Percent Cover Analysis: Background Info and Project Overview (1st edition McCollum 11/2010, 2nd edition Sebens 03/2020, 3rd edition McCollum 06/2020-2022)

Data collection for the Sebens lab long-term research project near Nahant, MA began in 1977. Sampling has continued approximately every academic quarter ever since. There are five sites known as:

Halfway Rock Inner (HRI)

Halfway Rock Outer (HRO)

Halfway Rock Deep/Gersemia Wall (HRD) \*Analysis to start 2020

Shag Rocks Inner (SHI)

Shag Rocks Outer (SHO)

Dive Beach (DB)

Each site has between 4-7 “subsites” (rock walls, benches) where quadrat photos are taken of the substrate of a known area. At each subsite, between 3-6 photos are taken depending on area of the rock surface. See Table 1 for subsite labels and quadrats used and Appendix 1 for site drawings with subsite locations. Exactly where the photos are taken, number of photos at each subsite, and which subsites are used has changed slightly over time for various reasons, so you might not see all of the photos for every sample.

Table 1.

Site Subsites Quadrats

HRI WA (Wall Away) 1-4

VC (Vertical Control) 1-4, 6

VS (Vertical Shallow) 1-4, 6 or 5

HC (Horizontal Control) 1-4, no 2C

HS (Horizontal Shallow) 1-3, 7 or 1-4, 7

H2 (Horizontal 2) 1-4

H3 (Horizontal 3) 1-4

HRO HC (Horizontal Control) 1-4

VCT (Vertical Control Top) 1-3, 7-9, no 7C

VCB (Vertical Control Bottom) 4-6

VDL (Vertical Deep Left) 5-7

VDR (Vertical Deep Right) 1-4, no 2C

HRD SLW (Shallow Left Wall) 1-4

SRW (Shallow Right wall 1-4

LRT (Left Ridge Top) 1-4

RRT (Right Ridge Top) 1-4

LRB (Left Ridge Bottom 1-4

RRB (Right Ridge Bottom) 1-4

DWT (Deep Wall Top) 1-4

DWB (Deep Wall Bottom) 1-4

SHI WA (Wall Away) 1-4

VC (Vertical Control) 1-4

HC (Horizontal Control) 1-4

HS (Horizontal Shallow) 1-3

SHO VC (Vertical Control) 1-5, no 4D

VS (Vertical Shallow) 1-4

V3 (Vertical 3) 1-4

HC (Horizontal Control) 1-4

HS (Horizontal Shallow) 1-4

H3 (Horizontal 3) 1-4

DB HC (Horizontal Control) 1-4

WA (Wall Away) 1-4

VC (Vertical Control) 1-7

NWA or ALC 1-6

(New Alcyonium wall)

Percent cover of organisms in the photos used to be quantified by holding up a clear plastic overhead sheet with 200 random dots printed on it to the photo, then identifying and counting each organism located below each point. Later, a program called Coral Point Count (**CPCe**) (2007-2014) was used to upload each photo, place 200 points on the photo at random, and record everything we identify in the photo in an Excel sheet that calculates percent cover. Finally (2014 on) we used **CoralNet**, which also generates the 200 random points.

Using the **CPCe** produced Excel sheet, these data were entered into a specific Excel Percent Cover Macro Template sheet that can then be run through the Macro to transform and back-transform means and standard deviations. Data can then be analyzed and added to the summary output spreadsheets for graphical interpretation.

When photos contain mobile fauna, the images are uploaded into the program ImageJ, where scale is calculated, the mobile fauna are measured and these data are recorded by hand, then entered into another specific Excel Macro template sheet for Mobile Fauna, which allows these data to be run through a different Macro and then analyzed. Alternatively, if the photos are projected to the screen at actual size, measurements can be made directly and data entered into the spreadsheet without Image J.

Notes on identifying things correctly

Unfortunately, there is no great field guide for identifying organisms from the rocky subtidal zone of the Northwest Atlantic. Ken’s drawings and descriptions (Appendix 4) are actually quite good, but sometimes you just need a color photograph of the organism in its natural setting. Google image search for the species name, or see our new MA Species Guide for approved ID photos. *Marine Life of the North Atlantic: Canada to Cape May* by Andrew J. Martinez and the frequently updated companion phone app (“Marine life of the North Atlantic”) are also quite good resources.

If you are lucky, the photo will be completely two-dimensional with no canopy forming species, no shadow, no mobile fauna, and nothing out of focus or beyond your identification skills. However, most of the time you will have to deal with at least one of these issues.

Canopy items

When your photo has a canopy, you will have to analyze it twice if **using CPCe** , once for percent cover of substrate occupying organisms and once for the percent cover of organisms with a canopy that obscures some portion of the substrate (kelp blade, anemone tentacles, etc...). For percent cover substrate, when a point falls on canopy, mark it as “BAD” (one of the codes in the code file), and redo the point using one of your extra points beyond 200. Then once the substrate version is done, save, and redo the photo in canopy version. Use just 200 points, and mark all the points the DON’T fall on canopy as “BAD” while correctly marking the canopy items with the abbreviation for the canopy version of that species. “ALc” for “Alcyonium can”, not “ALS” for “Alcyonium substrate”

Save the canopy version to .cpc file as normal but with “canopy” just before the file extension and process with the original substrate file(s).

In the original **manual analysis using acetate** sheets, canopy was done first to get N points out of 200 and each category was identified. Then the substrate was analyzed, and finally, another acetate sheet was used with points randomly selected until 200 substrate points were reached. There were many acetate sheets with different sets of points and each sheet could be held up to the photo 4-8 different ways so the same position of the points was never used on the same photo or later photos of that quadrat.

If using **CoralNet,** you only do the analysis once but make sure that you use canopy designation for only those points that have a clear canopy and no substrate below it, of the same type. For example, anemone edge tentacles are only canopy. If the point has both substratum and canopy of the same category, call it substrate and we will add a canopy point later in the files. This will usually produce a set of canopy points very close to 200.

