

Hierarchical segmentation-based software for cover classification analyses of seabed images (Seascape)

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Supplement 1. Summary of the basic operations of Seascape. The complete user manual is available online (<http://www.seascapesoft.org>)

(1) Create the Excel file by the user with a species/category list

	A	B	C	D
1		Code Group	Label species	
2	Group 1 Sponges			
3	Avinella damicornis	S	1	
4	Crella pulvinar	S	2	
5	Dendroxea lenis	S	3	
6	Dyctionella sp.	S	4	
7	Dysidea avara pallescens	S	5	
8	Ircinia variabilis	S	6	
9	Oscarella imperialis	S	7	
10	Petrosia ficiformis	S	8	
11	Pleraplysilla spinifera	S	9	
12	Prosuberites longispina	S	10	
13	Raspaciona aculeata	S	11	
14	Reniera fulva	S	12	
15	Reniera mucosa	S	13	
16	Sponge orange	S	15	
17	Spongia virgatosa	S	16	
18	Group 2 Cnidaria			
19	Caryophyllia inornata	C	18	
20	Hoplangia durothrix	C	19	
21	Corallium rubrum	C	20	
22	Leptopsammia pruvoti	C	21	
23	Group 3 Ascidians			
24	Aplidium fuscum	A	23	
25	Group 4 Complex			
26	Animal complex	Co	25	
27	Bare space	Co	26	
28				
29				
30				
31				
32				
33				
34				

Requirements:

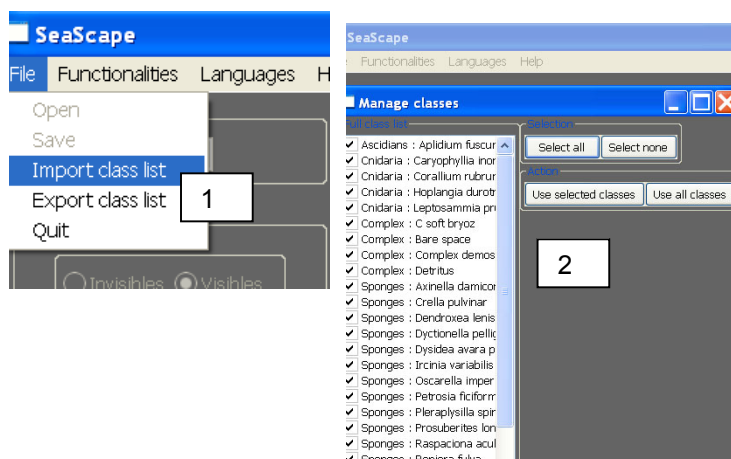
- Only Excel 1997-2003 spreadsheet
- File located in Data directory
- Only Sheet 1 is functional and written in English. Delete other sheets

Description

Column A: Species name classified by groups
Column B: Code Group
Column C: Label Species

Empty cells

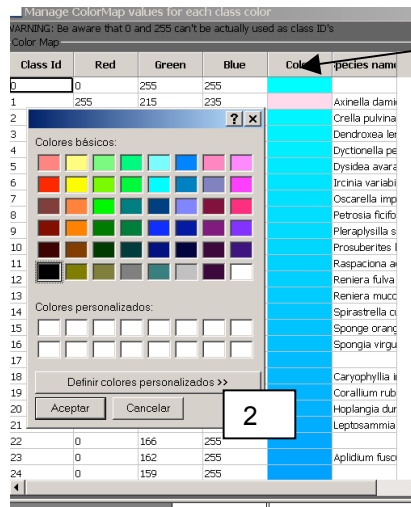
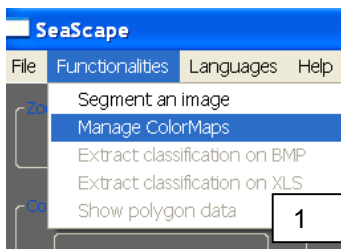
(2) Import species list



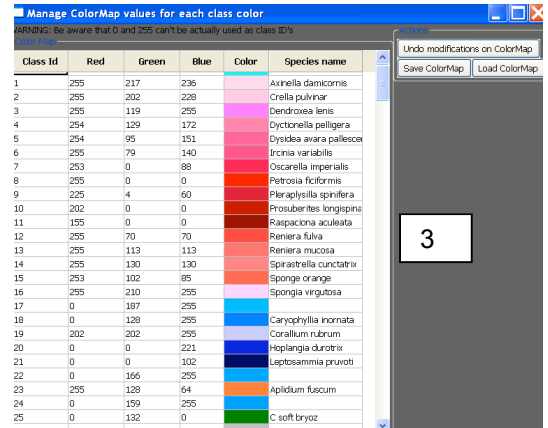
Description

- (1) Select File > Import class list
- (2) User can select all or a subset of species (Select all, Use selected classes, Use all classes, Select none)

