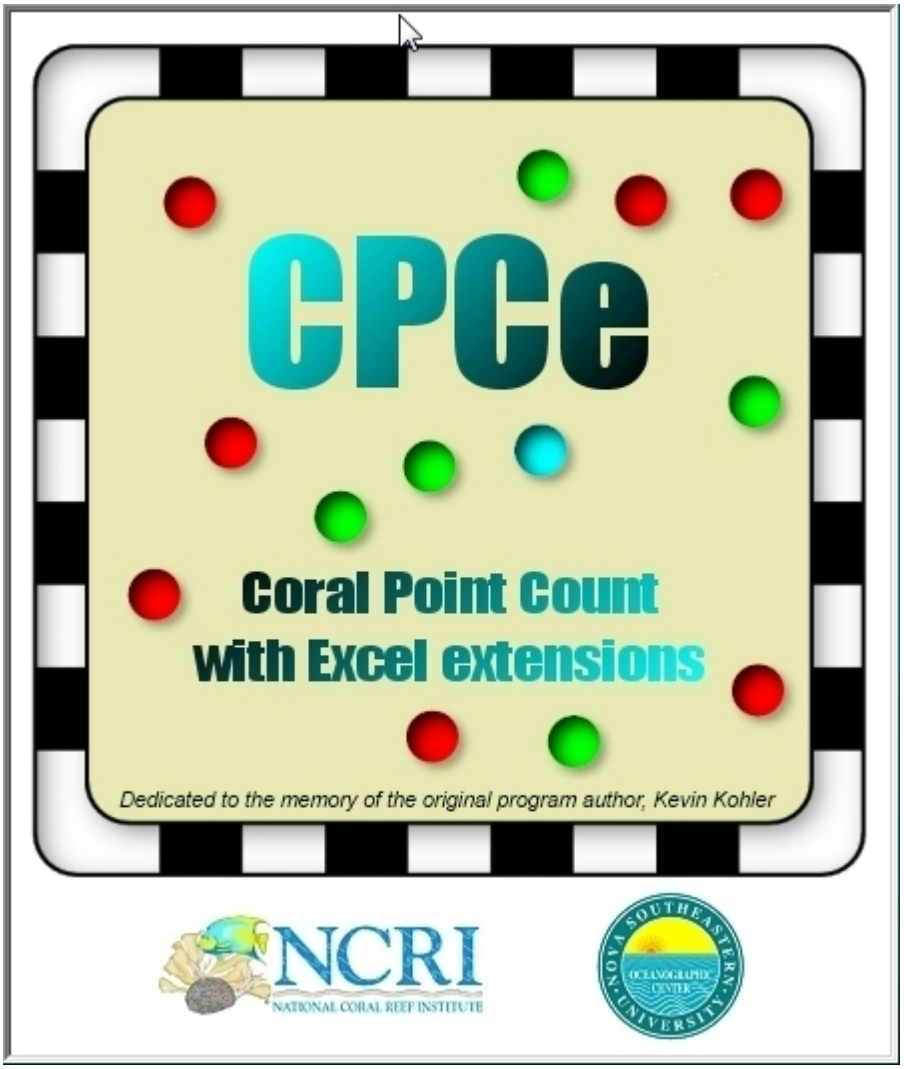
CPCe 4.1 Help

CPCe overview



Coral Point Count with Excel extensions (CPCe) is a Windows-based program that provides a tool for the determination of coral cover using underwater images. A specified number of random points are distributed on an image, and coral species/substrate lying under these points are user-identified. Microsoft Excel spreadsheets can be created to further analyze the data. Additionally, the planar area and length of benthic features can be calculated and analyzed.

Computer requirements

The computer requirements for CPCe are not excessive. Probably the most important criteria is having enough memory. Systems using CPCe should have a minimum of 1Gb memory, with 2Gb or more preferable. This is because CPCe is graphics-intensive, having to keep multiple copies of images in memory concurrently. If you receive a message "Cannot create Autoredraw image", this is usually due to insufficient memory. Try closing down other applications to see if this helps. More memory might be required as a permanent solution.

The control and data entry buttons in CPCe are positioned on the screen assuming a screen resolution of **96 dpi,** so you must ensure that your screen is set to this resolution. In practice, an incorrect setting will be manifested, among other things, in the inability to add more than a certain number of random points.

Checking your screen dpi:

Windows XP: Right-click the desktop, choose Properties-Settings-Advanced.
Vista: Right-click the desktop, choose Personalize-Adjust font size (DPI) (in left column).

Regional considerations

Regional considerations

CPCe expects certain conventions regarding output data formatting. In particular, it expects the decimal character to be "." (period) and the digit grouping character to be "," (comma). If your computer does not follow these conventions, you must change it accordingly. You can do this via Control Panel - Regional and Language Options.

CPCe menu options

Using CPCe is simple and straightforward. The main form is where the underwater image is displayed, along with the identification codes and data entry areas.

The main form of CPCe has the following menu options:

File:

Open:

Raw image file: The name of the .jpg file containing the image.

CPCe data file (.cpc) (keep original directories): The name of a file containing previously analyzed CPCe data (.cpc file). Choosing this option assumes the code and image file used to create the .cpc file are in their original locations.

CPCe data file (.cpc) (override original directories): The name of a file containing previously analyzed CPCe data (.cpc file). Choosing this option allows the user to specify the new locations of the code and image files, and gives the opportunity to make these changes permanent in the .cpc file.

CPCe area file (.ara): The name of a file containing previously analyzed CPCe area data (.ara file).

Save:

Save data to .cpc file: Saves the current dataset to a .cpc file.

Save .cpc file(s) to Excel: Assembles one or more .cpc files into an Excel spreadsheet.

Save .ara file(s) to Excel: Assembles one or more .ara files into an Excel spreadsheet.

Multiple images/files processing:

Process multiple images: Specify the directory containing multiple file images to be processed.

View/edit multiple .cpc files: Specify the directory containing the multiple .cpc image/data files to be displayed.

Exit: Exits the CPCe program.

Mark border: This allows the specification of the rectangular area of interest on the frame image. This area can be marked manually or the entire frame image can be used.

Point Overlay:

Specify/apply overlay points: Specifies the number of points overlayed on the image for analysis.

Recalculate point coordinates: Re-specifies the positions of the random points drawn on the image.

Measurement:

Image scaling/calibration: Calculates the number of pixels per specified unit length of the image.

Area/length analysis: Calculates the area or length of a traced region on the image.

Batch linear extension analysis: Allows the rapid calculation of a single accumulative length from each of many images.

Feature counter: Allows the counting of features contained in image areas of specified dimensions.

Image enhancement: Allows the selection of a specified area of the analysis image, and the modification of brightness,

sharpness, and contrast of the selected area image.

Utilities:

Create code file: Provides a graphical interface for creating a code file.

Create inter-observer .cpc files: Creates .cpc files from a set of image files with borders and random points specified the same for all files. Only the border and points are created, no data is assigned to the points. This allows the distribution of identical .cpc files to a group of observers for analysis.

Code file checker: Finds any obvious errors with the specified code file.

Change code file / image file directory location: Changes the directory location of either the coral code file or image file in a selected set of .cpc or .ara files. This allows the user to move the code or image files post-analysis.

Data check/species search in .cpc files: Searches a selected set of .cpc files for unassigned points or the occurrence of a specified species code.

Fix image calibration: Re-calculates the areas or lengths of a traced regions based on a new scaling calibration value.

Batch change .ara file header data: Allows user to change the header data in multiple .ara files.

File sequencer: Allows user to rename filenames in a sequential manner.

Convert pre-V3.4 .ara files to V3.4 format: Converts the format of .ara files created with CPCe versions prior to V3.4 to V3.4 (or later) format.

Options:

Specify code file: Allows the specification of the file containing the major categories and sub-categories (e.g. species).

Data point graphical parameters: Allows the specification of the shape, size, and colors of the object used to indicate the locations of the random points. Also specify the font size of the code boxes.

Color code codename category boxes: Allows color coding of the various codebox categories.

Expand small images: In cases where the size of the analyzed image is smaller than the available screen space, this determines whether the image is expanded to fill that available space, or keeps its original dimensions.

Letter symbols/Number symbols: Allows the use of either letters or numbers to label the random data points.

Auto-advance point: When checked, advances to the next data point in sequence when a data point is assigned a value. This can speed up analysis time.

Auto-follow: When checked, maintains zoom level and centers the current data point in focus in the image.

Maintain zoom: If maintain zoom is not checked, and auto-follow is checked, the image is redrawn at 100% when each new data point has focus. This is to allow the user to see the point in relation to the entire image, rather than at the current zoom level which may eliminate much of the image's visible area.

Help:

Help: Information about using the CPCe program

About CPCe: Information about the CPCe program

Point counting with CPCe

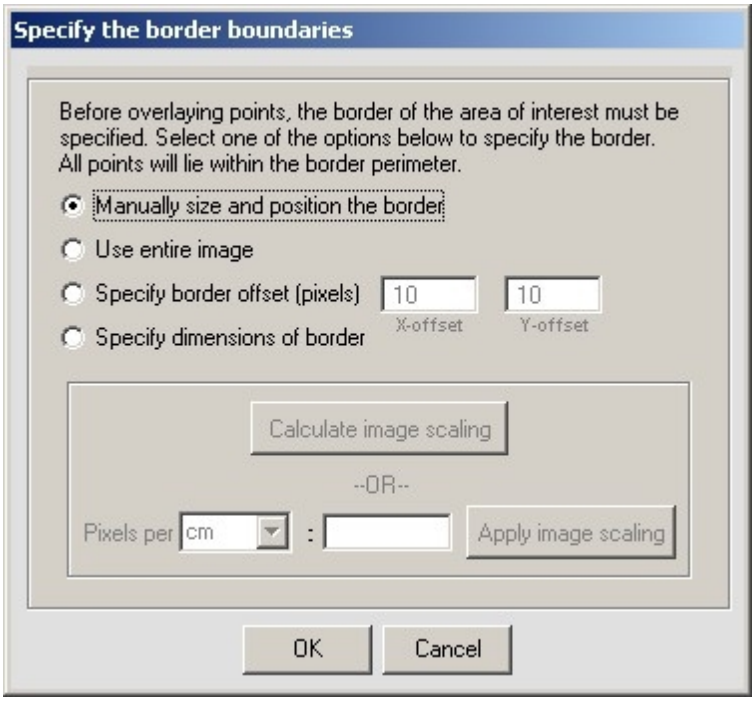
For best results, CPCe should be run on a computer having a screen resolution of at least 1024 x 768.

The first step in using CPCe is to specify the image to be analyzed. This image must be in the form of a .jpg, .gif, or .bmp image file, or a previously processed .cpc file. To open an image file, choose *File-Open-Raw image file*, and specify the image filename. If retrieving a previously analyzed image and dataset, choose *File-Open-CPCe image/data file (.cpc)*.

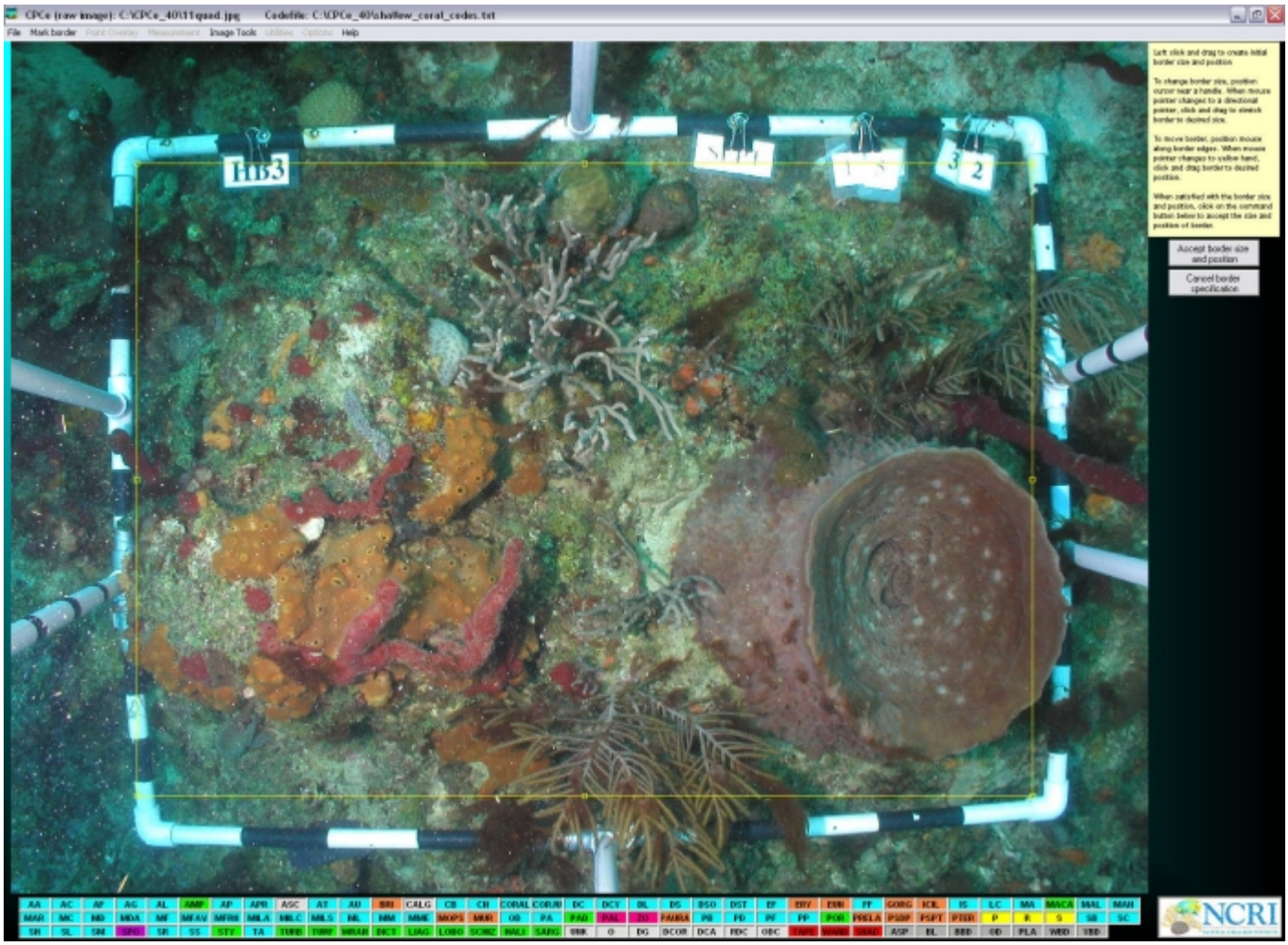
To speed analysis, you can sequentially process multiple files by choosing *File-Multiple images/files processing-Process multiple images*. This option eliminates the need to manually select each frame image. In this case, you specify a directory containing the files to process. All files of the specified type (.bmp, .gif. or .jpg) in the directory will be displayed. You then select the files you wish to process by highlighting the filename. To highlight multiple files, use shift-click or cntrl-click. To perform the processing, click on the *Start file processing* button.

After specifying the image(s) to process, the image is displayed on the screen. If the image is smaller than the available screen space, the image is either scaled up or left in its original size, depending on the setting of Expand small images. If the image is larger than the available screen space, the image is scaled down to fit in the available screen space.