Substrate/Canopy Determination

* Most organisms are strictly considered substrate because they are encrusting., and only a few mm tall.
* *Alcyonium, Metridium, Isodictya,* hydroids, erect bryozoans and certain algae can be either substrate or canopy, or both:
* When a + lands on the extended polyps of *Alcyonium* or the tentacle crown of *Metridium*, or the branching fingers of *Isodictya*, it is considered CANOPY.
* When a + lands on the stalk or upper portions of a hydroid or erect bryozoan, it is considered CANOPY.
* When a + lands at the base of an erect bryozoan, hydroid, *Isodictya* body, *Metridium* body, or contracted *Alcyonium*, it is considered SUBSTRATE if there is no canopy
* When a + falls on a canopy organism, but the substrate can be seen through it, tally up both the canopy and substrate (1 dot of each). If the substrate cannot be seen, this dot should be tallied as the canopy and then recounted at another location for substrate (not in **CoralNet** though)
* *Modiolus* is a substrate organism. When a + falls on an organism **growing on** *Modiolus* it is to be marked as trace, “T”, and then tallied under *Modiolus* as substrate. In other words, creatures on secondary substrate are not counted as percent cover.
* Any points falling on mobile fauna, a poor portion of the photo, or an unidentifiable object need to be redone. Click on the code **BAD** and use one of the points past 200 to redo any of these points.
* Items growing on dead items are considered the primary substrate and are tallied, not the dead organism. Dead barnacle bases or dead coralline algae are scored as bare rock.
* Dead *Mytilus edulis* is considered shell hash and should be tallied under the code **SHL**.

Sediment/Complex

* Sediment falls into two categories: 1) **Thin sediment** (not part of substrate)

2) **Thick sediment** (not part of substrate)

* Thin sediment is not considered part of the substrate. It consists of the light brown film which constantly moves with heavier wave action. If the substrate below can be seen, use it as substrate, and also record the dots on thin sediment (old method). In **CPCe** or **CoralNet** just score the thin sediment if it can’t be seen through, and score the underlying organism if it is easy to see through.

* Thick sediment appears stationary and looks sort of “curly”, and also may be moved easily. Count dots on this, but do not include as substrate.
* Complex is attached to the substrate and falls into two categories:

1) **Tube complex** 2) **Hydrozoan/Bryozoan complex.**

* Tubes look like sediment but contain amphipods or polychaetes. The openings of tubes can be seen and thus identified from thick sediment.
* Hydrozoan and bryozoan bases are what is left of old hydrozoans and bryozoans that have broken off and become covered with complex. They are their own category called “Hydro/Bryo complex”.

Trace Organisms

* + ALL sessile organisms present in the slide should be recorded. If no point falls on an occurring organism, it is considered “trace”(less than 1%) and is marked with “T” on the data sheet. It is NOT part of the 200 points, even if it is an ample organism. These are added to the data files as 0.5 points each, and are not used in percent cover, only in species counts for diversity.
* When a photo is completed, we should have a total of 200 points on the substratum, plus additional points on canopy and sediment. In **CoralNet**, the total will be less than 200. So points that fall on canopy that you see substrate through are counted in the 200 points as that substrate organism, as well as in canopy totals. Points that you cannot see through, as in the case of the thick and thin sediment are in their own category.

Shadow and Rubble/Shell hash

If the point falls on shadow, rubble, shell hash, etc…mark the point as “SHD” and redo it using one of your extra points beyond 200 **using CPCe**. Also redo points that fall on tape, framer, thick sediment, and thin sediment (“TAP”, “FRM”, “TKS”, “TNS”, respectively). You can call framer/tape “BAD”, they are not important.

But the points that fall on sediment are interesting, so please identify them as such. “TAP” and “FRM” are **CPCe** required codes, otherwise we wouldn’t use them. See Appendix 6 ‘Protocol Notes for Percent Cover’ for more discussion.

If using **CoralNet,** photos are already trimmed so as to not include many of these bad points. The few that are scored will be subtracted from the overall total.

Mobile Fauna

Mark points that fall on mobile fauna as “BAD” and redo these points on **CPCe**. In **CoralNet** the program tries to identify them, so ok to score them as such, they just won’t be used.

Out of Focus

When you can’t tell what something is, because you can’t see it clearly, not because you don’t know what it is, you may mark it as “BAD” and redo it using **CPCe**, though this is a good time to ask someone for a second opinion. It does not have to be redone in **CoralNet**.

**Further analysis in Excel**. – 2019

Each raw data file in excel contains columns of data from each of the 3-6 quadrats. There are separate columns for canopy and for substrate points. These are the raw data points that were generated by the manual method, by **CPCe** or by **CoralNet**. In the latter case, there is a separate page for the raw data, which is then transposed to pages 1-6 so it is in the same format and cell locations. There is also a summary page where percent cover is calculated for the entire subsite at that one sampling date, using arcsine transformed percent cover data to get a mean and standard deviation, then to back-transform the mean, mean +sd and mean-sd for graphing.

Several modifications are made to the data here. One is that unidentified coralline algae points are redistributed to the three species groups based on their relative abundance in any of the quadrates. In other words, if there are 10 points on unidentified corallines, and *Phymatolithon* and *Lithothamnion* each make up 50% of all other points on corallines, then 5 points are given to each of those species.

This page also takes into account how many total substrate and canopy points there are before calculating percent cover. In **CoralNet** data sets, this is very important.

Here, each canopy category is examined. If for example, *Metridium* has 10 substrate points and no canopy points, the spreadsheet produces 10 canopy points because there is always canopy above the base of the anemone. If there are 10 canopy points, and no substrate points, it assumes these are correctly identified as edge tentacles.

For each other canopy species, the same analysis is done. This will change the number of total canopy points. For foliose algae categories, the person doing the analysis in **CoralNet** will record the points as substrate only if they are in the very center, most will be scored as canopy.

Also, any points identified as complex in the older data (to 1999), that are not either tube or hyd/byr complex are now considered to be thick sediment. Any points identified as *Gersemia* are changed to *Alcyonium* since this is a misidentification for sure. *Molgula manhattensis* and *Molgula citrina* are combined into *Molgula* spp. because I don’t think they are easy to separate, especially when small.