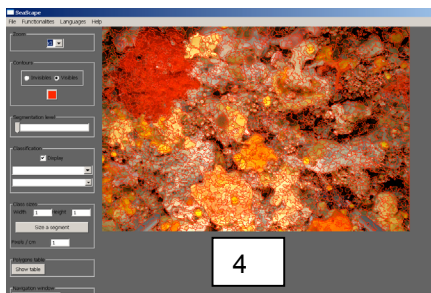
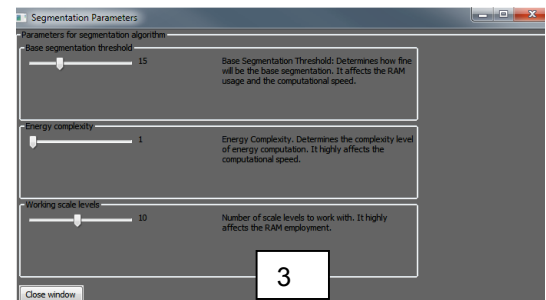
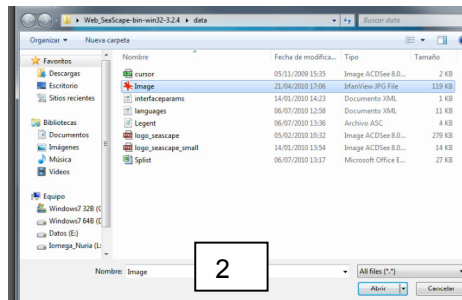
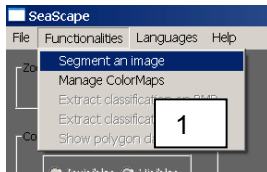
(3) Define the color code of species list (RGB, values range from 1 to 255)



Description
 (1) Select Functionalities > Manage ColorMaps
 (2) Double-click in the color cell. Select the color for each species
 (3) Save the legend for further analysis - Once it is saved, the user can load it



(4) Import and segment an image



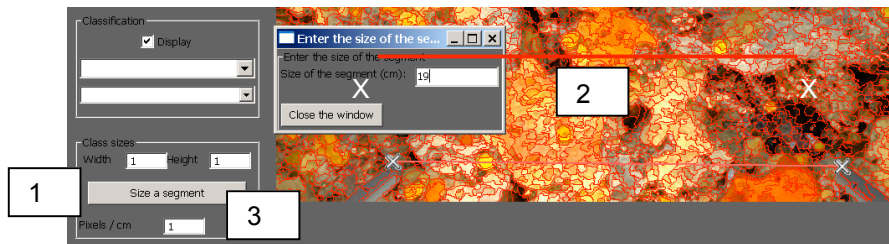
Description

- (1) Select Functionalities > Segment an image
- (2) A dialog window will pop-up, choose the image to be analyzed. It is mandatory that the image file be located in 'Data' directory.
- (3) A dialog window will pop up, requiring the value for 3 segmentation parameters to be set: Threshold, Energy complexity, Working scale levels. We recommend working with the default values. Close window to start the segmentation process.
- (4) Result of the segmentation process with the finest level of segmentation.

RAM requirements:

Seascope needs RAM memory to segment the images. We highly recommend working with images with intermediate number of pixels (e.g. approximately 1000 _ 900 pixels) and the default segmentation values (e.g. working scale levels of 10). It is more relevant to have a standard image of 1000 _ 900 pixels, to choose a working scale level of 10 to 15 (meaning 10 to 15 intermediate images) and to adjust dynamically the optimal level of segmentation rather than to have a large image (3347 _ 2276 pixels) with a working scale of 3 to 5.