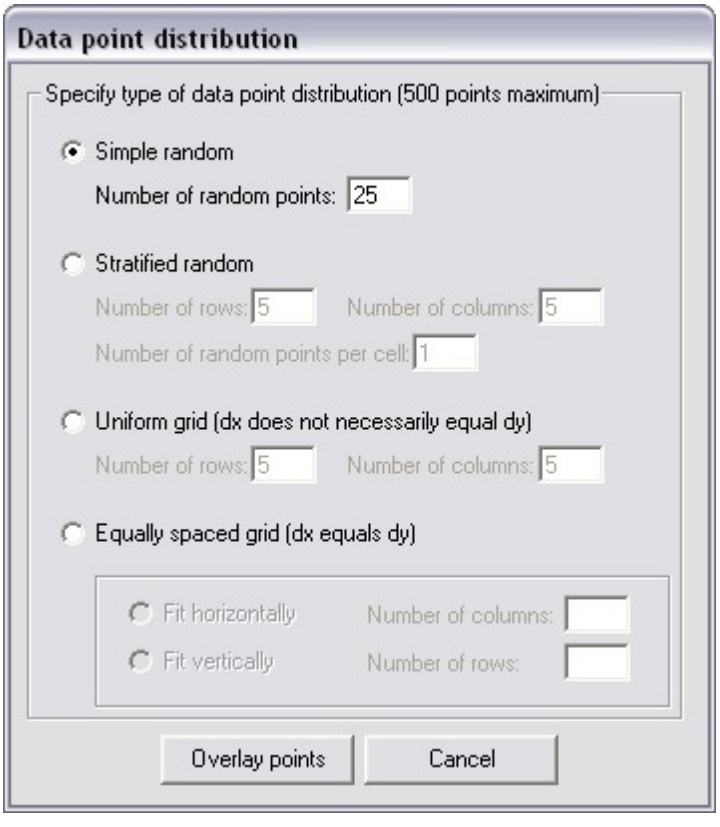
To begin data assignments, the perimeter of the area to be analyzed must be marked. **All random point positions will lie within the specified border**. You can choose to either size and position the border location manually, specify the border dimensions and then position the border, or you can choose the entire image as the usable frame area, with or without a border offset.
If manually sizing and positioning the border, left-click on the image, and stretch the border to its initial size. Handles will appear on the border edges. Place the mouse cursor over one of the handles of the border box until the cursor changes to a directional arrow cursor and click and drag to the desired size. You can move the border by moving the mouse over one of the border edges until the cursor changes to a yellow hand and click and drag the border to the desired position.



If specifying the border size, you must first calibrate the image to get the scaling factor (e.g. pixels/cm). To calibrate the image, choose the *Specify dimensions of border* option and click *OK*. You will be asked to calibrate the image. Another form is presented, displaying the image. You then click on 2 points on the image which are a known distance apart, and provide the distance between them. The scaling factor is calculated, and you are returned to the border specification form, with the maximum dimensions of the image. You then can specify the width and height of the border. The border is drawn, and you can position it by moving the mouse over a border edge until it changes to a yellow hand, and then clicking and dragging it to the desired position. Note that at this point, you can only move the border, not resize it.



The number of random points to be drawn on the image is now specified. You can choose among 4 distribution types: simple random, stratified random, uniform, or equally spaced. For a random distribution, the points are distributed randomly throughout the bounded region. For a stratified random distribution, you divide the bordered region into an array of cells (rows and columns), and then specify the number of random points to be placed in each cell. For a uniform distribution, you must specify the number of rows and columns of points. The points are then fit exactly into the bounding region. Note that for a uniform distribution, the x-spacing of points does not necessarily equal the y-spacing. For an equally spaced distribution, the x-spacing of points is set equal to the y-spacing of points. You must specify whether to fit the distribution exactly in the horizontal or vertical direction. The distribution is centered in the direction not chosen.



The maximum number of points allowed is 500, and the default number of points is stored in the configuration file (after the first specification). Click *Overlay points* to accept the default, or manually enter the desired distribution type and number of points, and click *Overlay Points*.

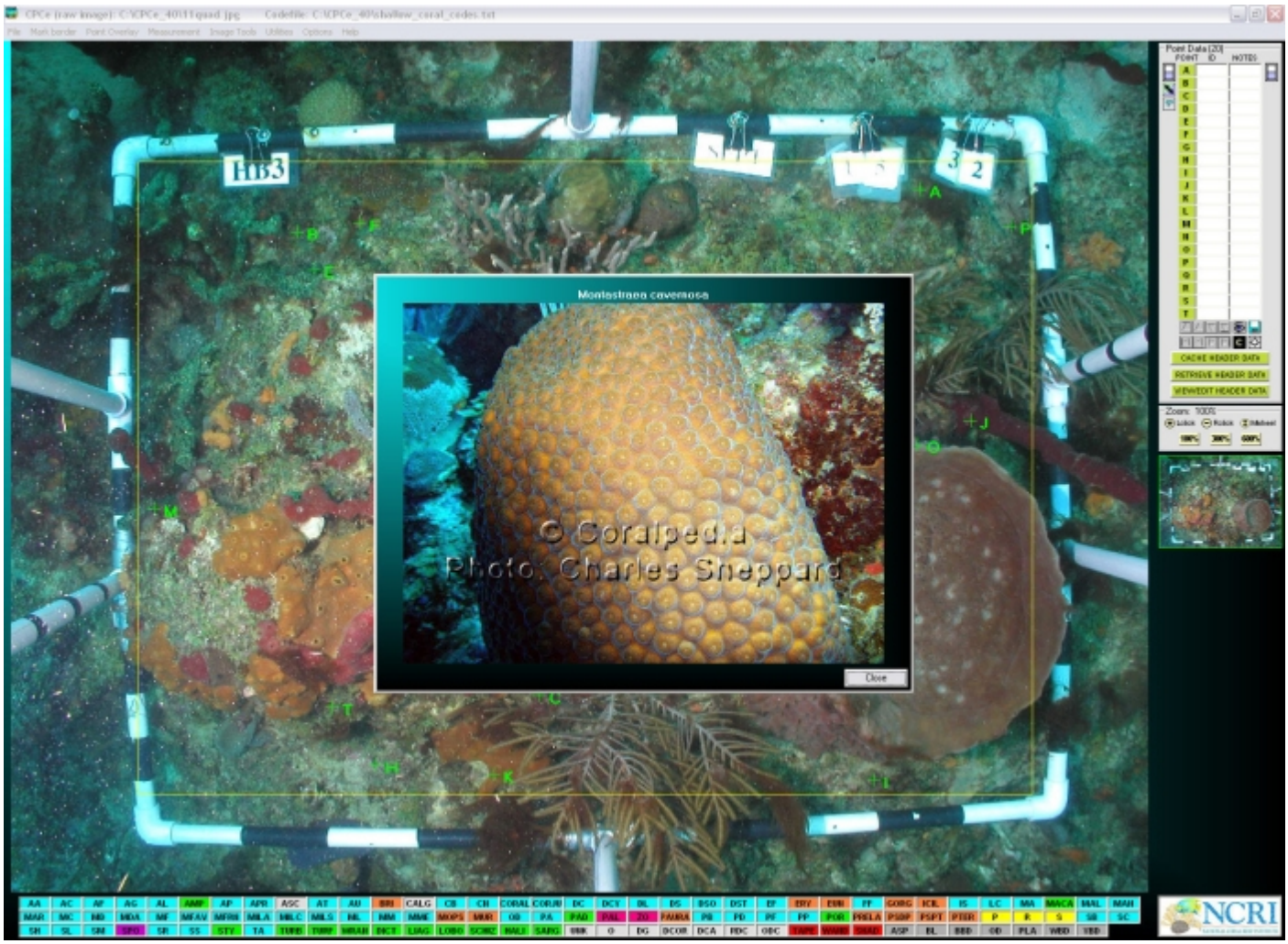
The random points are then superimposed on the image, and the coral codes for the current code file are displayed beneath the image. You can specify a different code file by choosing *Options-Specify code file* from the main menu.

The file shallow_water_corals.txt is supplied with CPCe. However, you can create your own to suit your individual needs (see Creating a code file).

The data can now be classified. Each of the random points is assigned an alphabetical or numerical label, depending on the setting of *Options-Letter symbols*. Points with no associated data classification are shown in the unassigned_color (see Colors). To associate a data point with a classification, click on the point label in the point codes box on the right side of the screen in the ID column. The corresponding data point will change to the current_focus color (see Colors). Then click on the appropriate coral code from the list of codes beneath the image. The corresponding coral code will be inserted in the point code table. After the coral code has been entered, the data point changes to the assigned_color (see Colors), indicating that it has been classified. The NOTES column is used to further classify the data points pertaining to disease, bleaching, etc. Data for the NOTES column is entered in the same manner as for the ID column. Note that only darkly shaded classifications in the code table beneath the image can be entered in the NOTES column.

Species display and reference images

If the mouse is left to hover over a code box at the bottom of the image, a pop-up box is displayed with the full name of the species/substrate. If a code box is right-clicked, a picture of the code in question is displayed (if it exists). You can also create your own reference images. The name of the image file must be in the form *species*.jpg or *species*_whatever.jpg (or .gif or .bmp). The name *species* must match the code name exactly (case insensitive), and must either be the entire filename, or be located before the first "_" in the filename. For example, the reference image for macroalgae (code name MACA) could be maca.jpg or maca_mypic.jpg (or .gif or .bmp). These reference files must be placed where the CPCe executable is located, in a subdirectory called codeimages (e.g. C:\CPCe_40_inst\codeimages). See image below for an example of a code image display.



During the point data assignments, the image can be zoomed-in or zoomed-out using left-click and right-click, respectively, or by using the mouse scroll wheel. The small image in the lower right of the screen shows the current viewport of the image to aid in determining where the current data points lie on the image .

If the auto-follow option is checked, after a data point is assigned a value, the next point in sequence will be highlighted with the current_focus color. This eliminates the need to click each data point before assigning a value.

Additional items

[Controls](#)

[Header data](#)

[Saving data to a .cpc file](#)

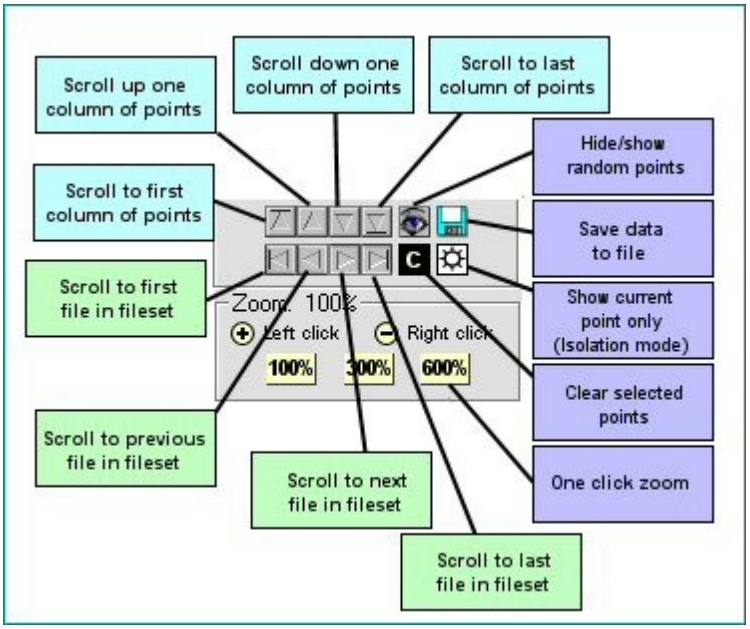
[Saving .cpc files to MS Excel](#)

[Viewing/editing existing .cpc files](#)

Controls

Controls

There are several controls designed to improve the efficiency of assigning values to the data points. A schematic diagram of the various buttons and controls are shown below.



Scrolling data points

When not all data points can be displayed on the screen, you can use the cyan buttons provided to allow you to scroll to the first, last, previous, and next column of data points.

Scrolling image files

To scroll between various files in a fileset, use the green buttons provided. You can scroll to the first, last, previous, and next file in the fileset. Note that these buttons are enabled only when using a fileset, rather than specifying the image files manually.

Zooming

To assist with the species classification, there is the ability to zoom in on the image. To zoom in, simply left-click anywhere on the image. To zoom out, right-click anywhere on the image. You can also use mouse scroll wheel to zoom in and out. Each click zooms by an additional 50%. The center of the zoomed image is as near the cursor position as possible. There are 3 one-touch zoom buttons, which zoom to 100%, 300%, and 600%, respectively.

Hide/show data points

By clicking on the hide/show button, the data points are removed/restored from/to the image. This can make it easier to see exactly what is lying beneath a data point. This button acts as a toggle.

Isolation mode

While in this mode, only the current point is shown on the image, rather than all of the random points. This can make points easier to discern in cases where points overlap or are in close proximity. This button acts as a toggle, that is, clicking it again will make all points re-appear.

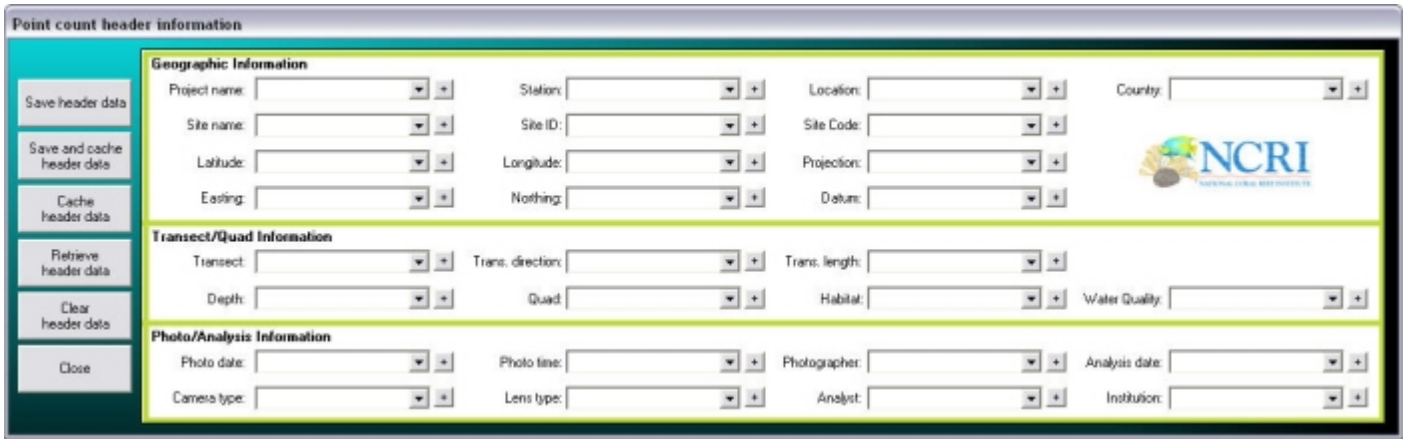
Clear selected points

Group selection allows multiple points to be assigned a single data value with one click. assignment. To select points, click on a point label, and then use either Shift-Click or Cntrl-Click to select a range of points. When this button is clicked, the data values for any points selected are cleared.

Header data

Header data

The header data consists of general information regarding the image and .cpc file analysis.



The command buttons on the left side of the dialog box allow you to save the header data, save and cache the header data
(in case you want to use the header data again for another image), cache the data, retrieve the previously cached data, clear the header data, and close the dialog box.

You can save header data as part of each .cpc file. If you begin to analyze a .jpg image (no initial header data), you are presented with a dialog box asking for header data. You can simply close the box if you do not wish to enter header data at
that time. If you are re-analyzing a .cpc file, you can manually view the header data using the green command buttons on the right side of the screen (see description below).

