 494			
Species ID(4 letters always):? Male			

Screen 1.24



Screen 1.22



Screen 1.23

