



App Physics

157

ACTIVITY 3 REPORT
Abdel Jalal D. Sinapilo

Background ImageJ



According to the US National Institute of Health, the developer of ImageJ:

"ImageJ is a public domain Java image processing program. It can display, edit, analyze, process, save and print 8-bit, 16-bit and 32-bit images. It can read many image formats including TIFF, GIF, JPEG, BMP, DICOM, FITS and "raw". It supports "stacks", a series of images that share a single window. It is multithreaded, so time-consuming operations such as image file reading can be performed in parallel with other operations.

It can calculate area and pixel value statistics of user-defined selections. It can measure distances and angles. It can create density histograms and line profile plots. It supports standard image processing functions such as contrast manipulation, sharpening, smoothing, edge detection and median filtering.

It does geometric transformations such as scaling, rotation and flips. Image can be zoomed up to 32:1 and down to 1:32. All analysis and processing functions are available at any magnification factor. The program supports any number of windows (images) simultaneously, limited only by available memory. Spatial calibration is available to provide real world dimensional measurements in units such as millimeters. Density or gray scale calibration is also available."

Objective

1. Assemble different objects of different shapes, or texture.
2. Take a picture of them on a plain background.
3. Extract their properties using ImageJ.

Examples of objects for feature extraction:

- Coins
- Electronic components
- Candies
- Rice grains
- etc.