Fundamentals of header data

The parameters available as header data are:

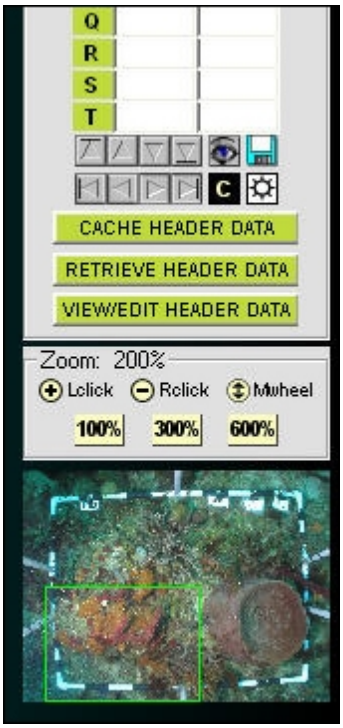
- Institution
- Project
- Station name
- Location
- Country
- Site name
- Site ID
- Site code
- Latitude
- Longitude
- Easting
- Northing
- Projection
- Datum
- Transect name
- Transect direction
- Transect length
- Depth
- Quad ID
- Habitat
- Water quality
- Photograph date
- Photograph time
- Photographer
- Camera
- Lens type
- Analysis date
- Analysis technician

The control panel on the right of the screen contains 3 buttons related to header data:

Cache header data: Clicking this button allows the user to save (or cache) the current contents of the header data for later use.

Retrieve header data: Clicking this button retrieves the current contents of the header data cache and imports them into the current header data variables. These values will be saved when you save the .cpc file.

View/Edit header data: Clicking this button displays the form shown above which contains the current contents of the header data variables, and allows you to change or add to them.



Populating header data drop-down menus

The drop-down menus on the form can be populated by the user by editing the file **cpcheader.cfg** which is located in the run directory of CPCe, usually C:\CPCe_40_inst\.

The contents of the file are shown on the right. The header category markers, shown in bold, must not be changed. To customize the drop-down menus, add items underneath the the appropriate header category.

The contents of the file cpcheader.cfg file is shown below:

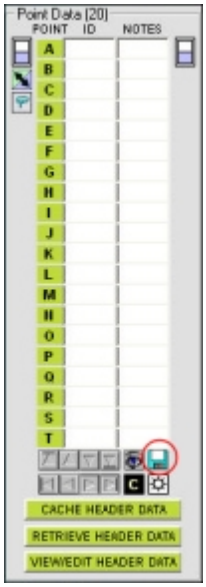
```
** 99 Replace the items in each category with your own**
** 99 Do not alter or remove any lines containing **
** 1 Institution header items - Do not delete or alter this line
** 2 Projectname header items - Do not delete or alter this line
** 3 Station header items - Do not delete or alter this line
** 4 Location header items - Do not delete or alter this line
Location 1
Location 2
** 5 Country header items - Do not delete or alter this line
** 6 Sitename header items - Do not delete or alter this line
** 7 Siteid header items - Do not delete or alter this line
** 8 Sitecode header items - Do not delete or alter this line
Site 1
Site 2
** 9 Latitude header items - Do not delete or alter this line
** 10 Longitude header items - Do not delete or alter this line
** 11 Easting header items - Do not delete or alter this line
** 12 Northing header items - Do not delete or alter this line
** 13 Projection header items - Do not delete or alter this line
Globe
Mercator
Transverse Mercator
Oblique Mercator
Space Oblique Mercator
Miller Cylindrical
Robinson
Sinusoidal Equal Area
Orthographic
Stereographic
Gnomonic
Azimuthal Equalidistant
Lambert Azimuthal Equal Area
Albers Equal Area Conic
Lambert Conformal Conic
Equidistant Conic
Polyonic
Biplolar Oblique Conic Conformal
** 14 Datum header items - Do not delete or alter this line
GRS80
ITRF00
NAD27
NAD83
WGS72
WGS84
** 15 Transect header items - Do not delete or alter this line
Transect 1
Transect 2
** 16 Transectdir header items - Do not delete or alter
```

	this line **** 17 Transectlen header items - Do not delete or alter this line** **** 18 Depth header items - Do not delete or alter this line** Depth 1 Depth 2 **** 19 Quad header items - Do not delete or alter this line** Quad 1 Quad 2 **** 20 Habitat header items - Do not delete or alter this line** **** 21 Water quality header items - Do not delete or alter this line** **** 22 Photodate header items - Do not delete or alter this line** **** 23 Phototime header items - Do not delete or alter this line** **** 24 Photographer header items - Do not delete or alter this line** **** 25 Camera header items - Do not delete or alter this line** **** 26 Lens header items - Do not delete or alter this line** **** 27 Analysisdate header items - Do not delete or alter this line** **** 28 Analysistech header items - Do not delete or alter this line** Tech 1 Tech 2 **** 99 End of header data - Do not delete or alter this line**

Saving data to a .cpc file

Saving data to a .cpc file

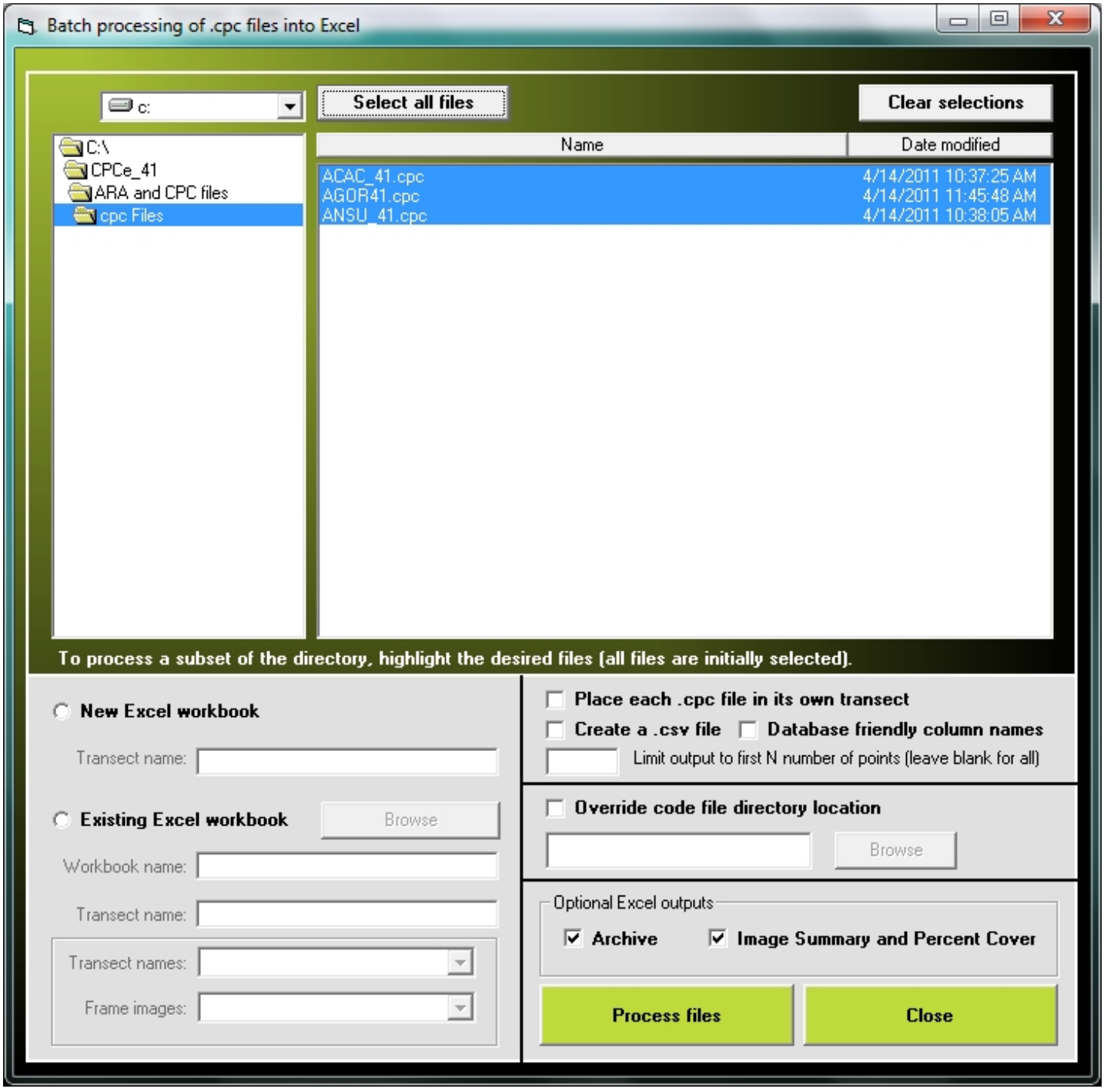
After the data points have been classified on an image, they must be saved to a .cpc data file, where they can be retrieved at a later time for modification or analysis. The image filename, code filename, border coordinates, and the data points are saved to the file. To save to a .cpc file, click on the *File-Save-Save data to .cpc file* menu item, or click the disk icon in the control box on the right hand side of the screen.



Saving .cpc files to MS Excel

Saving .cpc files to MS Excel

One or more .cpc data files can be converted into an MS Excel spreadsheet by choosing *File-Save-Save .cpc file(s) to Excel.* The data can be saved either to a new Excel spreadsheet, or added to an existing spreadsheet. **Note: CPCe versions V3.5 or later require Microsoft Excel 2003 or newer.**



You are shown a dialog box containing the eligible .cpc files to be saved to Excel. All .cpc files to be saved must be contained within a single directory, and **must have used the same code file in their creation**.

The two upper command buttons allow you to select all or none of the files.

On the left area of the form, you choose whether to create a new Excel workbook (file) or add to an existing one.

If the data is being saved to a new workbook, you must supply the name of the transect in the adjacent text box (unless you're saving each file to a separate worksheet, in which case the transects are automatically named. See explanation below).

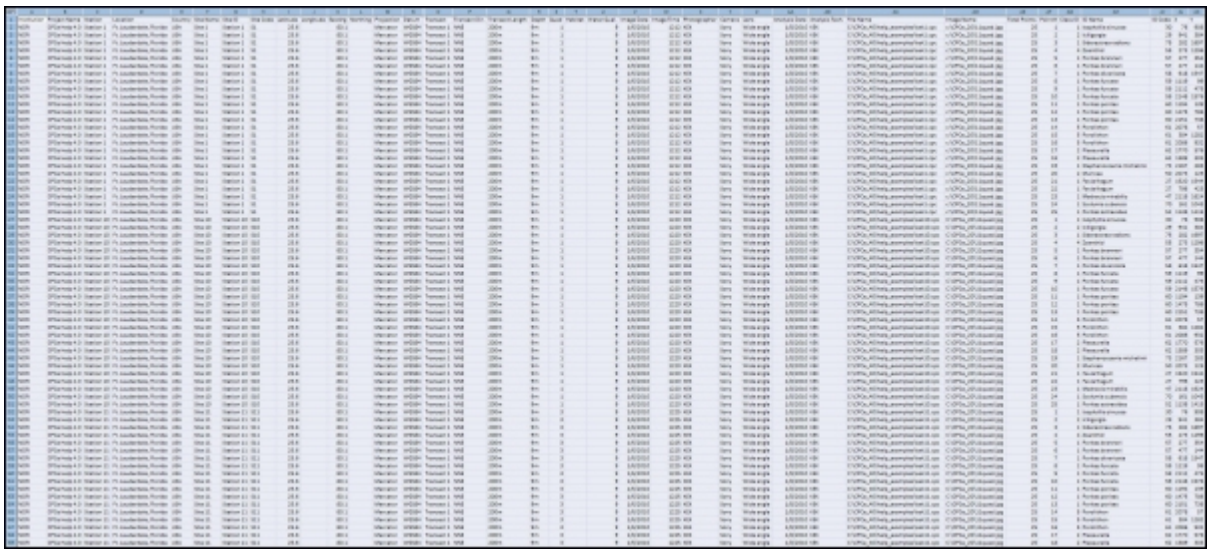
If the data is being saved to an existing spreadsheet, you select an existing Excel file, the current worksheets (transects) in the file are displayed. If you are not saving each file to a separate worksheet, you must supply the name of the transect

in the adjacent text box. You may not choose a transect name already in the workbook.

On the right area of the form are a series of checkboxes.

The first checkbox allows you to save each .cpc file as a separate transect. This will allow statistics to be calculated comparing each frame (inter-site comparisons). If this option is checked, the transect names are automatically assigned to the name of the .cpc file itself. Also, the imgsummary and %cover sheets are not calculated.

The second checkbox asks whether you'd like to create a **.csv file** from this set of files. The .csv file contains the header data, code file name, image file name, and point coordinates for each point in all .cpc files (see example below).



Example of a .csv file

The checkbox titled 'Database friendly column names', when checked, will remove special characters and spaces from the column names in both the .csv file (if the option to create a .csv file is checked) and the 'archive' excel sheet.

To limit output to only the first N number of points in each selected .cpc file, enter this number in the box provided. If this number is greater than the number of points in the file, all points will be out put to the Excel file. If a number is not entered, all points will be included in the Excel file.

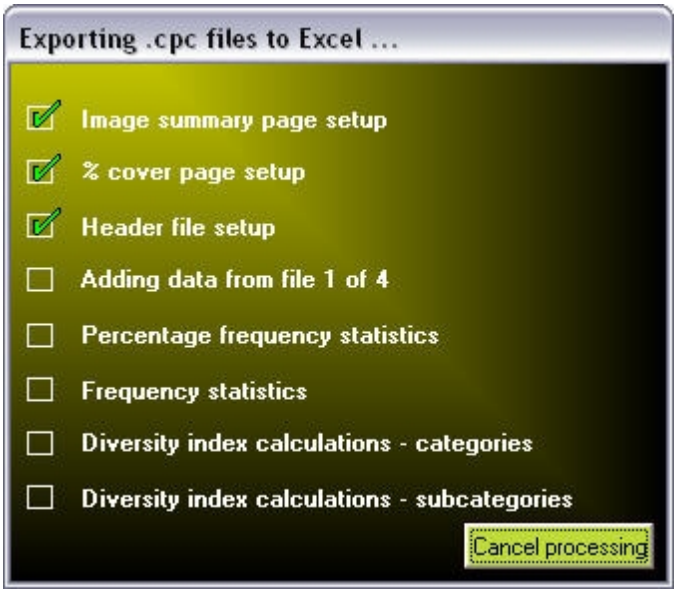
Two additional checkboxes are provided under 'Optional Excel outputs' to include or suppress output of the archive and image percentage and summary sheets.

The appropriate coral categories and classes specified in the coral class code file are inserted into the Excel sheets automatically. Thus, the program must know the location of the code file as specified in the .cpc files. The third checkbox allows you to override the location of the code file by specifying the location of the code file used in the creation of the selected .cpc files. This is often useful when the saving of the .cpc files is performed on a computer different than that used to analyze the .cpc files.

After making your selections, highlight the .cpc files you want saved to Excel and click *Process files*.

To exit the dialog box, click *Close*.

If you are using Excel 2007 or later, you can choose the format of the output Excel workbook.



During the creation of the Excel files, a progress pop-up is displayed to show the current status of the creation process.

Five Excel spreadsheets are generated automatically for each transect: raw, image summary, percent coverage, statistical, and archive.

To suppress the output of the image summary, percentage cover, and archive spreadsheets, uncheck the appropriate box.