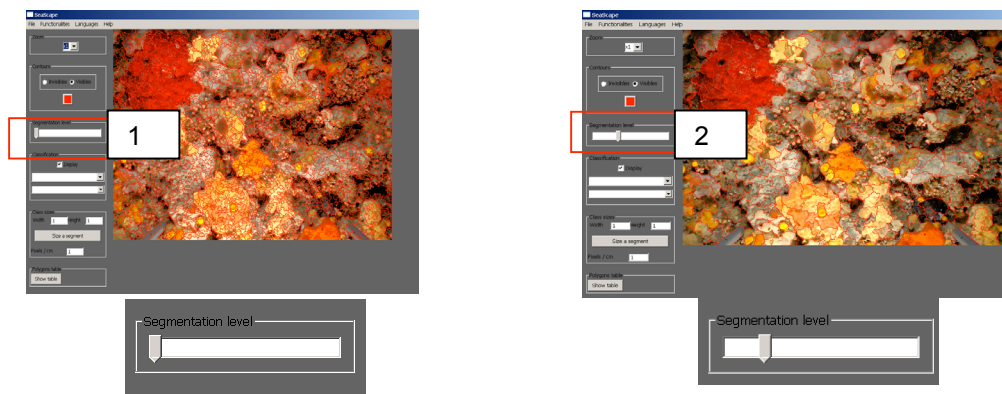
(5) Specify image scaling



Description

- (1) Click Size a segment. Then click one point and then the second point.
- (2) A window will pop up requiring the user to enter the distance spanned (in cm) between the 2 points. Close the window and the scaling resolution will be calculated.
or
- (3) The user can directly indicate the known number of pixels cm^{-1}

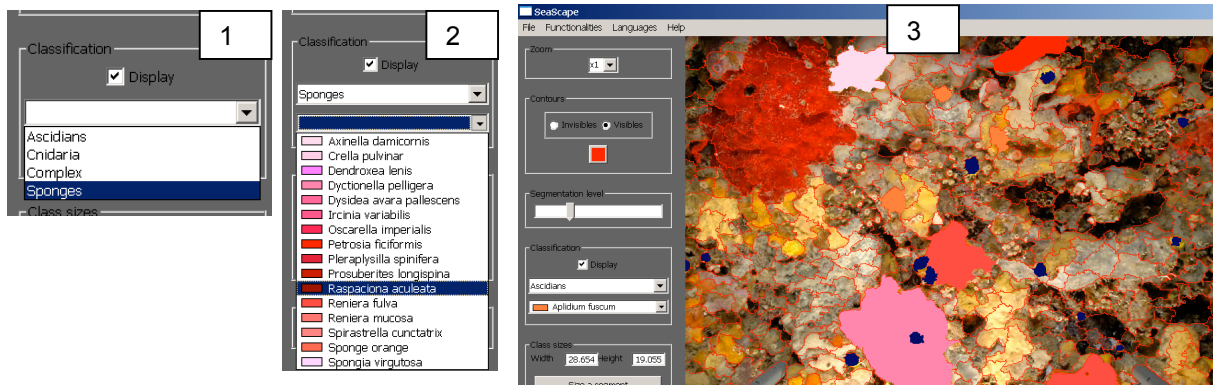
(6) Choose a segmentation level. This is a dynamic procedure.



Description

- (1) It is highly recommended to change the segmentation level in the function of the image complexity. This is a dynamic procedure.
- (2) To change the segmentation scale move the slider to the segmentation level desired in the 'Segmentation level' section.

(7) Label the regions

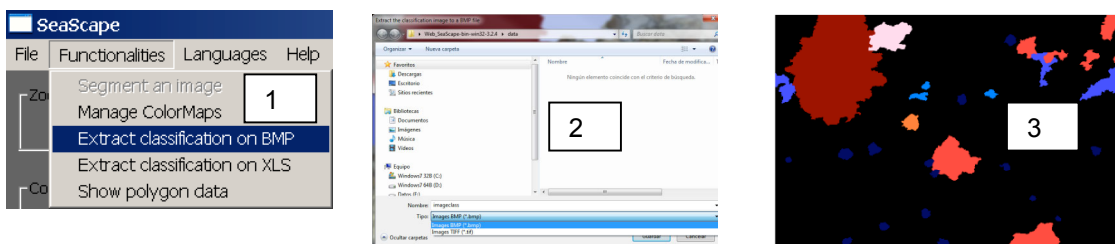


Description

- (1) To calculate areas of selected regions select a group from the first drop list of the Classification section.
- (2) Then, select the species name to be labeled from the second drop list.
- (3) Once the species is selected go to the segmented image and label the region.