McCollum Dissertation Analysis Mods – 2022

In order to match identified organisms with community thermal indices, we need species rather than genera (*Molgula citrina* vs *Molgula* spp.). Though unsatisfactory, for my analyses, as of this moment I am searching through Andrew Martinez’ field guide “Marine Life of the North Atlantic” (4th edition, 2010) and World Registry of Marine Species (WoRMS) to determine most likely species candidates.

Going forward, images will be processed by polygon rather than point count, using Labelbox, until the Algorithm developed by SeaDeep is fully trained. Both Labelbox and the SeaDeep Algorithm will be using the species names from Appendix 5. These have been checked for accepted status as of 11/2022.

**Appendix 1. Using Coral Point Count**

Percent Cover:

**CPCe** only runs on PC. It was installed on the older PC in the Sebens Lab (Dell Optiplex GX620) and several of the computers with PC operating systems in the computer lab. Ask one of the computer techs if you cannot find the program.

Before using the program on a new computer you will need to install the Species Code File into **CPCe**. The Nahant specific species code file is called “MA **CPCe** Codes.txt” it is currently located on the server **Tritonia** in the directory folders as follows:

sebens\_lab: All Sebens Data: MA CPCe Codes.txt

But may be moved to a more specific location in the future. The codes in this file are in a particular format. Do not modify them unless you know what you are doing. How to modify them, and a copy of the codes can be found in Appendix 2 and 2a.

Once you have located the code file, open **CPCe**. Check to make sure it works properly using the “Code File Check” function. This can be found in the Utilities drop-down menu. It will check the code file for any missed quotation marks, unused categories etc… that will prevent the program from loading properly.

Once the code file is error free, you are now able to load the codes and photo and begin image analysis.

Load the code file by going to the Options drop down menu and selecting “Specify code file” then locate where you code the code file. I found it easier to place a copy of the code file on my desktop so I don”t have to sign in and out of Abyss each time. **CPCe** will generally remember which code file you want to use, so you may only have to do this once.

Now, go to File, select “Open”, and “Raw image file”, then find where your photos are on Abyss. Right now they are located in:

…All Sebens Data: Nahant Photos

Then you will need to specify a border for the point overlay using the “Mark/remark region border” from the Mark Border drop-down menu. Choose the option to manually size and position the border. Do so by clicking on a corner of the photo and drag your cursor across the image while holding the cursor down. You can adjust the size and positioning before moving on to the point overlay.

If possible, exclude border areas of shadow, framer, shell hash, etc…Do your best to include as much of the quadrat in this outline area. Some images may have the framer offset, so including all the area may be difficult or impossible. Once you are satisfied with the border and position, click “Accept Border Size and Position”.

A box titled “Data point distribution” will pop up. Choose Simple random, and type in a number of points above 200 depending on the quality of the photo. If there are lots of mobile fauna, canopy forming organisms etc…you will need to add several additional points. I have found 250 is a good starting place, sometimes you will have to do the photo a second time anyway, but sometimes you wont use all the points.

Once you hit okay, the points will be overlayed in your specified border region. Below the photo are the codes from the code file. If you have a hard time remembering what code goes to what species, you can color-code them by category under the Options drop-down menu option “Color code codename category boxes”.

To the right of the photo, is a box where you identify the species below each point. Click in box 1 of the “ID” column. The point marked with “+ 1” will be highlighted in blue. You can zoom into the point by rolling the roller ball on your mouse forward, or by clicking on the buttons “300%” or “600%” below the ID boxes. Click on one of the code buttons below the photo to identify what is under the point, and your cursor will move into the next ID box, and the next point will be highlighted.

Another way to identify points is by holding down “Ctrl” while clicking on several points that fall on the same species. This is a great way to speed through photos with a large portion of crustose coralline algae. You have to click on the “+” not the number, for this to work.

Once the image has all points labeled, go to File, “Save”, “Save data to .cpc file”. Then, … “Save .cpc file(s) to Excel”.

A “Batch Processing” box will pop up, and the file you just saved should be in the main box. If not check to see that the directory box shows the correct pathway to where you just saved the file. Click on the file or files you wish to process on one sheet. Click the box that says “Place each .cpc file in its own transect” and click “Start file processing”.

If your photo required multiple attempts to obtain 200 useable substrate points, save the additional .cpc files with the same file name but a -2, -3, etc… just before the .cpc file extension so you will know to process them together. Then proceed with the batch processing box instructions as normal, but click on all of the files that make up 200 points for that file in the main box, instead of just one. Then you can process these together on the same Excel sheet. The **CPCe** output file will have additional columns for the additional files. See Appendix 3a vs. 3.

Saving **CPCe** Files to server **Tritonia**

After completing and processing each photo, you will end up with 1 (or more) .cpc files, depending on how many attempts it took you to get to 200 points, Canopy, etc… and 1 Excel sheet. No computer, that doesn’t have **CPCe** on it, will be able to open the .cpc files. However we still store them on the Abyss, and can drag them to PCs with **CPCe** to open later if need.

Go to:

Tritonia: All Sebens Data: Nahant Data: % Cover: Coral Point Count Data

You will see the folders called “CPCe Files” and “Excel Files”. Open this Abyss directory on the PC where you are using **CPCe** and dump the .cpc files into “CPCe Files” and your Excel files into “Excel Files”. Then sort them by Site and Subsite.

**Appendix 2. Percent Cover Pre-Macro Protocol**

This is how we get the data from the **CPCe** excel files to a format that can be macroed. You will need the **CPCe** excel files for all the photo quadrats of that particular subsite, as they are combined in the data analysis process from this point forward.

On Abyss, go to:

All Sebens Data: MA Monitoring: 1. Blank Data Sheets: Percent Cover: % Cover Raw Datasheet

Immediately ‘save as’ according to the file you are working with. For example:

HRI0005HC.xls

This would be the file name for the datasheet where percent cover **CPCe** data for all 4 photo quadrats, from the subsite HC, at the site HRI, taken 05/00, gets entered.