The archive sheet is the counterpart to the optionally-created .csv file mentioned above. The two columns ***Class ID*** and ***ID Code*** apply numerical codes to the major categories and species. These numerical codes are assigned via the text files **classid_lookup.txt** and **idcode_lookup.txt**, both located in the CPCe run directory (typically c:\cpce_40_inst\cpce_40\). The format for these files is the numerical code, followed by a tab character, followed by the name of the class or the species abbreviation.

A single data summary sheet is generated for the entire spreadsheet.

These sheets are intended as a general starting point. They can be further modified by the user for additional purposes or information.

Viewing/editing existing .cpc files

Viewing/editing existing .cpc files

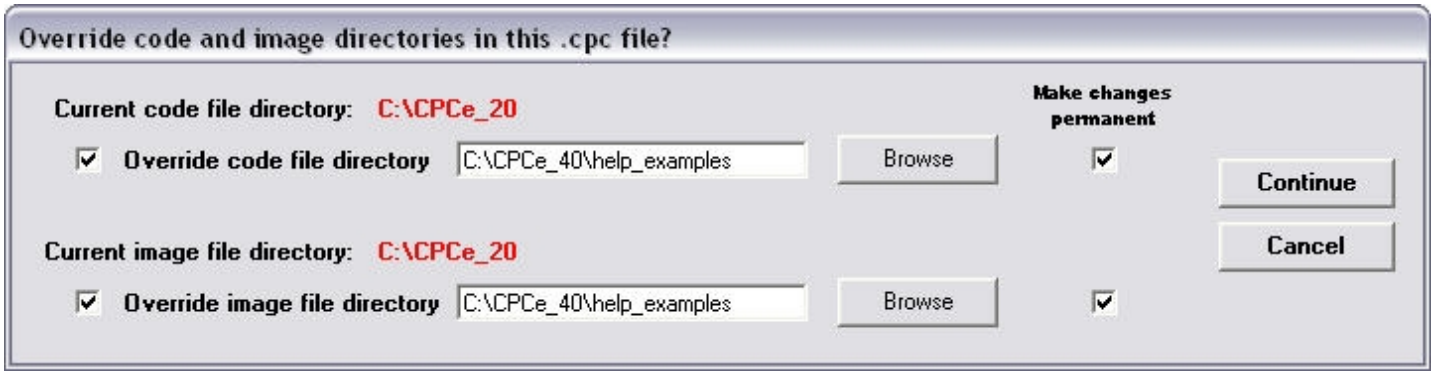
This option allows the viewing and/or editing of existing .cpc files.

Viewing a single .cpc file

File-Open-

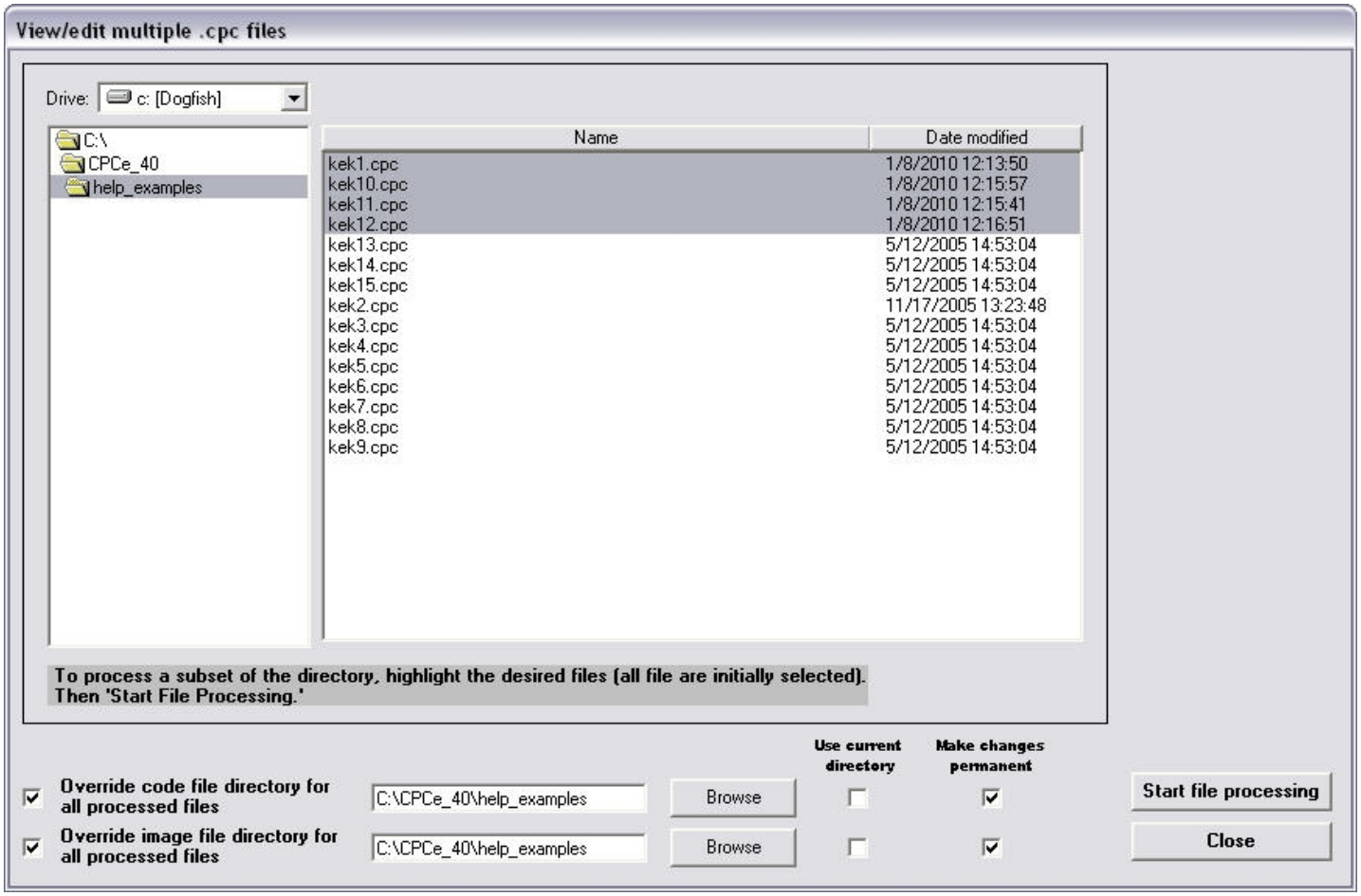
CPCe data file (.cpc) (keep original directories): The name of a file containing previously analyzed CPCe data (.cpc file). Choosing this option assumes the code and image file used to create the .cpc file are in their original locations.

CPCe data file (.cpc) (override original directories): The name of a file containing previously analyzed CPCe data (.cpc file). Choosing this option allows the user to specify the new locations of the code and image files, and gives the opportunity to make these changes permanent in the .cpc file.



Viewing multiple .cpc files

File-Multiple images/files processing-View/edit multiple .cpc files



The directory containing the .cpc files is shown, the resident .cpc files are identified, and the .cpc files to view/edit are selected. The user has the choice to ignore the locations of the code and image files in the .cpc files, and instead can indicate the new location of these files. The user also has the option to make these location changes permanent in the .cpc files. The option provided in this form to change directories is most useful when updating individual files requiring additional changes.

For large groups of files that require *ONLY* directory changes, the *Change code file/image directory directory location* utility located under the *Utilities* menu is optimized for this operation and does not require you to open each individual file.

Measurement

Measurement

Area/length analysis

Area/length analysis

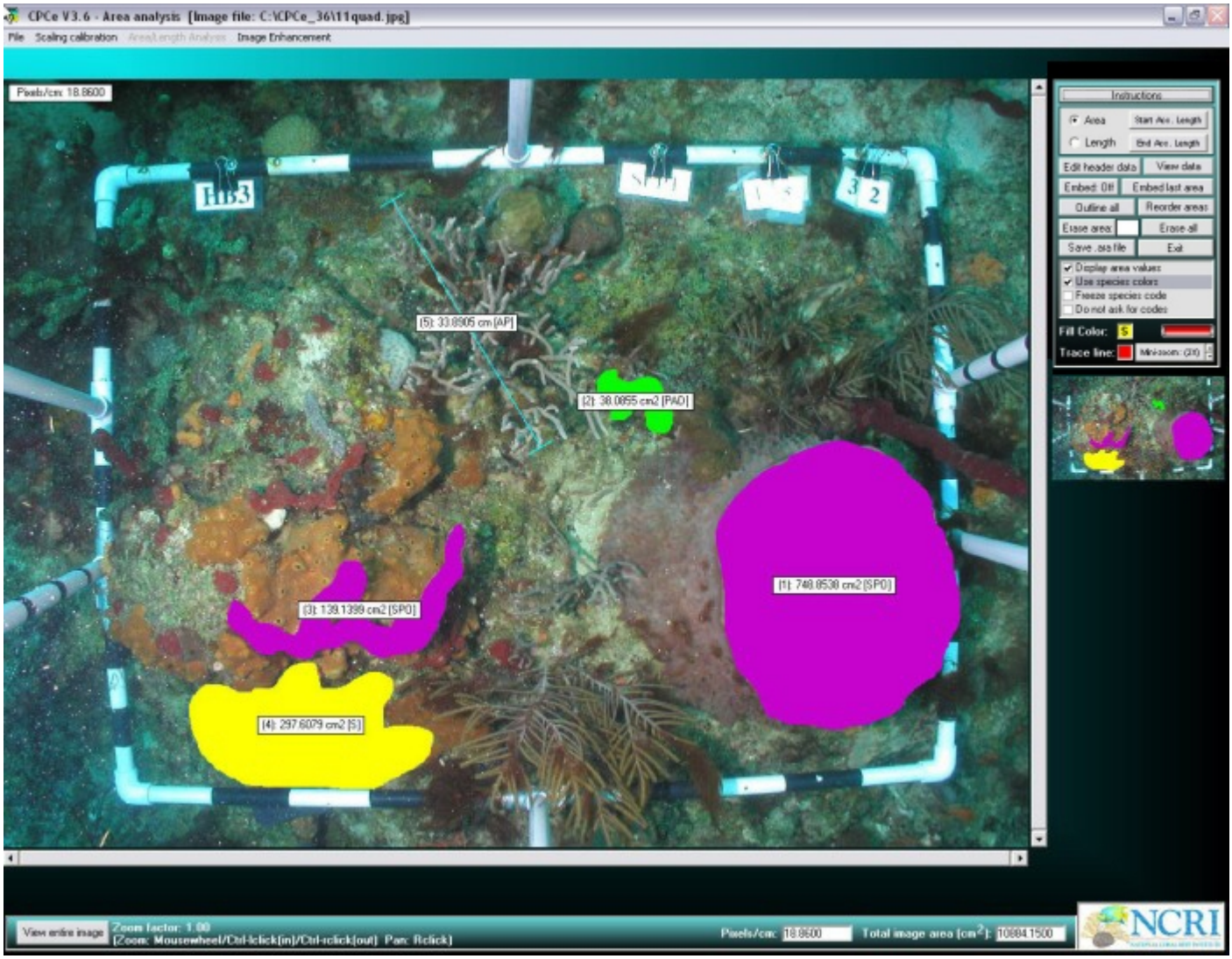
In order to perform area analysis with CPCe, you must first determine the scaling of the image via image calibration. After determining the scaling factor, you can then calculate the areas and/or lengths of regions of interest.

Image scaling calibration

Choosing this option allows you to determine the scale of an image (e.g. pixel/cm). After opening an image, you need a portion of the image containing two points of a known distance apart (e.g. ruler, quadrat scale, etc.) You click on one of the points, and fine-tune the position using the left/right arrows keys. Hit "Enter" to accept the point position. Repeat this procedure for the second point. After both points have been specified, you are asked to provide the distance spanned between the two points, as well as the units (cm., in., etc.). The program then calculates the scaling factor and the total image area.

Area/length Analysis

Choosing this option allows you to determine the area or length of a region traced on an image. After opening an image, you first need to specify or determine the image scaling factor. You can either determine this as described above, or enter it directly. You can then choose *Area Analysis* to begin the analysis.



You can trace either areas or lengths by selected the appropriate area type radio button.

To trace a length on the image, i.e. to determine the distance between two points on the image, left-click on the first point, right-click on the second point.

Accumulated lengths are lengths grouped together for the purpose of determining a sum length. You can trace accumulated lengths by clicking the *Start Acc. Length* button. It will turn yellow to indicate accumulation mode is active. The lines are drawn as dashed lines in the default color. You can continue to add lengths and when finished, click the *End Acc. Length* button. The sum of the lengths will be be stored. All lengths belonging to an accumulated lengths group must be entered consecutively, i.e., after ending an accumulated lengths group, you cannot add another length at a later time.

To trace an area, left-click and release at the path starting point. Move the cursor around the area perimeter to trace the path. While tracing the image, the trace indicator button is green. Left-click to temporary pause path tracing (e.g. to scroll the image). Left-click again to resume (the last and first points are joined). To close the path and calculate the area, right-click and release. The trace indicator button turns red, and the program calculates the area of the enclosed region.

To display a zoomed area around the cursor, click the Mini-zoom button. You can change the amount of mini-zoom from a factor of 1x to 4x, which is reflected in the button label.

To trace an outline for analysis, left-click and release at the path starting point. Move the cursor around the area perimeter to trace the path.

To erase the most recent area path segment, press <Esc>. Repeatedly pressing <Esc> erases each segment in reverse order.

To totally erase a partially traced area path, press Ctrl-z.

You can zoom in or out of the image by Cntrl-lclick or Cntrl-rclick or using the mouse scroll wheel. **Note that you cannot**

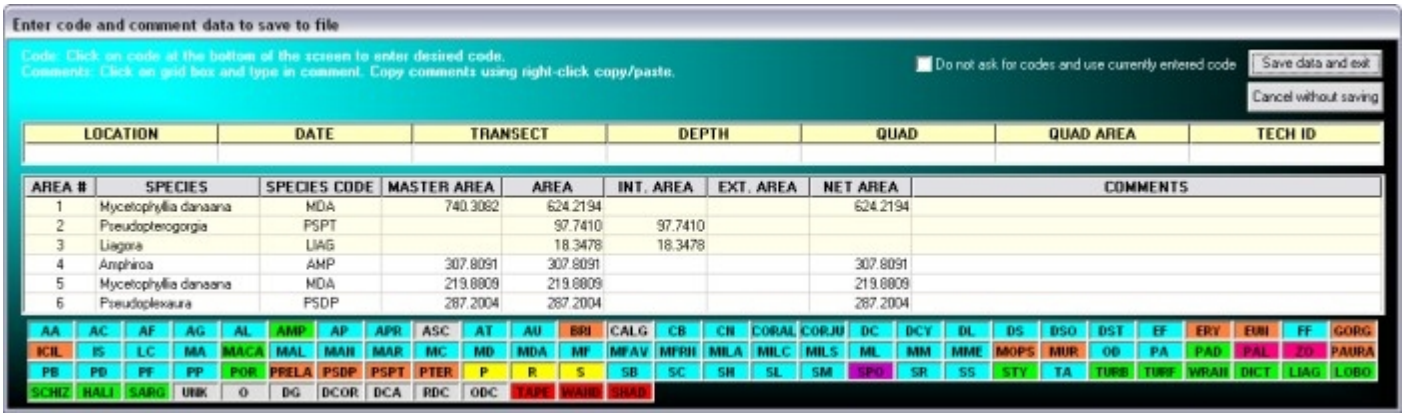
zoom in or out while performing a trace.