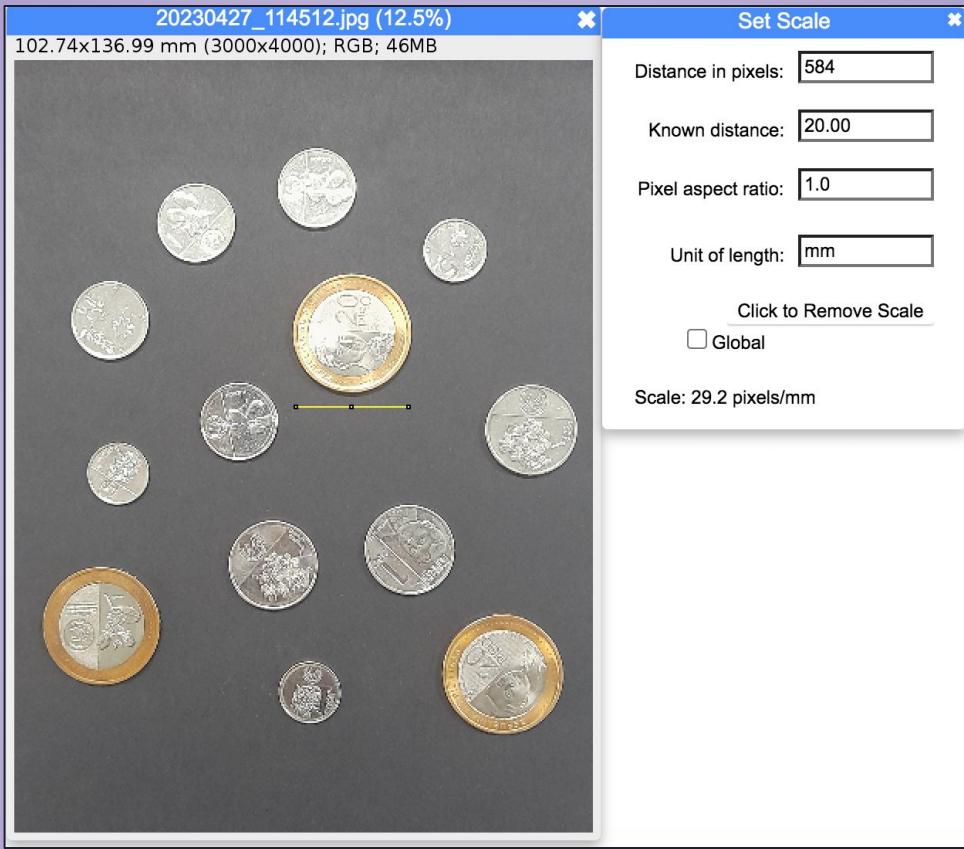
Results & Analysis

Coins

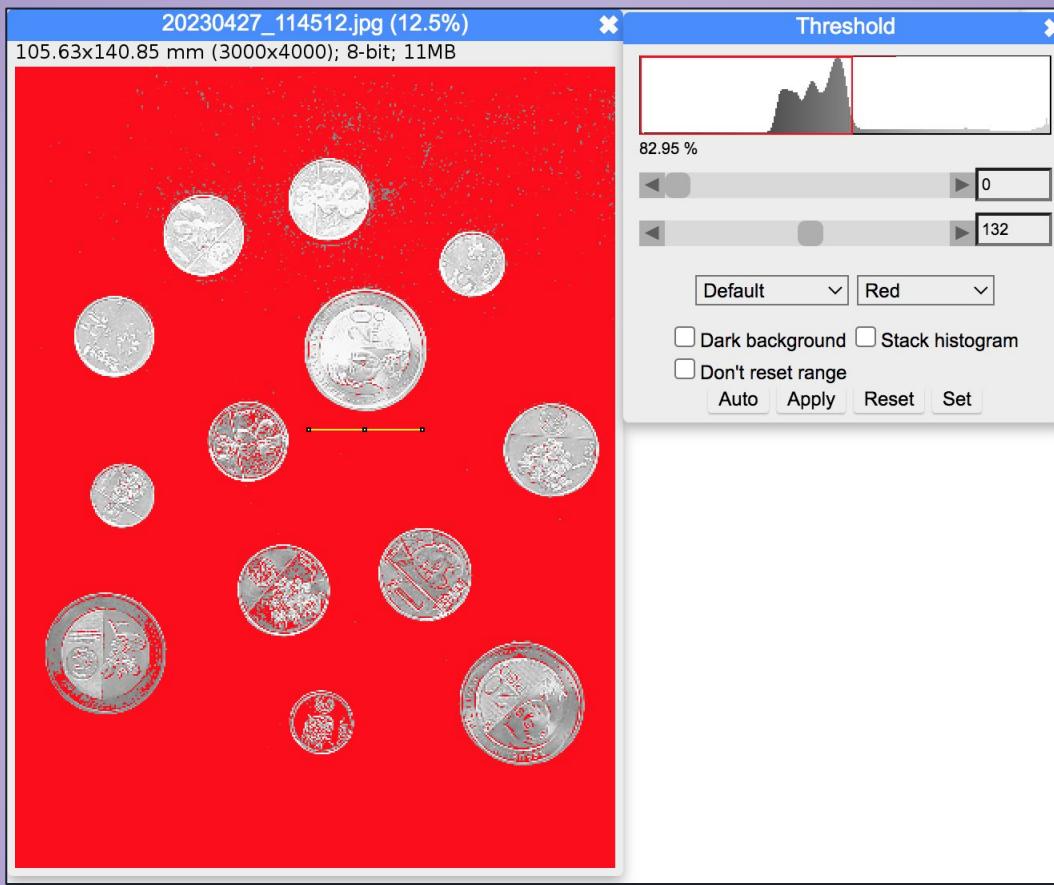


COINS

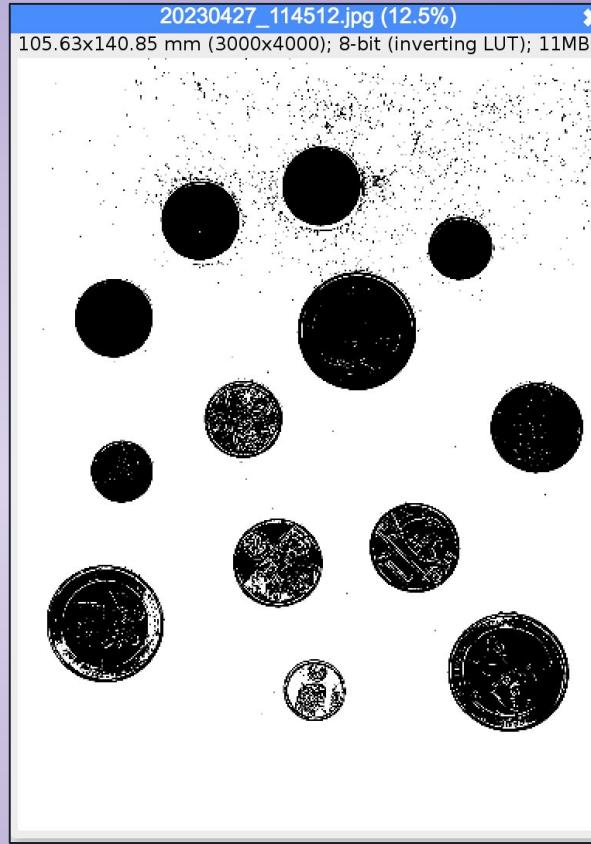
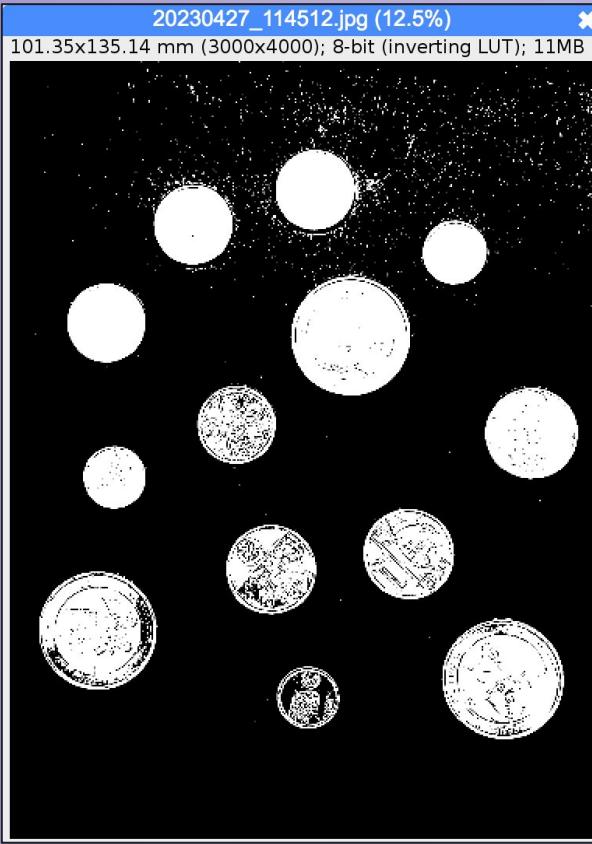