- If the user simply clicks on a point with the left button of the mouse, the region encompassing that point will be labeled.
- If the user holds the left button of the mouse down and moves the cursor around the region, a line will be drawn following the cursor's path. Once the mouse button is released all the regions will be labeled
- If the user needs to unlabel a region, press the right button of the mouse over the interested region and label will be removed.

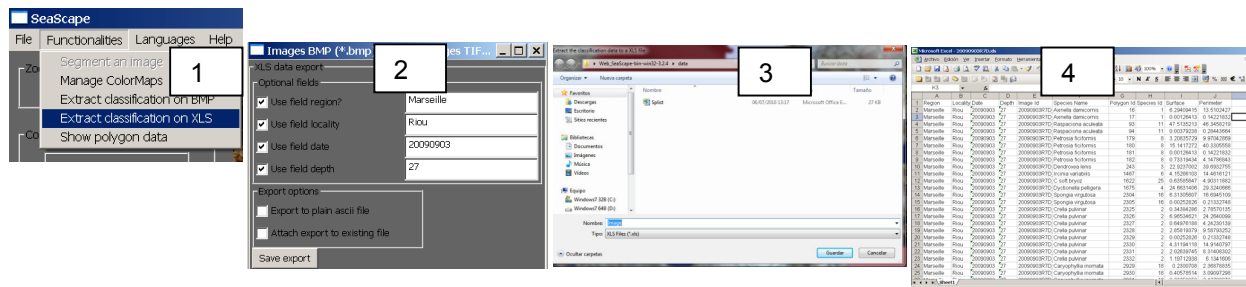
(8) Extract the classification to TIFF or BMP files



Description

- (1) Select Functionalities > Extract classification on BMP.
- (2) A window dialog will pop up requiring the user to browse the path and enter the filename. The user can save it as a BMP or TIFF file. By default, files will be saved in the 'Data directory'.
- (3) Labeled polygons will present the previous selected color, whereas regions not labeled will appear in black.

(9) Extract the classification to MS Excel files



Description

- (1) Select Functionalities > Extract classification on XLS.
- (2) A window dialog will pop up from which the user can choose the optional fields containing information of region, locality, date and depth. The user can also choose to export the data to an ASCII file or choose to export the data to an existing Excel file for statistical analysis (e.g. all the data from several images of the same transect in the same file).
- (3) After clicking Save export button, a window dialog will pop up requiring the user to browse the path and to enter the filename. By default, the Excel file will have the same name as the image file.
- (4) Overview of the data in Excel files. The data is automatically assembled into an Excel spreadsheet containing information on Image identification, Species name, Polygon identification, Species identification, Surface (cm²) and Perimeter (cm).

Supplement 2. Species list and benthic category/functional group of benthic images analyzed with Seascope. Data include number of patches (NP), mean patch area (MPA) \pm SE and cover area (CA).

Benthic community: coral reefs

Species list	Benthic category/functional group	NP	MPA (cm ²)	CA (%)
<i>Acropora valida</i>	Hard coral	8	169.4 \pm 52	23.1
<i>Acropora sp.1</i>	Hard coral	1	33.1 \pm 0	0.8
<i>Acropora sp.2</i>	Hard coral	1	50.5 \pm 0	0.5
<i>Fungia scutaria</i>	Hard coral	1	32.3 \pm 0	0.5
<i>Pocillopora meandrina</i>	Hard coral	3	314.3 \pm 91	16.1
<i>Pocillopora meandrina</i> coated with crustose coralline algae	Hard coral	4	203.2 \pm 69	13.8
<i>Porites sp.</i>	Hard coral	1	57.4 \pm 0	0.9
Coral unidentified	Hard coral	5	55.8 \pm 14.2	4.7
<i>Lobophytum sp.</i>	Soft coral	1	130.8 \pm 0	2.3
<i>Halimeda opuntia</i>	Macroalgae	7	155.9 \pm 69.7	18.6
Crustose coralline red algae	CCA	8	135.2 \pm 47.9	18.4