Name your file using the same format “Site, year, month, subsite”. Pay attention that you type in the date correctly. It is probably written in the form mm/dd/yy on the files you will be entering data from, so you will need to convert it to yy/mm when you are labeling the file to save.

Save the file to:

MA Monitoring: 2. % Cover Raw Data: (then your Site, and Subsite)

Data Entry

In cell C1, of the % Cover Raw Datasheet you just renamed, type in the site and subsite. Ex: HRIHC (the letters of the file name, minus the date, in the same order). In D1 type the date in mm/yy format (yes that is correct, it is different than before). Watch out because Excel may try to ‘help you out’ by changing it to the wrong format. This is perhaps the most common error you will see in the Macro.

Next, in cell C2, change the # of quadrats from 4 to how many you actually have (which might be 4, then you don’t have to change anything).

Now open the data sheets you will be using.

On Abyss go to:

All Sebens Data: Nahant Data: % Cover: Coral Point Count Data: Excel Files

(The directory is highlighted in yellow)

First, make sure there are 200 total points (that B9 says 200) minus tape+wand+shadow. There might be more than one column you need to use to get the total of 200, if you used more than one photo to get to 200 point, see Appendix 3 vs. 3A. Anyway just make sure you have 200 points. If not you have an error somewhere, or need to redo the photo.

Now scroll down to Row 111, this is where actual counted points show up, rather than calculated percent values. Rows 112-119 tell you which category to find the points you are looking for. For example, there will not be any points showing up in the coral category section.

In the case of HRI051300HC-01edit.xls (**CPCe** excel file), all 200 points landed on species in the ‘Algae’ category.

If a photo was done more than once, look in the ‘sums’ column, which should be around column ‘c’, ‘d’, or ‘e’, for the grand total of points out of 200 that fell on that species or category.

Now, you will type the number of points for each species into the % Cover Raw Datasheet that you just renamed to match the site and subsite of the photo you are working with.

You will see in Row 3 of your newly renamed sheet, Quadrats 1-7. Ignore the column B that says ‘SQ’ and the ‘A’s and ‘B’s below it, those are remnants of a different sized framer that produced smaller photos, meaning two photos, A and B, had to be taken to cover the same area as one of our photos now. Going down column A, after the site/date, quadrat business, is the same list of species that you have codes for on **CPCe**, though in a more logical order. Type the number of points that fell on each species in the corresponding box.

Open the file HRI0005WA.xls. It is in All Sebens Data: Nahant Data: % Cover: Coral Point Count Data: HRI. It will help you to follow along in the next section.

If you were entering data from the **CPCe** excel sheet for photo ‘HRI051300WA-15edit’ (which is Appendix 3), 100% of the 200 points fell on algae. So you go to the Algae category section of Transect points not Percent (2nd page). 129 points fell on Clathromorphum, and because when you did this photo, you knew it was the 3rd of 5 quadrats, you type 129 in cell E84, 3RD quadrat Clathromorphum. Likewise, the 51 points on Lithothamnion go in cell E80, the 2 points that fell on Peyssonnelia go in cell E78, and the 18 Phymatolithons go in cell E82.

Knowing which quadrat column to type these data into is essential and can screw up the whole marco if done wrong. Refer to Figure 1 at the beginning of this manual. Each subsite has a varying number of quadrats that are used, but sometimes other photos are taken at these sites and those photos are excluded from analysis. To stay with our same example, WA at HRI uses only quadrats 1-4. The fact that 5 quadrats are being used here is an **error**. But that is not the worst mistake you can make here. The worst mistake would be assuming that where it says quadrats 1-3, 7 for HS at HRI means you should type in columns 1-3, and 7. DON’T DO THIS. Type in columns 1-4, these are a count of quadrats, and from this point on no one cares where the quadrats came from. Type them sequentially, 1-4, not 1-3 and 7; 1-6, not 1-3 and 7-9 for VCT at HRO (obviously, since you don’t get any columns past 7 to type, and don’t think about adding them).

Got it?

This brings up another point. You are not allowed more than 7 quadrats, ever. If you have more, and you try to use them, the macro will crash. So give it up and drop the ones past 7. Don’t try and modify things, it wont work and its not worth it. Plus then, you say you are sampling an area for that particular date that is larger than all the other samples and they are not comparable. You just wasted your time by doing **CPCe** on a file that we don’t want to use, accept the fact and move on.

This is what happened with HRI051300WA-15edit. I could have changed my example, or fixed my mistake before you noticed it, but I wanted to make this point very clear, and to let you know that I am not actually perfect and that you will probably find several errors along the way, hopefully all minor.

Take home message, double check Figure 1 before you start working on a new subsite. If you are really good, memorize Figure 1. Now please do me the favor of changing cell C2 to say 4 quadrats and deleting all the points in column G.

New problem with data entry in the raw data sheet:

Excel has a hard time calculating Arcsine SD (column L), if the number of points is greater than 100. If it won’t calculate, put the number of points greater than 100 in the ‘B’ column below and the points will be totaled and calculated that way.

Back to data entry. Once you have entered all the points, row 119 should say 200 for all the quadrats. Good? This sheet is ready to macro, once you move it into the proper folder so the macro can recognize it.

Move the raw datasheet files to their appropriate folders here:

All Sebens Data: MA Monitoring: % COVER: RAW DATA: [appropriate site and subsite]

Now you are ready to use the Macro.

**Appendix 3. Running the Percent Cover Macro**

On Abyss, go to

All Sebens Data: MA Monitoring: % COVER: GRAPHS AND FIGURES

First, open the % COVER folder, and find the folder for the site you are working on. Then open the file [… ]% COVER DATA/GRAPH for that particular site and subsite.

When prompted, **Open with Macros.** Don’t click on the ‘open and remove macros’ button.

Go to the ‘Macro 1’ tab.

The rows highlighted in yellow display the filename for the last file that was macroed. The rows highlighted in green show the directory or pathway to get to the file that was just macroed.