SCALING



THRESHOLDING



BINARIZATION

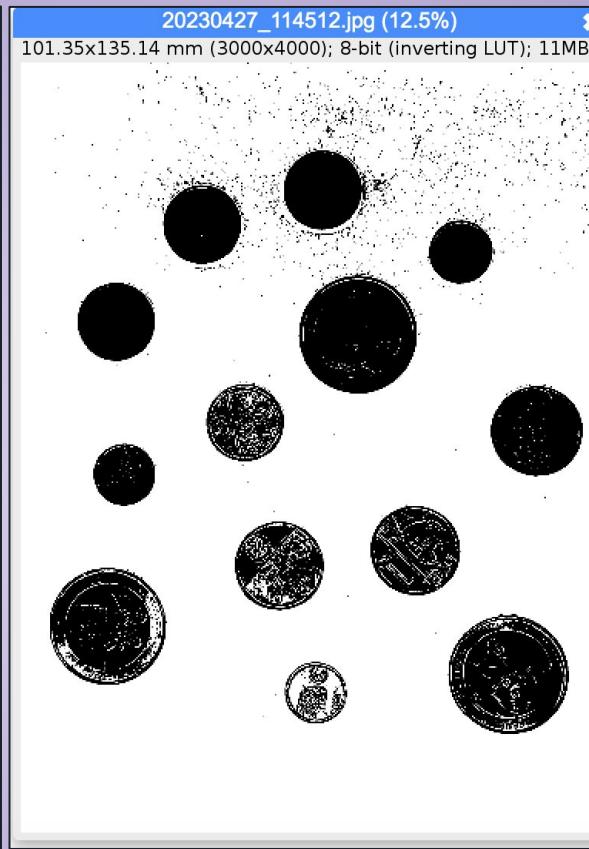
Set Measurements

Area Mean gray value
 Standard deviation Modal gray value
 Min & max gray value Centroid
 Center of mass Perimeter
 Bounding rectangle Fit ellipse
 Shape descriptors Feret's diameter
 Integrated density Median
 Skewness Kurtosis
 Area fraction Stack position

Limit to threshold Display label
 Invert Y coordinates Scientific notation
 Add to overlay NaN empty cells

Redirect to:

Decimal places (0-9):