Benthic community: coralligenous community

Species list and bare substrate	Benthic category/functional group	NP	MPA (cm ²)	CA (%)
<i>Axinella damicornis</i>	Sponges	1	6.5 \pm 0	1.1
<i>Crella pulvinar</i>	Sponges	10	2.9 \pm 0.6	5.0
<i>Dendroxea lenis</i>	Sponges	1	27.5 \pm 0	4.8
<i>Dyctionella sp.</i>	Sponges	1	26.4 \pm 0	4.7
<i>Dysidea avara (pallescentes)</i>	Sponges	3	13.9 \pm 0	7.2
<i>Ircinia variabilis</i>	Sponges	1	4.1 \pm 0	0.7
<i>Oscarella imperialis</i>	Sponges	2	3.8 \pm 6.4	1.3
<i>Petrosia ficiformis</i>	Sponges	4	5.9 \pm 3.9	4.1
<i>Pleraplysilla spinifera</i>	Sponges	9	3.8 \pm 2.2	5.9
<i>Prosuberites longispinus</i>	Sponges	4	6.5 \pm 5.5	4.5
<i>Raspaciona aculeata</i>	Sponges	1	52.4 \pm 0	9.0
<i>Reniera (Haliclona) fulva</i>	Sponges	7	3.5 \pm 3.1	4.3
<i>Reniera (Haliclona) mucosa</i>	Sponges	3	4.4 \pm 3.2	2.3
Sponge orange non identified	Sponges	1	2.3 \pm 0	0.4
<i>Spongia virgultosa</i>	Sponges	1	7.0 \pm 0	1.2
<i>Caryophyllia inornata</i>	Hexacorals	10	0.4 \pm 0.1	0.7
<i>Hoplania durotrix</i>	Hexacorals	22	2.4 \pm 6.3	9.3
<i>Leptopsammia pruvoti</i>	Hexacorals	16	0.4 \pm 0.3	1.2
<i>Corallium rubrum</i>	Octacorals	4	2.3 \pm 3.0	1.6
<i>Aplidium fuscum</i>	Tunicates	3	1.1 \pm 0.2	0.5
Thin and filamentous animal complex	Complex	32	3.3 \pm 1.0	18.0
Bare space	Bare space	29	2.3 \pm 0.5	11.7

Benthic community: deep-water coral reefs

Species list and bare substrate	Benthic category/functional group	NP	MPA (cm ²)	CA (%)
<i>Madrepora oculata</i>	Hexacorals	8	235.8 ± 112	51.2
<i>Corallium rubrum</i>	Octocorals	2	2.0 ± 0.3	0.12
Hard substrate	Boulders	1	1091 ± 0	28.6
Not readable background				20.0

Benthic community: Antarctic benthos

Species list and bare substrate	Benthic category/functional group	NP	MPA (cm ²)	CA (%)
<i>Rossella nuda</i>	Hexactinellids	3	5359.3 ± 2365.2	12.8
<i>Cinachyra barbata</i>	Demosponges	19	1670.4 ± 386.5	23.5
<i>Cinachyra antarctica</i>	Demosponges	8	375.3 ± 93.5	2.0
Yellow branches	Demosponges	14	212.7 ± 54.3	2.0
<i>Notisis</i> sp.	Octocorals	1	380 ± 0	0.2
<i>Primnoisis antarctica</i>	Octocorals	5	127.8 ± 32.6	0.4
<i>Primnoisis formosa</i>	Octocorals	1	316 ± 0	0.2
<i>Thouarella</i> sp.1	Octocorals	1	432 ± 0	0.3
<i>Camptoplites lewaldii</i>	Bryozoans	1	930 ± 0	0.6
<i>Cellaria incula</i>	Bryozoans	8	2916 ± 1883.9	15.8
<i>Cellarinella</i> spp.	Bryozoans	3	335.3 ± 170.5	0.8
<i>Paracellaria wandeli</i>	Bryozoans	1	251 ± 0	0.2
<i>Myxicola</i> cf. <i>sulcata</i>	Polychaetes	1	127 ± 0	0.1
<i>Dendrochirotida</i> sp.1	Holothurians	1	281 ± 0	0.2
<i>Polysyncraton trivolutum</i>	Tunicates	3	783.3 ± 410	1.6
Synascidia family 1	Tunicates	1	636 ± 0	0.4
<i>Synoicum adareanum</i>	Tunicates	7	143.1 ± 24.9	0.7
Thin bryozoan complex	Complex	5	7896.6 ± 4192.1	16.1
Demosponge complex	Complex	3	5538.6 ± 4278.8	2.7
Thin and rigid bryozoan complex	Complex	16	1700.8 ± 781.8	14.4
Filamentous gorgonian complex	Complex	3	2387 ± 1511.5	4.8