If the Directory says “Volumes:cousteau:Sebens’ Lab Projects 1:MA Monitoring…”

Change it to say “sebens\_lab:All Sebens Data: MA Monitoring…”

The easy way to do this is by going to the drop-down menu ‘Edit’, then selecting ‘Replace’. When the ‘Replace’ window pops up,

type ‘Volumes:Cousteau:Sebens’ Lab Projects 1’ in the ‘Find what:’ box (without parenthesis)

and

type ‘sebens\_lab:All Sebens Data’ in the ‘Replace with:’ box.

Click ‘Replace All’.

Sometimes, and eventually, this will already be done. Save the file now.

Then, check to see if your raw datasheet has a file extension of ‘.xls’ on the file name in the RAW DATA folder.

Now replace the existing filename in cell A8, with the name of the file you are working on, paying attention to whether or not you need to include the ‘.xls’ file extension. Do this the same way you changed the Directory cells, by ‘Replacing All’ with the new file name. There should be 3 changes.

Leaving this file open, go back to the folder GRAPHS AND FIGURES. Open the Transformed %C Data-ALL DATES folder, and the appropriate site folder, then the file for that particular site and subsite.

Now go back to the % COVER DATA/GRAPH file where you made the replacements. And brace yourself.

The files are now prepared to be macroed.

Hold down ‘command+option+m’. Screens will flash in front of you as they open and close. When boxes open saying ‘### replacements were made’, click okay. Around 3 of them will pop up, but move slowly here, you have the potential to really screw something up if you go too quickly. The next box that pops up, asks if you want to save your changes to the Template. **DON’T, I REPEAT DON’T SAVE CHANGES TO THE TEMPLATE. Or raw datasheet, if it asks…**

When things stop flashing, go to the RAW tab of the % COVER DATA/GRAPH sheet. A new row should have been entered with the date of the file you just macroed. Make sure Excel didn’t change the date on you. Scroll along to the right to make sure the values are logical numbers, these numbers are the mean and 1 standard deviation above and below the mean. If it says #NUM or FALSE! You have an error on the raw data sheet, for example more than 100 points in a box, etc…

If it all looks right, cut this row, and insert it numerically where it belongs in the list of dates. Then copy the row again, and insert it below the blue line, again where it belongs in the list. This magic blue line graphs it on the tab R GRAPH. Zoom in on the graph to make sure your data points showed up where they belong. If everything looks good, congratulations, you completed your first Macro!

If not, see the extensive troubleshooting section.

If points don’t show up on the graph:

Click in the graph area, starting with the first graph. If you are using Microsoft Word 2008 for Mac, or probably, any of the newer versions, when you click in the graph area ‘Chart’ shows up as a drop-down menu. From Chart, click on Source data. You want the Chart Data Range box to say =RAW!$[column where that species begins in the RAW tab]$[row where the magic blue line is]:$[next column to the right]$[row 298 rows below the magic blue line]. For example “=RAW!$F$32:$G$330”. Double check that the formula moves down as you insert additional rows each time a new date is macroed. You may have to reformat each graph for all the different species. This sucks, but really what else did you expect? Maybe there is a way to format them all at the same time, but I couldn’t figure it out.

If Macro won’t run in “…% Cover Data/Graph” sheet, make sure the file name says

**DATA/GRAPH** not **DATA-GRAPH**

This seems to change back-and-forth on it own sometimes, not sure why…

**Appendix 4. Explanation of CPCe Codes**

The format of these codes is specific to **CPCe** and required for **CPCe** to recognize them.

The number “9” refers to the number of categories of species you have, in this case our 9 categories are:

Coral, Sponges, Tunicates, Coelenterates, Complex, Algae, Other, Canopy, and Tape, Wand, Shadow

“Coral” and “Tape, Wand, Shadow” are not optional categories, as the others are. These two are built into **CPCe** and the program will crash if they are not present in the code file.

Listed before each category is an abbreviation. This abbreviation will be applied to each species so Excel can arrange the species in the same category together on the **CPCe** output sheet (Appendix 3).

Notice the quotation marks and comas around the abbreviations and categories, and lack of space between them.

“C”,“Coral” “Abbreviation”,“Category”

This same format is followed with the species codes below, except for the inclusion of the category abbreviation for which the species belongs to.

“COR”,“CORAL”,“C” “HPA”,“Halichondria panicea”,“S”

Species listed in the category “TWS” (Tape, Wand, Shadow) will be excluded from the total number of points. See Appendix 3 the ‘**CPCe** Output’.

Notice where it says ‘NOTES,NOTES,NOTES’, the codes below this, are not species ID codes, rather Notes that you can use to flag certain points. I use the ‘X’ to call my attention to points that I need to redo. Notes go in the right column of the box to the right of the photo when **CPCe** is open.

Each category must contain at least one species, hence “COR”,“CORAL”,“C”