To toggle between filled and outlined areas, press Shift-rclick inside the area. You can also change all filled areas to outlined by clicking the *Outline all* button.

To temporarily show an area value when *Display values* is unchecked, place the cursor on an area and press "d" (for Display). The calculated area will be displayed until you release the "d" key.

Pan mode allows you to pan through an image while holding down the right mouse button. Enter pan mode by right-clicking the mouse button (not in trace mode). The cursor will turn into the pan icon (yellow hand). Holding the right mouse button down, drag on the image to move the viewport seen in the inset box. You will exit pan mode when you release the right mouse button.

After each area or length is traced, a table displaying the area data for the current image is displayed (unless the *Do Not Show Codes* option is active, see *Checkbox Options* below). You can enter species and comment data for a traced area at this time.



After tracing areas on the image, you can save the parameters to an area file for later analysis by choosing "*File-Save area (.ara) file*" or by pressing the *Save Data* button. This file contains the image, scaling calibration, scaling units, and parameters for each of the traced areas. You can retrieve this file by choosing "*File-Open-Open area (.ara) file*".

The data for each of the areas are saved to the .ara file as a flexgrid data array. These data contain area, species, and comment data for each of the traced areas.

You can also save various area header data with each image (location, data, depth, etc.). You can modify the area header data by clicking the *Edit header data* button. By filling in the blanks, these header data are saved with the .ara file. You can modify the dropdown menus in the area header dialog box by editing (using Notepad or Wordpad) the file **areaheader.cfg** in the CPCe installation directory.

You can also save the image with or without the area/length labels as .bmp files for use with other applications.

Area Analysis Buttons

Instructions button:	Displays instructions for performing area and length traces
Start Acc. Length button:	Clicking this button starts length accumulation mode (turns yellow). Lengths that are subsequently drawn are summed together.
End Acc. Length button	Clicking this button ends length accumulation mode, and sums the lengths of the accumulated traces.
Edit header data:	Clicking this button allows the user to input header data for the image.
View data:	Clicking this button displays the current area data for the image.
Embed Mode:	Embedded areas are areas which contain other areas. The outer most area is called the embedded master area, and all contained areas are called embedded subordinate areas. To create an embedded area group, click the *Embed* button. It will change to yellow to indicate you are in Embed mode. The next area you trace will be the master area. Any areas subsequently drawn (with Embed mode still on)

	will be subordinate areas. On the grid data form, the areas comprising an embedded area group are shaded. All subsequently traced areas are subordinate areas until Embed mode is turned off. All areas belonging to an embedded group must be entered consecutively, that is, after specifying the master and subordinate areas you cannot add another subordinate area at a later time. Net area is calculated for embedded areas by subtracting the area values of the subordinate areas from the area value of the master area. If a subordinate area lies partially in the master area, only the portion of the subordinate area lying inside the master area is subtracted.
Embed last area:	If you forget to click the *Embed* button before tracing an area, you can click the Embed last area button, and it will make the last area traced an embedded master area.
Outline all:	Toggle button which changes the areas from solid to outlined.
Reorder areas:	You can reorder the drawn areas by moving an area to be first, last, or occur before a specific area.
Erase area #:	You can erase a specific area. All areas then move up in order to form a consecutive range of area numbers.
Erase All:	Erases all areas from the image.
Save data:	Saves the area data to an .ara file. This data can then be added to an Excel sheet using the *File-Save-Save .ara data to Excel* menu item.
Exit:	Exits the area analysis mode.

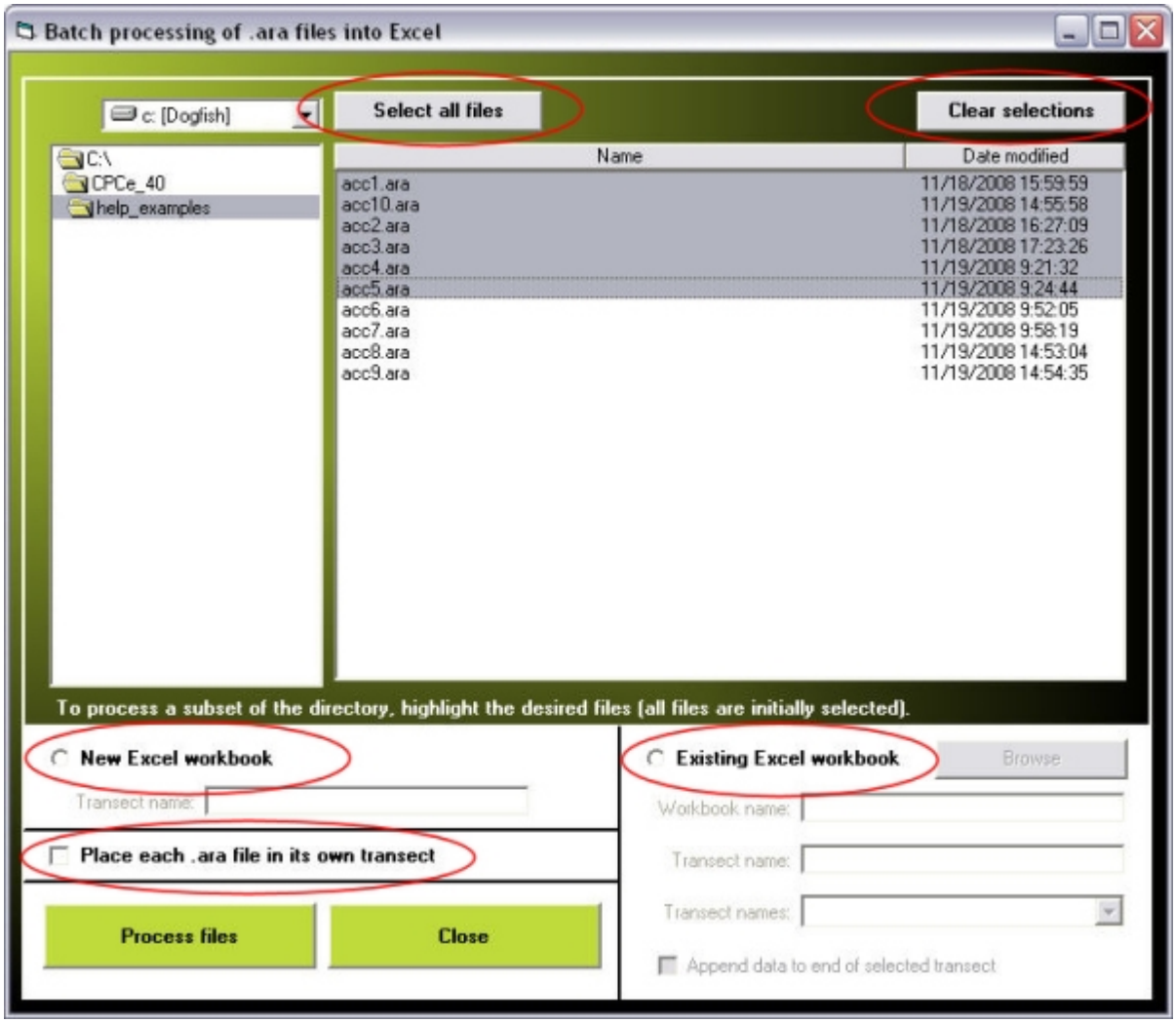
Area Analysis Checkbox Options

Display area values:	When checked, calculated area values are displayed in text boxes on the image.
Use species colors:	When checked, the areas are filled with the color of the corresponding species code box.
Freeze species code:	When checked, the table of area data appears after each area trace, but the species name and code are already filled in. You must enter the species code to use one time only.
Do not ask for codes:	When checked, the table of area data is not shown after each trace. The preset species name and code is entered, and comment data cannot be entered.

Saving .ara files to MS Excel

Saving .ara files to MS Excel

One or more .ara data files can be converted into an MS Excel spreadsheet by choosing *File-Save-Save .ara file(s) to Excel.* The data can be saved either to a new Excel spreadsheet, or added to an existing spreadsheet. **Note: CPCe versions V3.5 or later require Microsoft Excel 2003 or newer.**



You are shown a dialog box containing the eligible .ara files to be saved to Excel. All .ara files to be saved must be contained within a single directory.

The two upper command buttons allow you to select all or none of the files.

Below the list of files, you choose whether to create a new Excel workbook (file) or add to an existing one.

On the left area of the form is a checkbox that allows you to save each .ara file as a separate transect. If this option is checked, the transect names are automatically assigned to the name of the .ara file itself.

If the data is being saved to a new workbook, you must supply the name of the transect in the adjacent text box (unless you're saving each file to a separate worksheet, in which case the transects are automatically named. See explanation below).

If the data is being saved to an existing spreadsheet, you select an existing Excel file, the current worksheets (transects) in the file are displayed. If you are not saving each file to a separate worksheet, you must supply the name of the transect in the adjacent text box. You may not choose a transect name already in the workbook.

There is also a checkbox which allows you to append the data from the selected files to an existing transect in the workbook. Note that appending the data to an existing transect will take precedence over creating a separate transect for each file.

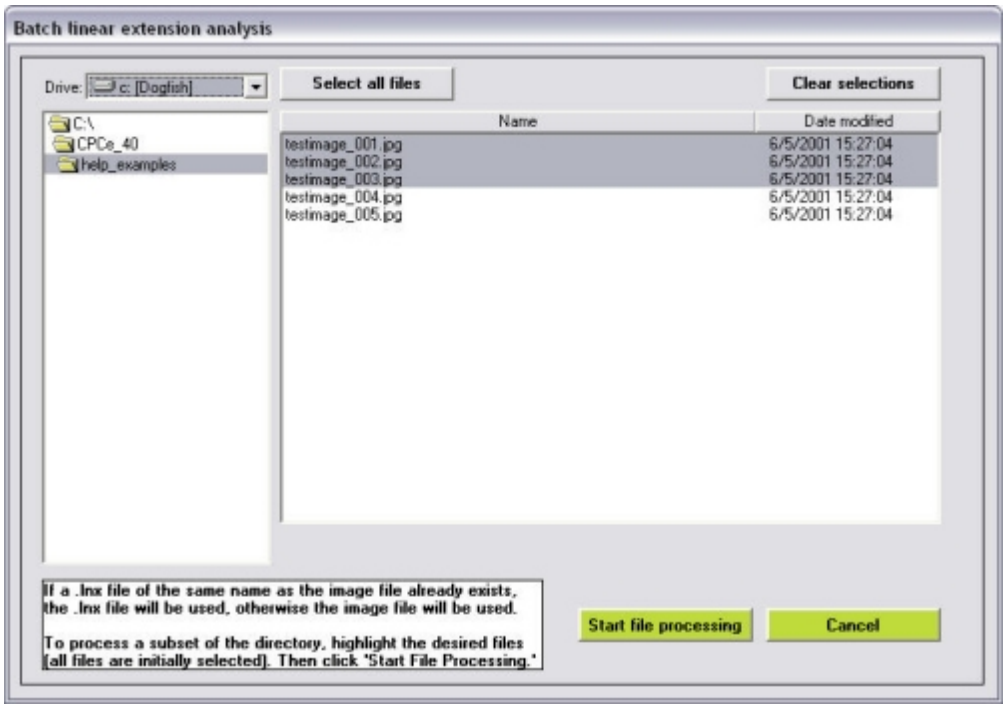
After making your selections, highlight the .ara files you want saved to Excel and click *Process files*.

To exit the dialog box, click *Close*.

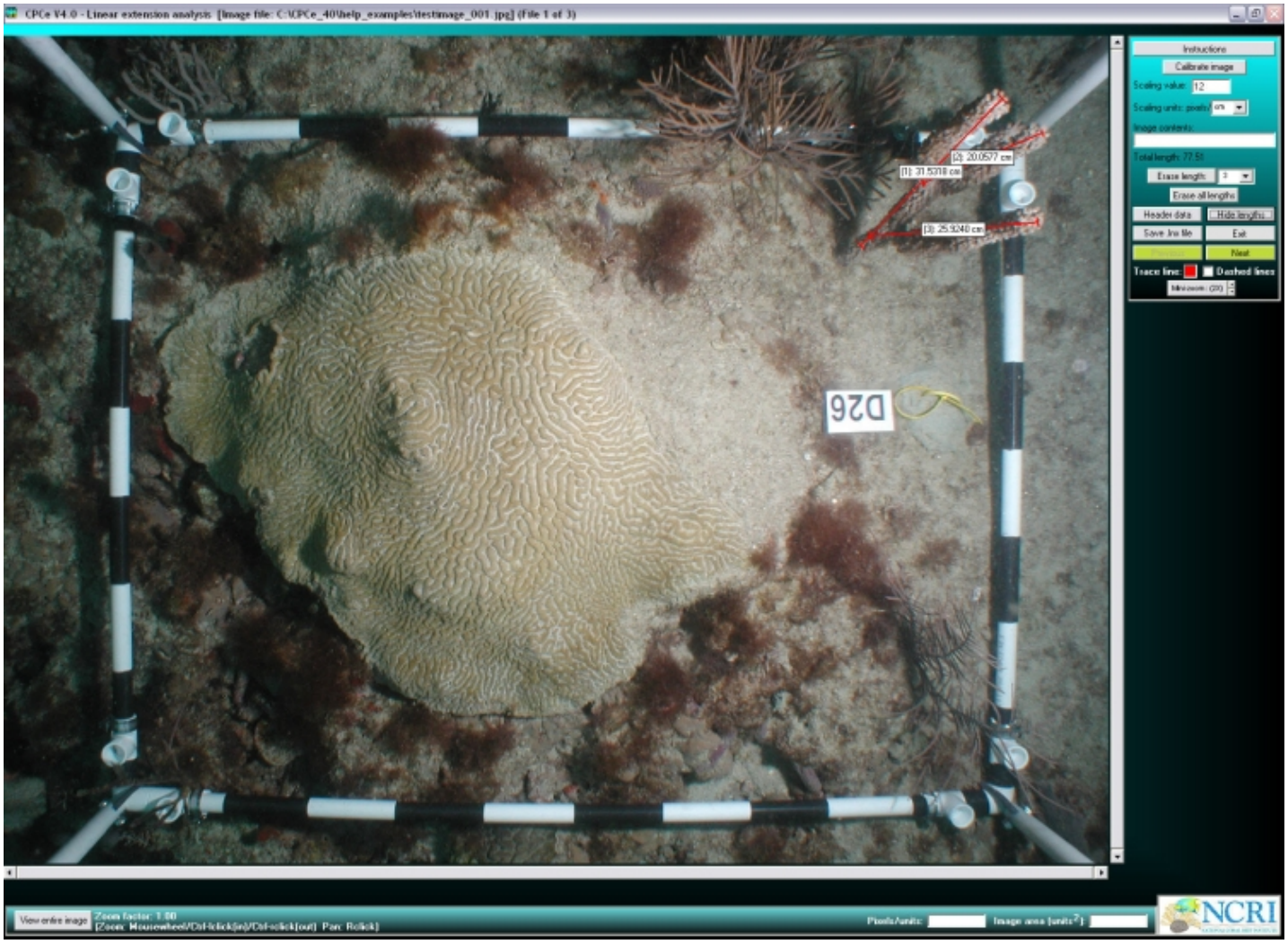
Batch linear extension analysis

This option allows the rapid calculation of a single length value for each of a number of images. This is useful for obtaining growth measurements from a set of coral nursery images in which you are only interested in length measurements.

The first step is to select the image file(s) to be analyzed.