Then save the file as a .txt file and load it into **CPCe**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Appendix 4a. CoralNet Codes 2018**  Aeolidia papillosa | APA | Mollusca | New motile |  |
| Agarum clathratum (canopy) | ACC | Heterokontophyta |  |  |
| Agarum clathratum (substratum) | ACSUB | Heterokontophyta |  |  |
| Alaria esculenta (canopy) | AEC | Heterokontophyta |  |  |
| Alaria esculenta (substratum) | AES | Heterokontophyta |  |  |
| Alcyonium digitatum (canopy) | ALC | Cnidaria |  |  |
| Alcyonium digitatum (substratum) | ALS | Cnidaria |  |  |
| Ancula gibbosa | ANC | Mollusca | New motile |  |
| Anomia simplex | ANS | Mollusca |  |  |
| Anomia/Heteranomia spp. | ANO | Mollusca |  |  |
| Aplidium glabrum | AGL | Chordata |  |  |
| Aplysilla sp. | APL | Porifera | New deep sponge |  |
| Artemesina sp. | ARTE | Porifera | New deep sponge |  |
| Ascidians: unstalked: colonial | ASUC | Chordata |  |  |
| Ascidians: unstalked: solitary | ASUS | Chordata |  |  |
| Ascidiella aspersa | ASC | Chordata |  |  |
| Asterias spp. | AST | Echinodermata | New motile |  |
| Astrangia poculata | ASTRA | Cnidaria |  |  |
| Bad point | BAD | Other |  |  |
| Balanus/Amphibalanus spp. | BAS | Arthropoda | Fixed |  |
| Bangiaceae (canopy) | BANC | Rhodophyta |  |  |
| Bangiaceae (substratum) | BANS | Rhodophyta |  |  |
| Bare panel | BAREP | Hard substratum |  |  |
| Bare space rock | Rock | Hard substratum |  |  |
| Boltenia echinata | BEC | Chordata |  |  |
| Boltenia ovifera (canopy) | BOC | Chordata |  |  |
| Boltenia ovifera (substratum) | BOS | Chordata |  |  |
| Botrylloides violaceus | BOVO | Chordata |  |  |
| Botryllus schlosseri | BSC | Chordata |  |  |
| Buccinum undatum | BUC | Mollusca | New motile |  |
| Bugula neritina (canopy) | BNC | Bryozoa |  |  |
| Bugula neritina (substratum) | BNS | Bryozoa |  |  |
| Bugula simplex (canopy) | BSI | Bryozoa |  |  |
| Bugula simplex (substratum) | BSS | Bryozoa |  |  |
| Bugula turrita (canopy) | BTC | Bryozoa |  |  |
| Bugula turrita (substratum) | BTS | Bryozoa |  |  |
| Cadlina laevis | CAD | Mollusca | New motile |  |
| Cancer spp. | CANC | Arthropoda | New motile |  |
| Caprella/Paracaprella spp. | CAP | Arthropoda | New motile |  |
| Carcinus maenas | CAM | Arthropoda | New motile |  |
| Ceramium virgatum (canopy) | CVC | Rhodophyta |  |  |
| Ceramium virgatum (substratum) | CVS | Rhodophyta |  |  |
| Ciona intestinalis | CIO | Chordata |  |  |
| Clathromorphum spp. | CLT | Rhodophyta |  |  |
| Cliona spp. | CLION | Porifera |  |  |
| Codium fragile ssp. fragile (canopy) | CODC | Chlorophyta |  |  |
| Codium fragile ssp. fragile (substratum) | CODS | Chlorophyta |  |  |
| Colpomenia peregrina | COP | Heterokontophyta |  |  |
| Corallina officinalis (canopy) | COC | Rhodophyta |  |  |
| Corallina officinalis (substratum) | COS | Rhodophyta |  |  |
| Corambe obscura | CORA | Mollusca | New motile |  |
| Crepidula fornicata | CREP | Mollusca |  |  |
| Crepidula plana | CRL | Mollusca |  |  |
| Crossaster papposus | CRP | Echinodermata | New motile |  |
| Cucumaria frondosa | CUCU | Echinodermata | New motile |  |
| Cuthona gymnota | CUT | Mollusca | New motile |  |
| Cyclopterus lumpus | CYC | Chordata | New motile |  |
| Dendronotus frondosus | DEN | Mollusca | New motile |  |
| Desmarestia aculeata (canopy) | DAC | Heterokontophyta |  |  |
| Desmarestia aculeata (substratum) | DASUB | Heterokontophyta |  |  |
| Desmarestia viridis (canopy) | DVC | Heterokontophyta |  |  |
| Desmarestia viridis (substratum) | DVS | Heterokontophyta |  |  |
| Diadumene lineata | DIA | Cnidaria |  |  |
| Didemnum spp. (native) | DSN | Chordata |  |  |
| Didemnum vexillum | DVE | Chordata |  |  |
| Diplosoma listerianum | DIP | Chordata |  |  |
| Ectopleura/Tubularia spp. (canopy) | ESC | Cnidaria |  |  |
| Ectopleura/Tubularia spp. (substratum) | ESSU | Cnidaria |  |  |
| Edwardsiella lineata (canopy) | ELC | Cnidaria |  |  |
| Edwardsiella lineata (substratum) | ELS | Cnidaria |  |  |
| Electra pilosa | ELEC | Bryozoa |  |  |
| Eubranchus exiguus | EUB | Mollusca | New motile |  |
| Facelina bostoniensis | FAC | Mollusca | New motile |  |
| Flabellina spp. | FLA | Mollusca | New motile |  |
| Framer | FRM | Other |  |  |
| Gellius arcoferus | GEL | Porifera | New deep sponge |  |
| Gersemia rubiformis (canopy) | GRC | Cnidaria |  |  |
| Gersemia rubiformis (substratum) | GRS | Cnidaria |  |  |
| Gravel | SUPG | Soft substratum |  |  |
| Halichondria panicea | HAPA | Porifera | Fixed |  |
| Halichondria sp. (blue) | BHA | Porifera |  |  |
| Haliclona oculata (canopy) | HOC | Porifera | Fixed |  |
| Haliclona oculata (substratum) | HOS | Porifera | Fixed |  |
| Haliclona spp. | HALS | Porifera |  |  |
| Halisarca spp. | HAS | Porifera | Fixed |  |
| Halocynthia pyriformis | HPY | Chordata |  |  |
| Hemigrapsus sanguineus | HEM | Arthropoda | New motile |  |
| Henricia sanguinolenta | HENR | Echinodermata | New motile |  |
| Hiatella arctica | HIA | Mollusca |  |  |
| Hippasteria phrygiana | HPP | Echinodermata | New motile |  |
| Hippothoa hyalina | HIP | Bryozoa |  |  |
| Homarus americanus | HOM | Arthropoda | New motile |  |
| Hyas spp. | HYA | Arthropoda | New motile |  |
| Hydrozoa/Bryozoa complex | HBCO | Other invertebrates |  |  |
| Hymedesmia spp. | HYM | Porifera | Fixed |  |
| Idotea spp. | IDO | Arthropoda | New motile |  |
| Iophon spp. | IOP | Porifera | New deep sponge |  |
| Isodictya spp. (canopy) | ISC | Porifera | Fixed |  |
| Isodictya spp. (substratum) | ISS | Porifera | Fixed |  |
| Jassa marmorata | JAS | Arthropoda |  |  |
| Lacuna vincta | LAC | Mollusca | New motile |  |
| Laminaria digitata (canopy) | LDC | Heterokontophyta |  |  |
| Laminaria digitata (substratum) | LDS | Heterokontophyta |  |  |
| Leptasterias spp. | LEP | Echinodermata | New motile |  |
| Leptosia sp. | TOS | Porifera | New deep sponge |  |
| Leucosolenia spp. | LEU | Porifera |  |  |
| Libinia spp. | LIB | Arthropoda | New motile |  |
| Lithothamnion spp. | LIT | Rhodophyta |  |  |
| Littorina littorea | LIL | Mollusca | New motile |  |
| Membranipora membranacea | MEMB | Bryozoa |  |  |
| Metridium senile (canopy) | MSC | Cnidaria |  |  |
| Metridium senile (substratum) | MSS | Cnidaria |  |  |
| Microciona prolifera | MPR | Porifera |  |  |
| Modiolus modiolus | MOMD | Mollusca |  |  |
| Molgula spp. | MOL | Chordata |  |  |
| Mycale spp. | MYCA | Porifera | New deep sponge |  |
| Myoxocephalus spp. | MYO | Chordata | New motile |  |
| Mytilus edulis | MED | Mollusca |  |  |
| Myxicola infundibulum | MYIN | Annelida |  |  |
| Myxilla fimbriata | MYF | Porifera | New deep sponge |  |
| Notoacmea testudinalis | NOT | Mollusca |  |  |
| Nucella lapillus | NUCE | Mollusca | New motile |  |
| Obelia spp. (canopy) | OBC | Cnidaria |  |  |
| Obelia spp. (substratum) | OBS | Cnidaria |  |  |
| Onchidoris bilamellata | ONB | Mollusca | New motile |  |
| Onchidoris muricata | ONM | Mollusca | New motile |  |
| Ostrea edulis | OST | Mollusca |  |  |
| Pagurus spp. | PAG | Arthropoda | New motile |  |
| Palio dubia | DUB | Mollusca | New motile |  |
| Petalonia fascia/Punctaria latifolia (canopy) | PETC | Heterokontophyta |  |  |
| Petalonia fascia/Punctaria latifolia (substratum) | PETS | Heterokontophyta |  |  |
| Pholis gunnelus | PHO | Chordata | New motile |  |
| Phycodrys rubens (canopy) | PRC | Rhodophyta |  |  |
| Phycodrys rubens (substratum) | PRS | Rhodophyta |  |  |
| Phyllophora/Chondrus (canopy) | PCC | Rhodophyta |  |  |
| Phyllophora/Chondrus (substratum) | PCS | Rhodophyta |  |  |
| Phymatolithon spp. | PHY | Rhodophyta |  |  |
| Polymastia spp. | POLY | Porifera | New deep sponge |  |
| Polysiphonia stricta (canopy) | PSC | Rhodophyta |  |  |
| Polysiphonia stricta (substratum) | PSS | Rhodophyta |  |  |
| Porania pulvillus | POR | Echinodermata | New motile |  |
| Pteraster militaris | PTE | Echinodermata | New motile |  |
| Ptilota serrata (canopy) | PTC | Rhodophyta |  |  |
| Ptilota serrata (substratum) | PTS | Rhodophyta |  |  |
| Saccharina latissima (canopy) | SLC | Heterokontophyta |  |  |
| Saccharina latissima (substratum) | SLS | Heterokontophyta |  |  |
| Sagartia elegans | SAG | Cnidaria |  |  |
| Sand | SAN | Soft substratum |  |  |
| Schizoporella unicornis | SCH | Bryozoa |  |  |
| Scrupocellaria scabra (canopy) | SSC | Bryozoa |  |  |
| Scrupocellaria scabra (substratum) | SSS | Bryozoa |  |  |
| Scypha sp. | SCY | Porifera |  |  |
| Semibalanus balanoides | SEMI | Arthropoda |  |  |
| Shadow | SHAD | Other |  |  |
| Shell hash | Shell | Hard substratum |  |  |
| Solaster endeca | SEN | Echinodermata | New motile |  |
| Spionidae | SPIO | Annelida |  |  |
| Spirorbis spp. | SPRO | Annelida | Fixed |  |
| Strongylocentrotus droebachiensis | DROE | Echinodermata | New motile |  |
| Styela canopus | STA | Chordata |  |  |
| Styela clava | STCL | Chordata |  |  |
| Suggested Change | Abbreviation | Phylum/Group | Comments |  |
| Tape | Trans | Other |  |  |
| Tautogolabrus adspersus | TAU | Chordata | New motile |  |
| Thick sediment | TKS | Soft substratum |  |  |
| Thin sediment | TNS | Soft substratum |  |  |
| Tonicella spp. | TLI | Mollusca | New motile |  |
| Tritonia plebeia | TRI | Mollusca | New motile |  |
| Tube complex | TUBE | Other invertebrates |  |  |
| Ulva spp. (canopy) | USC | Chlorophyta |  |  |
| Ulva spp. (substratum) | ULS | Chlorophyta |  |  |
| Ulvaria subbifurcata | ULV | Chordata | New motile |  |
| Unidentified arborescent bryozoan (canopy) | UAS | Bryozoa |  |  |
| Unidentified arborescent bryozoan (substratum) | UAB | Bryozoa |  |  |
| Unidentified brown blade (canopy) | BBC | Heterokontophyta |  |  |
| Unidentified brown blade (substratum) | BBS | Heterokontophyta |  |  |
| Unidentified brown branched (canopy) | BBD | Heterokontophyta |  |  |
| Unidentified brown branched (substratum) | BBR | Heterokontophyta |  |  |
| Unidentified brown crust | BRC | Heterokontophyta |  |  |
| Unidentified crustose coralline algae | UCC | Rhodophyta |  |  |
| Unidentified diatoms | UDI | Heterokontophyta |  |  |
| Unidentified encrusting bryozoan | UEB | Bryozoa |  |  |
| Unidentified green blade (canopy) | UGC | Chlorophyta |  |  |