After clicking *Start file processing*, the first image in the list will be shown. Note that if a linear extension (.lnx) file exists with the same name as the selected image file, the .lnx file will be shown rather than the image file. You then either calibrate the image (similar to the Image Calibration option in **Area analysis**), or you can manually input the scaling value. You then begin tracing lengths by left-clicking and releasing to indicate the starting point, and then right-clicking to indicate the end point. You can continue to trace several lengths on the image. You can also specify header data to attach information to this image file, as well as a contents text parameter.

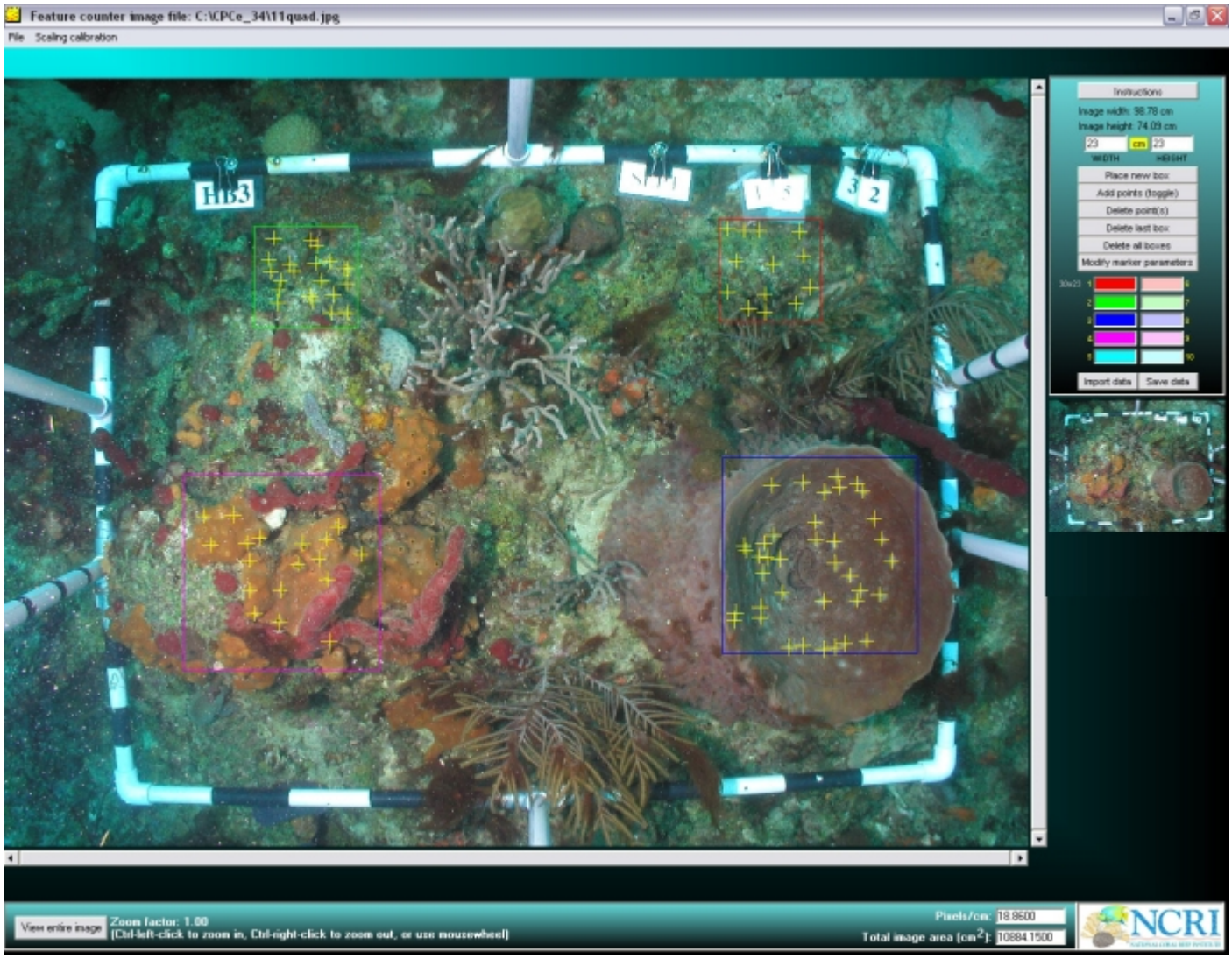


When you are finished with an image, you can click the *Next* button to proceed to the next image file. A linear extension file (.lnx) file is generated automatically which has the same name as the image file. When you've completed all of the images, you can click *Save .lnx file* to save the last .lnx file, and then click *Exit*. This will generate an Excel workbook containing the length information of all of the images analyzed.

Feature counter

Feature counter

This option allows you to count features (e.g. polyps, dead areas) in a rectangular area of specified size. You are first presented with a dialog box asked whether to load a new image, or to import previous counter data. After loading an image, and specifying the scaling calibration value, you must specify the size of the desired box(es). You can position up to 10 individual boxes on the image. After placing the box areas, you click on the *Add Points* button and proceed to click on features inside each box. A running total of points is accumulated for each box. This data can be saved to a .fct file for further analysis. Options are provided to delete the points in reverse order, delete entire boxes, and delete all boxes.

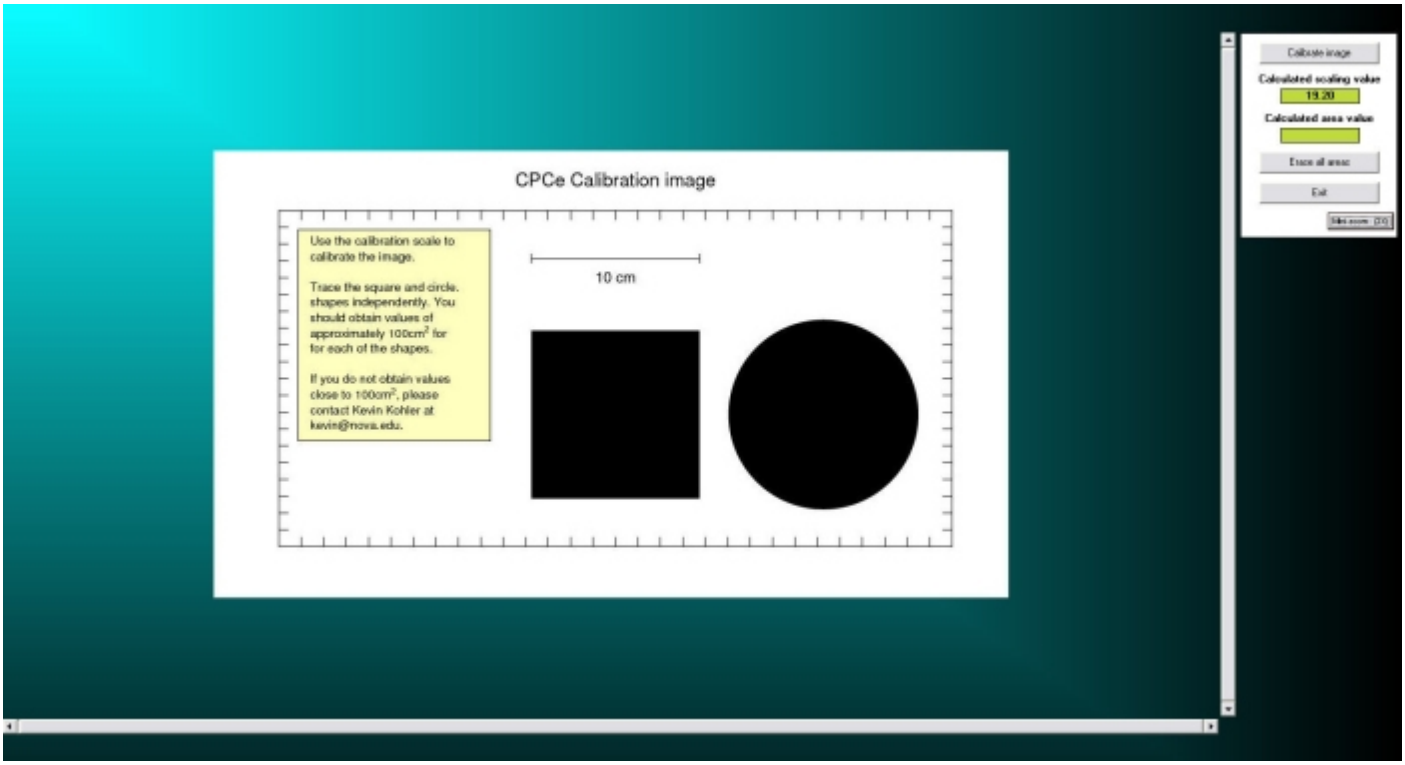


To import previously entered counter data, choose Import counter data from the initial dialog box, or click the *Import data* button on the right side of the form. Choose an existing .fct file, and the image and counter data are displayed.

Area calibration and training

Area calibration and training

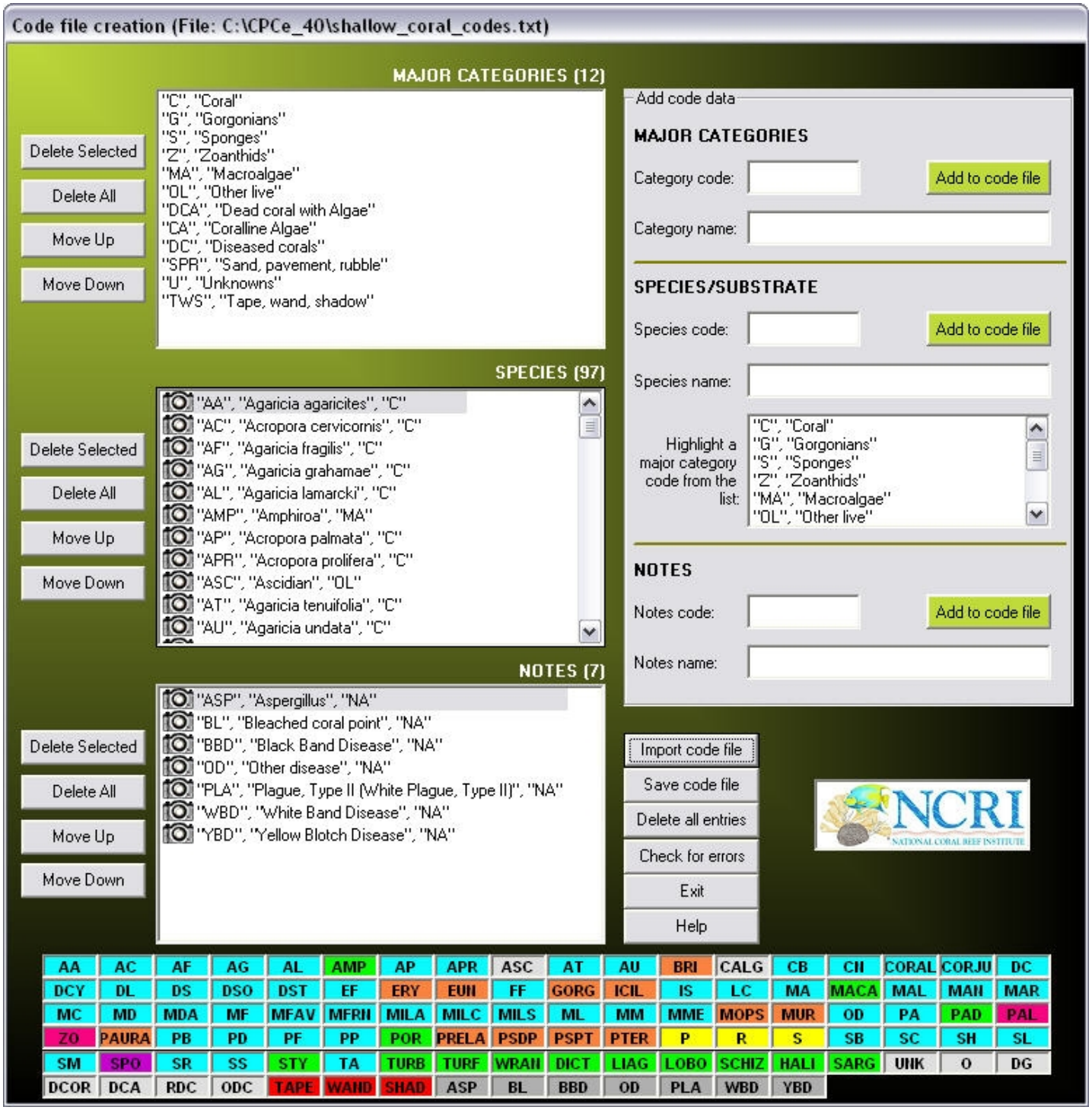
This option allows you to practice calibrating and tracing an image, and to confirm that your results are accurate and consistent. A calibration image is automatically loaded and displayed. You then calibrate the image by clicking the *Calibrate ima*ge button. The image is again displayed, and you are told to click on the first scaling point. You can zoom into the image using Cntrl-left click to better visualize the calibration scale line segment in the upper center of the image. Click on the left edge of the line segment, and then use the arrow keys to fine tune the location. When you are satisfied with the position, hit Enter. Do the same for the right edge of the line segment. You will then see a dialog box, asking for the spanned distance. Enter 10 cm. You will then be brought back to the original screen, with the value of the scaling calibration shown. You are now ready to trace an area. You should practice tracing the square and circle images separately. After tracing each, the traced area value will be shown in the green box on the right. You should obtain a value close to the actual area values of 100 cm^2.


CPCe Calibration image
Use the calibration scale to calibrate the image.
Trace the square and circle. shapes independently. You should obtain values of approximately 100cm² for for each of the shapes.
If you do not obtain values close to 100cm², please contact Kevin Kohler at kevin@nova.edu.
10 cm
Calibrate image
Calculated scaling value
19.20
Calculated area value
Erase all areas
Exit

Utilities

Create code file

This option provides a graphical interface for creating a customized code file. You can import an existing code file for modification, or create a file from scratch.



The code creation form is separated into three sections - Major Categories, Species/Substrate, and Notes. The white boxes on the left side of the screen contain the current codes and names for each section.

Using the buttons on the far left side of the screen, you can delete a code by selecting the code, and clicking the *Delete Selected* button. You can erase all of the codes in a section by clicking *Delete All*. You can also re-order the codes within a section by selecting a code and using the *Move Up* and *Move Down* buttons. The current configuration is shown in the code boxes at the bottom of the form.

To add a code, choose the appropriate section, and enter the code designation and name of the new code in the data entry box on the right. Both the code and the name must be entered. **Do not include quotation marks in your entry**. Also, when entering a code into the Species/Substrates section, you must assign the new code to an existing Major Category, which are shown in the box below the data entry location for this section. Click on the appropriate major category entry, and then click the *Add to code file* button to add the code.

If a reference image for a specific species or note field exists, a icon appears to the left of the text data. If there is an icon, double-clicking the entry will bring up a dialog box asking if you'd like to view, re-assign or delete the existing reference image for that entry. In the case of the latter, the image is not actually deleted, but rather the filename is

changed to xxx_filename, so that it will no longer be associated with this entry. The file can be renamed back to the original if desired. If no icon appears, double-clicking the entry will allow you to assign a reference image, and will add the image to the reference image database.

To import an existing code file, click the *Import code file* button.

To save the contents of the sections into a new code file, click the *Save code file* button.

Click the *Delete all entries* button to erase all data.

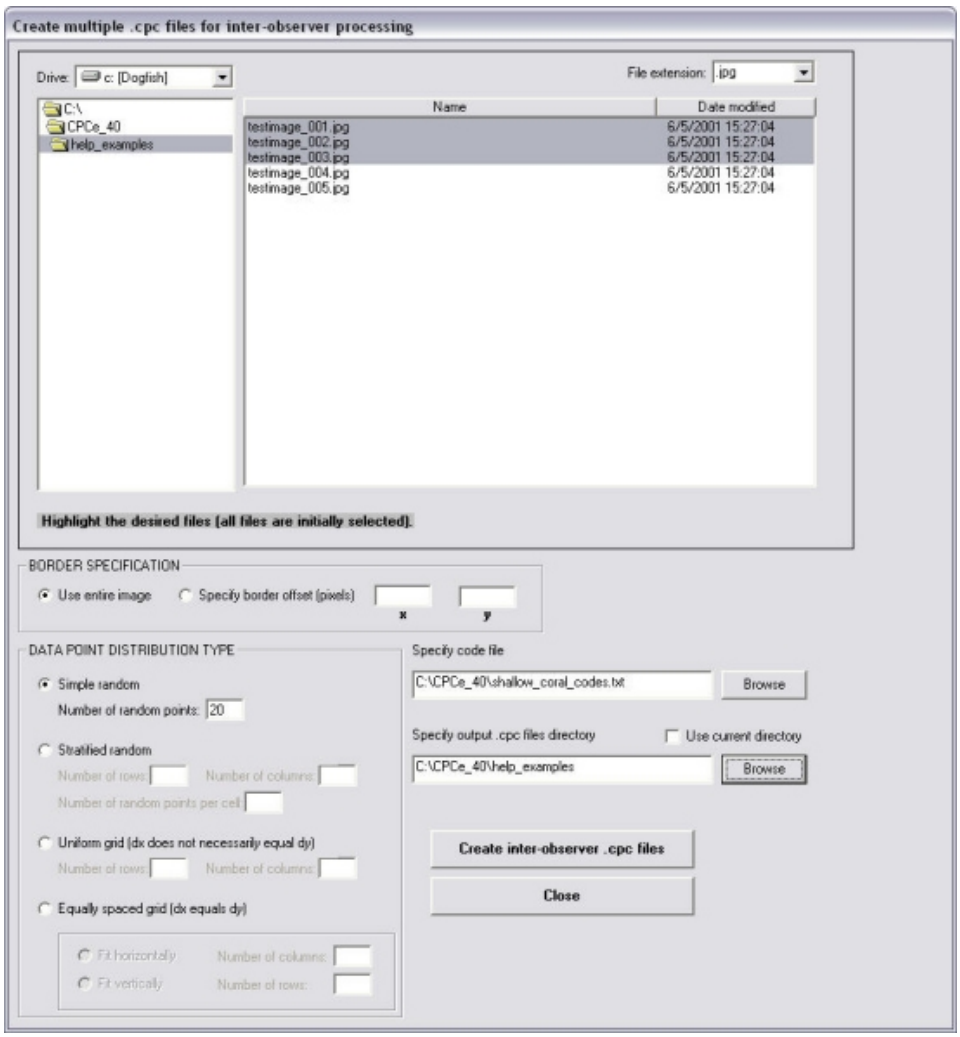
You can check for any obvious errors in the code file by clicking the *Check for errors* button.

Click *Exit* to leave the code creation form.

Click *Help* to view the help file for creating a code file via the GUI.

Create inter-observer .cpc files

Create inter-observer .cpc files



This option allows for the batch creation of .cpc files for use with inter-observer comparisons. Using a specified set of images, a .cpc file is generated for each image, and contains a specified number of points distributed in a specified manner. No data is assigned to any of the data points. Identical .cpc files can be distributed to several observers for data comparison.

Steps to create the inter-observer .cpc files:

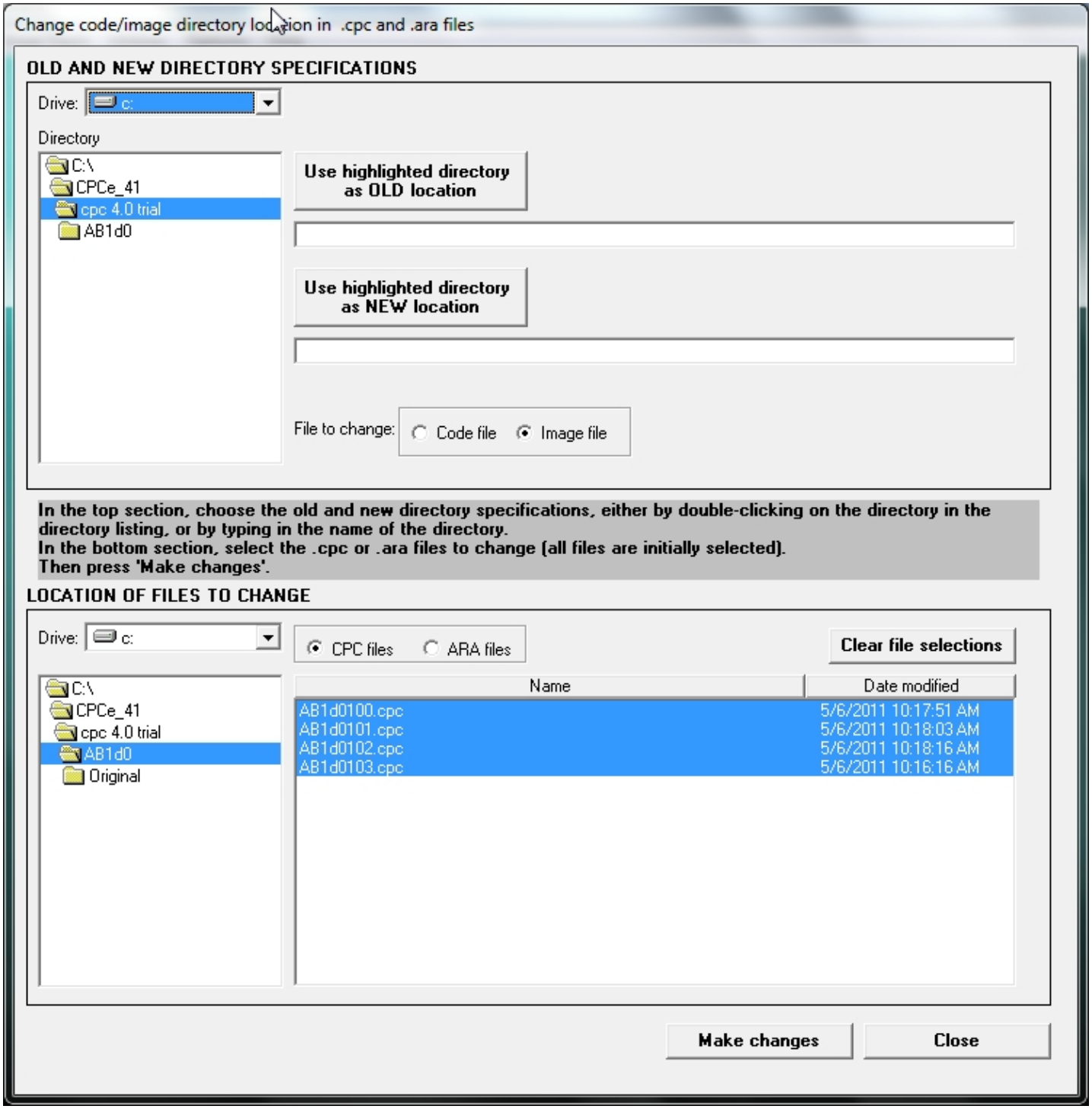
1. Navigate to the directory containing the image files, and select the desired images.
2. Specify the type of border, either the full image, or having a constant x- and y-offset from the image edges.
3. Specify the data point distribution type.
4. Specify the location of the code file.
5. Specify the destination directory of the created .cpc files.
6. Click the *Create inter-observer .cpc files button*.

Code file checker

This option allows you to check your code file for any obvious errors. You must specify the name of the code file to check. Any errors found are shown as highlighted and in color. You can then immediately edit the code file by selecting the *Edit code file* button. After editing, you can re-run the code file checker by selecting the *Re-run file check* button. You can save the error listing to a text file by selecting the *Save data to text file* button. There is also a *Code file format hints* button which directs you to the *Creating a code file* section of the Help file.

Change code file/image file directory location

This option allows you to change the location specification of the code file and/or image file for a group of .cpc files. This would be necessary in the situation where either of these files has been moved post-analysis. You must specify the .cpc files to change, the old directory and new directory locations.



Data check/species search

Data check/species search

This option allows you to search specified .cpc files for unassigned data points, and for the presence of a specific species. You must specify the selected .cpc files, and the species code to check for, if appropriate.

Fix image calibration

Fix image calibration

This option allows you to re-calculate areas and lengths of regions already stored in .ara files. The need for this could arise in the situation where you realize that the scaling calibration for the image is erroneous.

You first specify the .ara files to be re-processed and the new scaling calibration. If you do not wish to overwrite the .ara files (recommended), you can specify a suffix to be appended to all filenames. These newly named .ara files will contain the re-calculated values. To perform the re-calculation, click the *Make Changes* button.

Batch change .ara file header data

Batch change .ara file header data

This option allows you to change the header data in multiple .ara files. This option applies only to those .ara files created with CPCe versions 3.4 or higher, or those that have been converted to this format.

You first specify the .ara files to be re-processed. If you do not wish to overwrite the .ara files (recommended), you can specify a suffix to be appended to all filenames. You then enter the header data which will be included with each of the selected .ara files. To perform the batch header data change, click the *Batch change header data for selected files* button.

File sequencer

File sequencer

This option allows you to rename your image files in a sequential manner.

You first specify the image files to be sequenced (renamed). You then choose the destination folder, the specified filename, and the sequencing parameters. The files are renamed in the order they appear on the selected list.

For example:

You choose 3 files to be sequenced. You enter the specified filename as

aug08_site1_

and you choose the sequencing parameters as

Start=1
Increment=1
Minimum field width=3

The sequenced files would then be named

aug08_site1_001.jpg
aug08_site1_002.jpg
aug08_site1_003.jpg

The original files are copied, rather than renamed, so that you can test that the sequencing was done as expected. At that time, you can delete the original files.
You also have the options regarding the destination folder, using the original filename plus specified text, etc.

Convert Pre-V3.4 .ara files to V3.4 format

This option allows you to rewrite existing .ara files which were created using versions of CPCe prior to V3.4. The new format allows the easy assemblage of the .ara files into Excel worksheets.

You first specify the .ara files to be re-processed. If you do not wish to overwrite the .ara files (recommended), you can specify a suffix to be appended to all filenames. These newly named .ara files will be in V3.4 format, and ready for use by Area Analysis. To perform the re-creation of the .ara files, click the *Convert selected files* button.

Options

Options

Specify code file

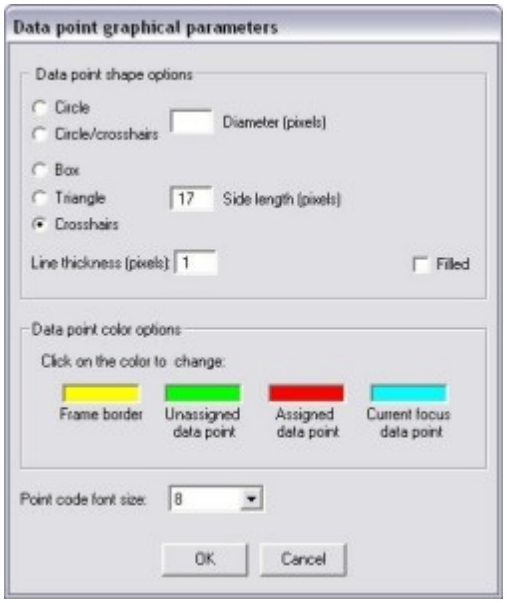
Specify code file

This option allows the specification of the file containing the major categories and sub-categories (e.g. species). This code file will be used for all subsequent image processing until it is changed again.

Data point graphical parameters

Data point graphical parameters

Several options are provided to allow the user to customize the data entry process. The data option shapes can be changed to circle, circle with crosshairs, box, triangle, and crosshair, each with a definable line thickness, and either filled or outlined. The colors of the frame border and unassigned, assigned, and current focus points can also be specified. The text size of the coral code boxes can be specified between 7-10 points.



Color code codename category boxes

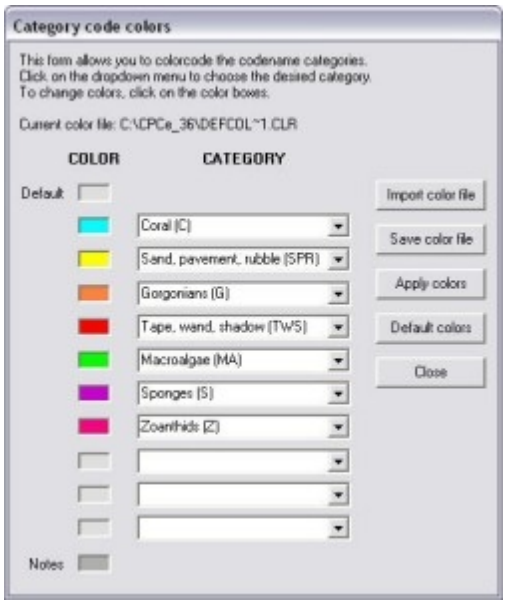
Color code codename category boxes

This option allows color coding of the various code box categories. You can specify up to 10 colors, plus the default and Notes colors.

To specify a category, click on the dropdown menu. To specify a color, click on the color box to the left of the category and select a color from the presented palette.

After specifying the custom colors, you can save these colors in a color file.

You can also import a previously created color file.



Expand small images

Expand small images

In cases where the size of the analyzed image is smaller than the available screen space, this determines whether the image is expanded to fill that available space, or keeps its original dimensions.

Letter symbols/Number symbols

Letter symbols/Number symbols

This option specifies the use of either letters or numbers to label the random data points.

Auto-advance point

Auto-advance point

When checked, advances to the next data point in sequence when a data point is assigned a value. This can speed up analysis time.

Auto-follow

Auto-follow

When checked, maintains zoom level and centers the current data point in focus in the image.

Show header info

Show header info

When checked, the header data form loads each time a new file is analysed. If unchecked, the form will not show unless the 'View/Edit Header Data' button is clicked.

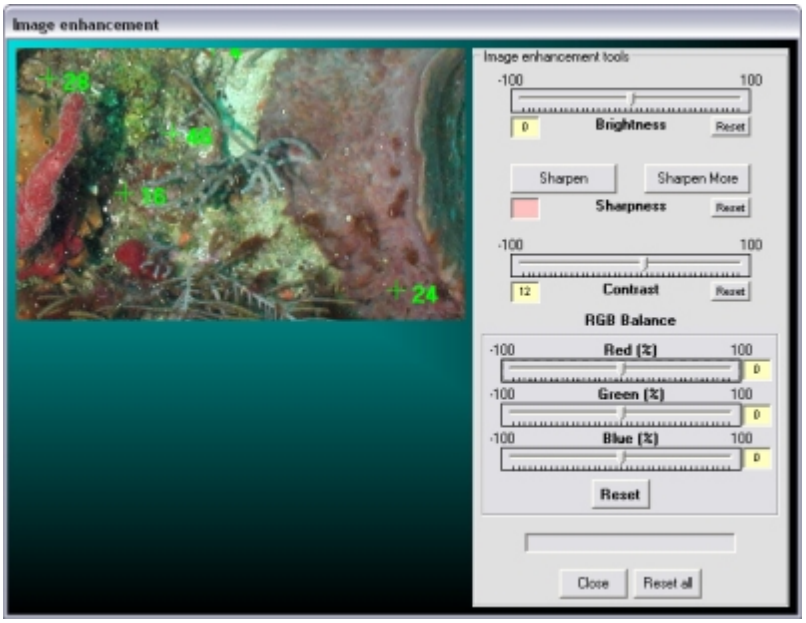
Maintain zoom

Maintain zoom

If this option is not checked, and auto-follow is checked, the image is redrawn at 100% when each new data point has focus. This is to allow the user to see the point in relation to the entire image, rather than at the current zoom level which may eliminate much of the image's visible area.