| Unidentified green blade (substratum) | UGS | Chlorophyta |  |  |
| Unidentified green branched (canopy) | GBC | Chlorophyta |  |  |
| Unidentified green branched (substratum) | GBS | Chlorophyta |  |  |
| Unidentified green film | UGF | Chlorophyta |  |  |
| Unidentified hydroid (canopy) | UHC | Cnidaria |  |  |
| Unidentified hydroid (substratum) | UHS | Cnidaria |  |  |
| Unidentified orange sponge | UOS | Porifera |  |  |
| Unidentified red blade (canopy) | UBC | Rhodophyta |  |  |
| Unidentified red blade (substratum) | UBS | Rhodophyta |  |  |
| Unidentified red branched (canopy) | URC | Rhodophyta |  |  |
| Unidentified red branched (substratum) | URS | Rhodophyta |  |  |
| Unidentified red fleshy crust | URF | Rhodophyta |  |  |
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|  |  |  |  |  |
| **Appendix 5. New Species list for Labelbox and SeaDeep, McCollum 11/2022**   |  |  | | --- | --- | | name | type | | Aeolidia papillosa | Mobile | | Agarum clathratum | Sessile | | Alaria esculenta | Sessile | | Alcyonium siderium | Sessile | | Ancula gibbosa | Mobile | | Anomia simplex | Sessile | | Aplidium glabrum | Sessile | | Aquiloniella scabra | Sessile | | Ascidiella aspersa | Sessile | | Asterias forbesi | Mobile | | Asterias rubens | Mobile | | Astrangia poculata | Mobile | | Bad area | Sessile | | Balanus balanus | Sessile | | Bare Rock | Sessile | | Boltenia echinata | Sessile | | Boltenia ovifera | Sessile | | Boreochiton ruber | Mobile | | Botrylloides violaceus | Sessile | | Botryllus schlosseri | Sessile | | Buccinum undatum | Mobile | | Bugula neritina | Sessile | | Bugula turrita | Sessile | | Cadlina laevis | Mobile | | Cancer borealis | Mobile | | Cancer irroratus | Mobile | | Catriona gymnota | Mobile | | Carcinus maenas | Mobile | | Celleporella hyalina | Sessile | | Ceramium virgatum | Sessile | | Chondrus crispus | Sessile | | Ciona intestinalis | Sessile | | Clathromorphum circumscriptum | Sessile | | Cliona celata | Sessile | | Codium fragile | Sessile | | Colpomenia peregrina | Sessile | | Corallina officinalis | Sessile | | Corambe obscura | Mobile | | Crepidula fornicata | Sessile | | Crepidula plana | Sessile | | Crossaster papposus | Mobile | | Cucumaria frondosa | Mobile | | Cyclopterus lumpus | Mobile | | Cylista elegans | Sessile | | Dendronotus frondosus | Mobile | | Desmarestia aculeata | Sessile | | Desmarestia viridis | Sessile | | Diadumene lineata | Sessile | | Didemnum albidum | Sessile | | Didemnum vexillum | Sessile | | Diplosoma listerianum | Sessile | | Edwardsiella lineata | Sessile | | Electra pilosa | Sessile | | Eubranchus exiguus | Mobile | | Facelina bostoniensis | Mobile | | Flabellina salmonacea | Mobile | | Flabellina verrucosa | Mobile | | Gersemia rubiformis | Sessile | | Halichondria panicea | Sessile | | Haliclona oculata | Sessile | | Halisarca nahantensis | Sessile | | Halocynthia pyriformis | Sessile | | Hemigellius arcofer | Sessile | | Hemigrapsus sanguineus | Mobile | | Henricia sanguinolenta | Mobile | | Heteranomia squamula | Sessile | | Hiatella arctica | Sessile | | Hippasteria phrygiana | Mobile | | Homarus americanus | Mobile | | Hyas coarctatus | Mobile | | Hydrobryo complex | Sessile | | Hymedesmia paupertas | Sessile | | Isodictya palmata | Sessile | | Jassa marmorata | Sessile | | Lacuna vincta | Mobile | | Laminaria digitata | Sessile | | Leptasterias polaris | Mobile | | Leucosolenia botryoides | Sessile | | Libinia emarginata | Mobile | | Lithothamnion glaciale | Sessile | | Littorina littorea | Mobile | | Membranipora membranacea | Sessile | | Metridium senile | Sessile | | Microciona prolifera | Sessile | | Modiolus modiolus | Sessile | | Molgula citrina | Sessile | | Molgula manhattensis | Sessile | | Myoxocephalus aeneus | Mobile | | Mytilus edulis | Sessile | | Myxicola infundibulum | Sessile | | Myxilla fimbriata | Sessile | | Nucella lapillus | Mobile | | Obelia geniculata | Sessile | | Ophiopholis aculeata | Mobile | | Onchidoris bilamellata | Mobile | | Onchidoris muricata | Mobile | | Ostrea edulis | Sessile | | Pagurus acadianus | Mobile | | Palio dubia | Mobile | | Petalonia fascia | Sessile | | Peyssonnelia rosenvingei | Sessile | | Pholis gunnelus | Mobile | | Phycodrys rubens | Sessile | | Phymatolithon rugulosum | Sessile | | Polymastia rara | Sessile | | Polysiphonia stricta | Sessile | | Porania pulvillus | Mobile | | Pteraster militaris | Mobile | | Ptilota serrata | Sessile | | Punctaria latifolia | Sessile | | Saccharina latissima | Sessile | | Schizoporella unicornis | Sessile | | Semibalanus balanoides | Sessile | | Solaster endeca | Mobile | | Spirorbis borealis | Sessile | | Strongylocentrotus droebachiensis | Mobile | | Styela canopus | Sessile | | Styela clava | Sessile | | Sycon ciliatum | Sessile | | Tautogolabrus adspersus | Mobile | | Testudinalia testudinalis | Mobile | | Tonicella marmorea | Mobile | | Tritonia plebeia | Mobile | | Tubularia crocea | Sessile | | Tube complex | Sessile | | Ulva lactuca | Sessile | | Ulvaria subbifurcata | Mobile | |  |  |  |  |
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