Image Enhancement

Choosing the Image Enhancement menu item brings up a dialog box indicating that you must select an area on the original analysis image to enhance. You select an area by clicking and dragging the mouse. The selected area is surrounded by a rectangular outline. Releasing the mouse brings up the Image Enhancement form shown below.



You can modify the brightness, sharpness, and contrast of the selected area image, as well as the red/green/blue color balance. This can help with species identification below a random point position.

Note that the original analysis image is untouched by any image modification. Any permanent image modifications must be done before importing the image into CPCe.

Efficient data processing

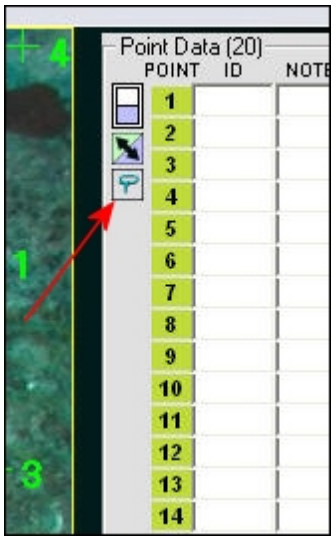
There are several features in CPCe which can be used to increase the efficiency of categorization and analysis.

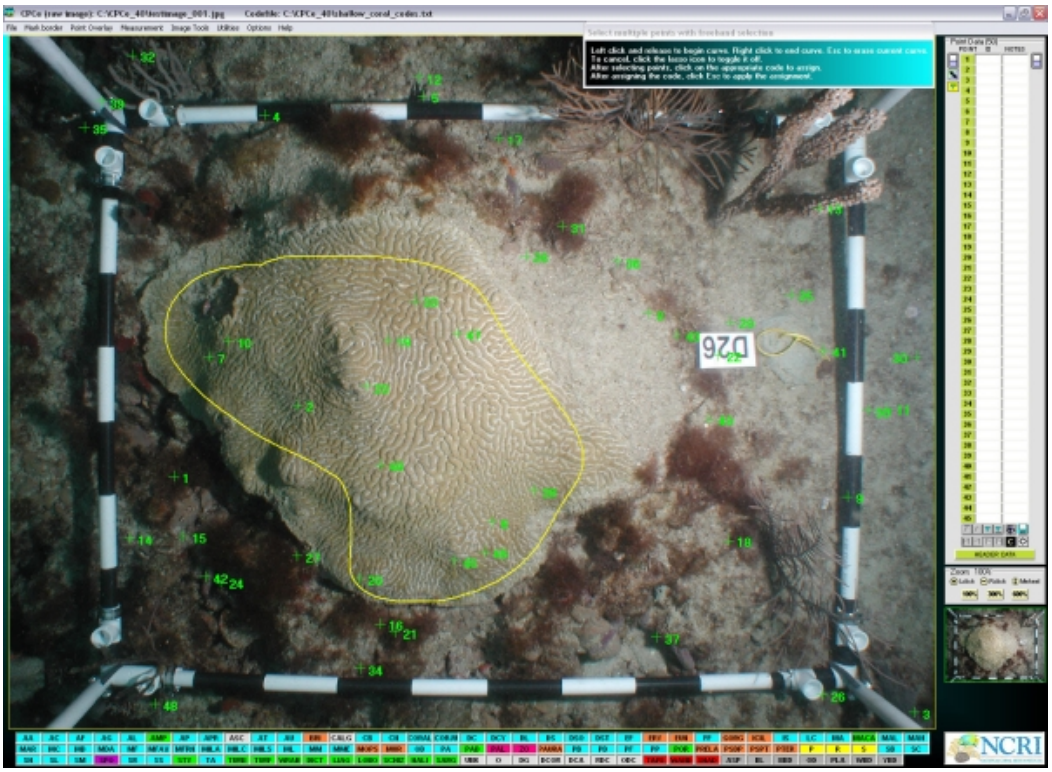
To assist in data entry, users can color code the category boxes, making data assignments more efficient by coloring similar data groups the same.

Users can group select points by clicking on a point label and then using Shift-Click or Cntrl-Click to select a range or group of points. This can also be accomplished by Cntrl-clicking on multiple points on the image itself. The corresponding point labels become highlighted, indicating which points have been selected. All points selected can be assigned a single data value at once by clicking on a code value. To cancel group select, click anywhere on the point frame or an individual text box or press <Esc>.

Another method to select multiple points is by using the freehand drawing tool (see example below). Click the lasso symbol  . The lasso symbol will turn yellow, indicating that you can begin drawing the curve which will enclose the points to select. Click and release to begin tracing, trace the enclosing curve, and right-click to close the curve. The selected points will blink, and you will be asked if you wish to select the points. After selecting the points, you can click a code at the bottom of the screen, and all selected points will be assigned that code.

Freehand Drawing Tool Example





To further speed processing, there is the ability to specify multiple image files for processing. By specifying the directory containing several image files, it is unnecessary to manually specify each image for analysis. All images of a given file extension (.bmp, .gif, .jpg) are processed in order. An additional benefit of processing multiple image files is that the analysis data is saved to a .cpc file having the same name as the image. This avoids having to manually specify names of saved datasets. When switching back and forth between images, the program opens up a .cpc file of the corresponding image if the .cpc file exists, otherwise it opens up the image itself.

Last, there is the ability to **add multiple .cpc files to an Excel spreadsheet**. This allows the user to concentrate on the categorization of images and the creation of .cpc datasets. After assembling all of the .cpc files for a specific transect, the data from the separate images can be added at once. There is also an option to add each .cpc file as its own transect, so that statistical differences between frames can be calculated.

Data analysis considerations

The .cpc and .ara files created by CPCe contain the data, image directory and filename, and codefile directory and filename. When these files are imported, the program expects to find these items in the same locations. In certain instances, these locations can be overridden. Hence, it is suggested that image files and code files not be moved once data analysis has begun. CPCe has the ability to change file locations, but confusion can occur.

If .cpc or .ara files are being used on different computers, it is preferable to set up identical directory structures on all computers so that the absolute file location remains the same.

The number of points overlaid on an image must be determined prior to data analysis so that the statistical power of the analysis is sufficient to yield meaningful results. The study of statistical power is beyond the scope of this help file, but an excellent starting point can be found at http://www.cs.uiowa.edu/~rlenth/Power

After creating a customized code file, it's important to run the code file checker utility in order to spot obvious errors in the file information or its formatting. **This is the most common difficulty encountered by new users.**

Common Run-Time errors

This section details several errors commonly encountered when running CPCe, and offers suggestions for their solution.

Run-Time error '5': Invalid procedure call or argument

A symptom of this error is that you are able to specify only a certain number of random points, e.g. 40 points, and a greater number of points causes the error. The problem is usually that the screen DPI setting is not equal to 96. Set the screen DPI setting to 96 by right clicking the screen - Properties- Settings- Advanced.

Run-Time error '13': Type mismatch

This error is often caused by regional settings. Make sure your system uses the period (".") for a decimal point and a comma (",") as a thousands separator. Change the characters via Control Panel - Regional Settings.

Run-Time error '62': Input Past End of File

This error is commonly caused by an invalid code file. Check the code file using Utilities-Code file checker.

Run-Time error '380': Invalid Property Value

This error often has the same cause as Runtime error 5. Make sure the screen DPI setting is equal to 96.

Run-Time error '480': Can't create AutoRedraw Image

This is almost always caused by insufficient memory. Try decreasing the size of the image being analyzed.

Run-Time error '481': Invalid picture

This error can result from several things. First, make sure the image file is valid, and can be opened in other image processing software. Another cause could be insufficient memory. CPCe requires at least 1GB of memory to run comfortably. One thing to try is to decrease the size of the image.

Run-Time error '1004': Application-defined or object-defined error

Creating a code file

A code file is a file which contains information pertaining to the possible data assignment values for a given image. It is an ASCII text file containing general categories and individual codes and species identifiers. The file shallow_coral_codes.txt is supplied with CPCe; however, users can easily create customized code files for their own use, as described below.

There are **two ways** you can create a customized code file:

One is by using the **GUI-based utility**.

The other is to manually create the ASCII file. With this method, you simply create an ASCII file which follows the format described below. The format of the coral code file is very specific. Errors in the formatting will result in the program either not running, or delivering incorrect results. Care should be taken to follow the format specifications exactly.

The **format of the coral code file** is as follows:

Number of general categories

General (major) categories:
Category symbol, Category Name

Individual codes and/or identifiers:
Coral code, coral description, category name

NOTES,NOTES,NOTES (this line separates the coral names from the disease descriptors).

For each Notes descriptor:
Notes code, description, NA (indicating not applicable)

Example

```
4
"C","Coral"
"G","Gorgonians"
"S","Sponges"
"TWS","Tape, wand, shadow"
"AA", "Agaricia agaricites","C"
"AC", "Acropora cervicornis","C"
"AF", "Agaricia fragilis","C"
"SPO",  "Sponge","S"
"SR",  "Siderastrea radians","C"
"PRELA",  "Plexaurella","G"
"PSDP",  "Pseudoplexaura","G"
"PSPT",  "Pseudopterogorgia","G"
"TAPE",  "Tape","TWS"
"WAND",  "Wand","TWS"
"SHAD",  "Shadow","TWS"
NOTES,NOTES,NOTES
"ASP",  "Aspergillus","NA"
"BL",  "Bleached coral point","NA"
"BBD",  "Black Band Disease","NA"
"OD",  "Other disease","NA"
"PLA",  "Plague, Type II (White Plague, Type II)","NA"
"WBD",  "White Band Disease","NA"
"YBD",  "Yellow Blotch Disease","NA"
```

To visually separate codes with a black box, you can insert blanks by entering "Blank","Blank","Blank" where desired.

Due to the requirements of the associated Excel spreadsheets:

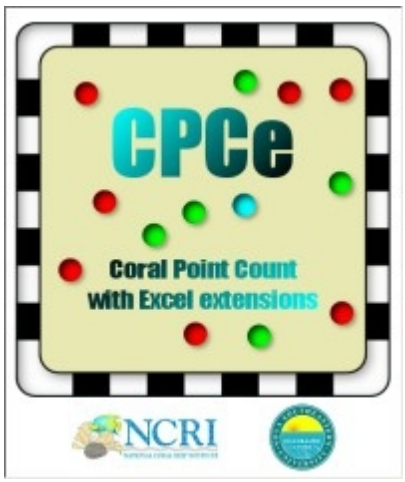
1. One of the major categories must be "Coral"
2. The category TWS (Tape, wand, shadow) must be present, and must be the last category.
3. Each major category must contain at least one species/substrate/etc. entry.

Citing CPCe

Please use the following citation in published literature using CPCe:

Kohler, K.E. and S.M. Gill, 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers and Geosciences, Vol. 32, No. 9, pp. 1259-1269, DOI:10.1016/j.cageo.2005.11.009.

Donations

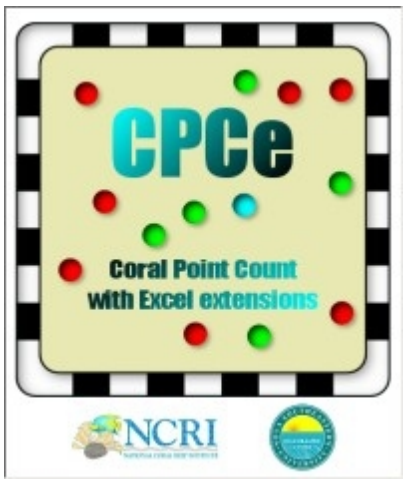


CPCe is released as copyrighted freeware. It is NCRI's aim to provide a useful tool for researchers, coral reef managers, and individuals involved in coral reef monitoring, assessment, and restoration.

Due to its popularity, updating CPCe and providing support via email and telephone requires a significant amount of time and effort. If you have found CPCe to be useful for your research, we encourage you to make a donation that will be used for the further development and support of CPCe.

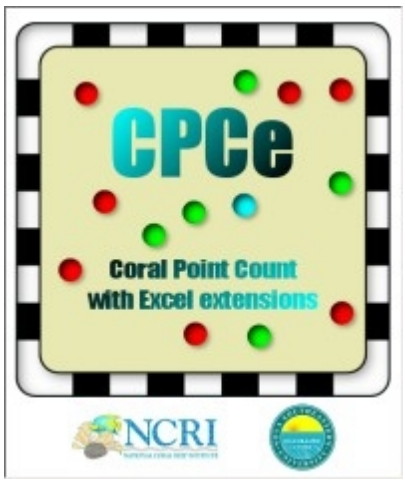
You can make a donation by directly sending a check or by credit card. Please email cpce_donation_1@mail.ocean.nova.edu or johnmatt@nova.edu for details.

Training



NCRI provides training in CPCe, either at the NSU Oceanographic Center or at your institution. For more information, please see http://www.nova.edu/ocean/cpce or contact cpce_training@mail.ocean.nova.edu.

Support

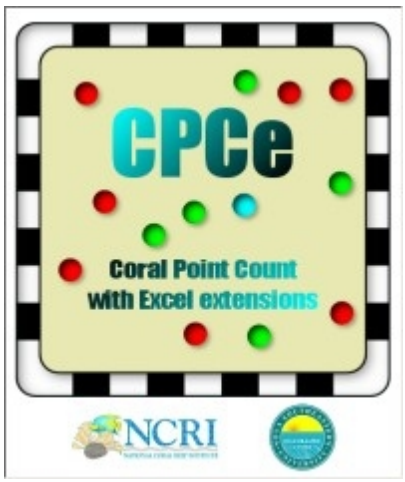


Some common errors occasionally encountered with CPCe are listed under 'Options – Common run-time errors'. Please check this list and see if any of errors you may encounter are applicable to your scenario. If your issue is not listed, please email the following information to johnmatt@nova.edu so we may be able to look into the issue:

1. The version of CPCe you are using.
2. A detailed description of how to reproduce the error including a screenshot of the error (a screenshot can be obtained by using the 'Print Screen' button and pasting the image into the email).
3. A copy of the code file that you are using.
4. A copy of the .cpc file that is causing the error and the image file that the .cpc file uses (if applicable).
5. The operating system you are using (i.e. Windows XP, 7, Vista, etc.).
6. The version of Excel you are using.

Once provided with this information, we will work to track down the issue and contact you with a resolution.

Contact Information



CPCe V4.1
Coral Point Count w/ Excel extensions
Maintained by Matthew W. Johnston
Email: johnmatt@nova.edu
Web: www.nova.edu/ocean/cpce/

Questions and suggestions regarding CPCe can be addressed to:

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Dania Beach, FL 33004
Phone: (954)262-3641
Fax: (954)262-4158

Dedicated to the memory of the original program author, Kevin Kohler