Analyze Particles

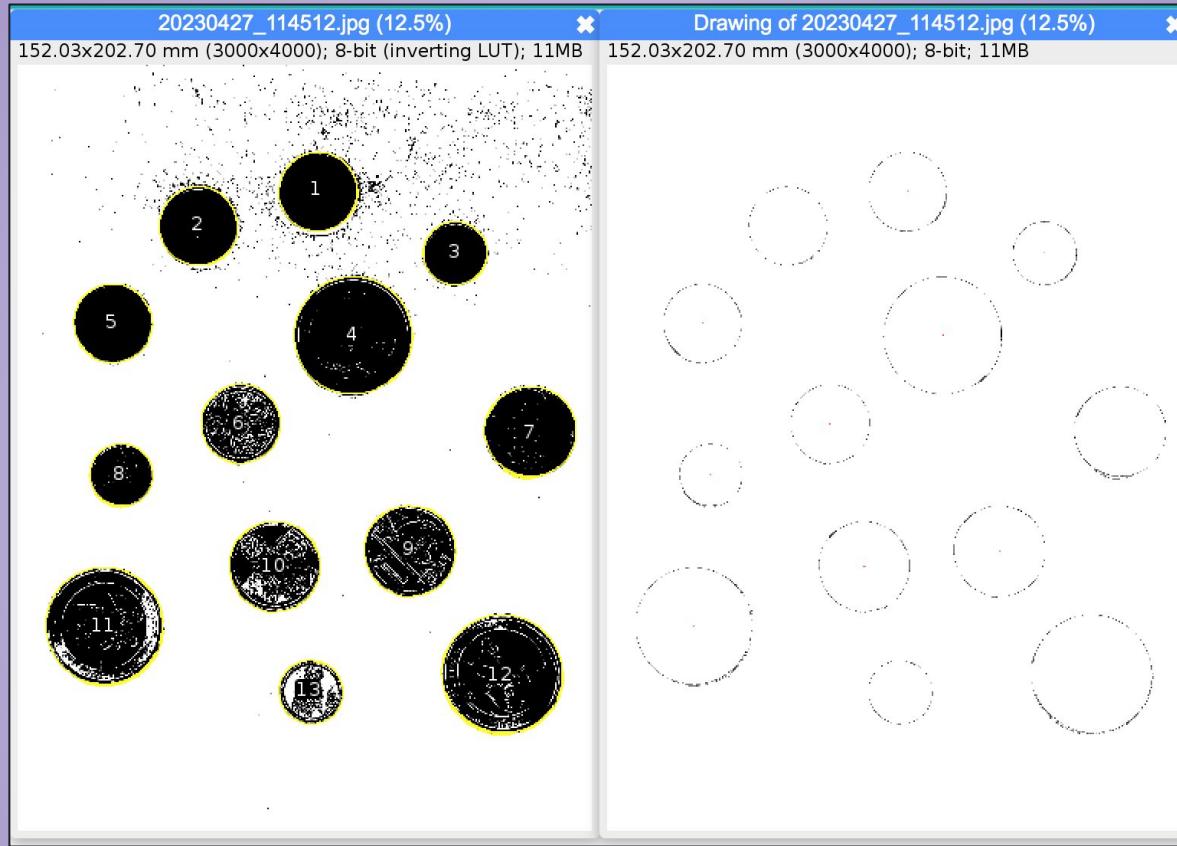
Size (mm²):
 Pixel units

Circularity:

Show:

Display results Exclude on edges
 Clear results Include holes
 Summarize Overlay
 Add to Manager Composite ROIs

SETTING MEASUREMENTS AND ANALYSIS



RESULTS (Initial)

Results

File Edit Font Results

| | Label | Area | X | Y | XM | YM | Circ. | AR | Round | Solidity |
|----|---------------------|---------|--------|---------|--------|---------|-------|-------|-------|----------|
| 1 | 20230427_114512.jpg | 154.591 | 53.708 | 22.695 | 53.704 | 22.710 | 0.895 | 1.015 | 0.985 | 0.993 |
| 2 | 20230427_114512.jpg | 152.799 | 32.288 | 28.819 | 32.291 | 28.840 | 0.894 | 1.011 | 0.989 | 0.993 |
| 3 | 20230427_114512.jpg | 100.550 | 78.274 | 33.698 | 78.272 | 33.732 | 0.896 | 1.014 | 0.986 | 0.992 |
| 4 | 20230427_114512.jpg | 346.802 | 59.992 | 48.403 | 59.979 | 48.454 | 0.899 | 1.008 | 0.992 | 0.995 |
| 5 | 20230427_114512.jpg | 150.658 | 16.982 | 46.130 | 16.983 | 46.145 | 0.865 | 1.006 | 0.994 | 0.990 |
| 6 | 20230427_114512.jpg | 149.138 | 39.896 | 64.078 | 39.827 | 64.146 | 0.896 | 1.004 | 0.996 | 0.993 |
| 7 | 20230427_114512.jpg | 205.373 | 91.810 | 65.564 | 91.815 | 65.564 | 0.895 | 1.022 | 0.979 | 0.994 |
| 8 | 20230427_114512.jpg | 95.007 | 18.445 | 73.306 | 18.454 | 73.367 | 0.898 | 1.001 | 0.999 | 0.992 |
| 9 | 20230427_114512.jpg | 200.517 | 70.209 | 86.824 | 70.225 | 86.846 | 0.897 | 1.012 | 0.988 | 0.994 |
| 10 | 20230427_114512.jpg | 196.420 | 45.988 | 89.550 | 46.046 | 89.412 | 0.893 | 1.008 | 0.992 | 0.994 |
| 11 | 20230427_114512.jpg | 339.763 | 15.464 | 100.307 | 15.069 | 99.853 | 0.882 | 1.006 | 0.994 | 0.995 |
| 12 | 20230427_114512.jpg | 354.462 | 86.782 | 108.890 | 86.828 | 108.947 | 0.895 | 1.025 | 0.976 | 0.995 |
| 13 | 20230427_114512.jpg | 95.032 | 52.476 | 112.120 | 52.484 | 112.364 | 0.896 | 1.015 | 0.985 | 0.992 |

Summary

File Edit Font

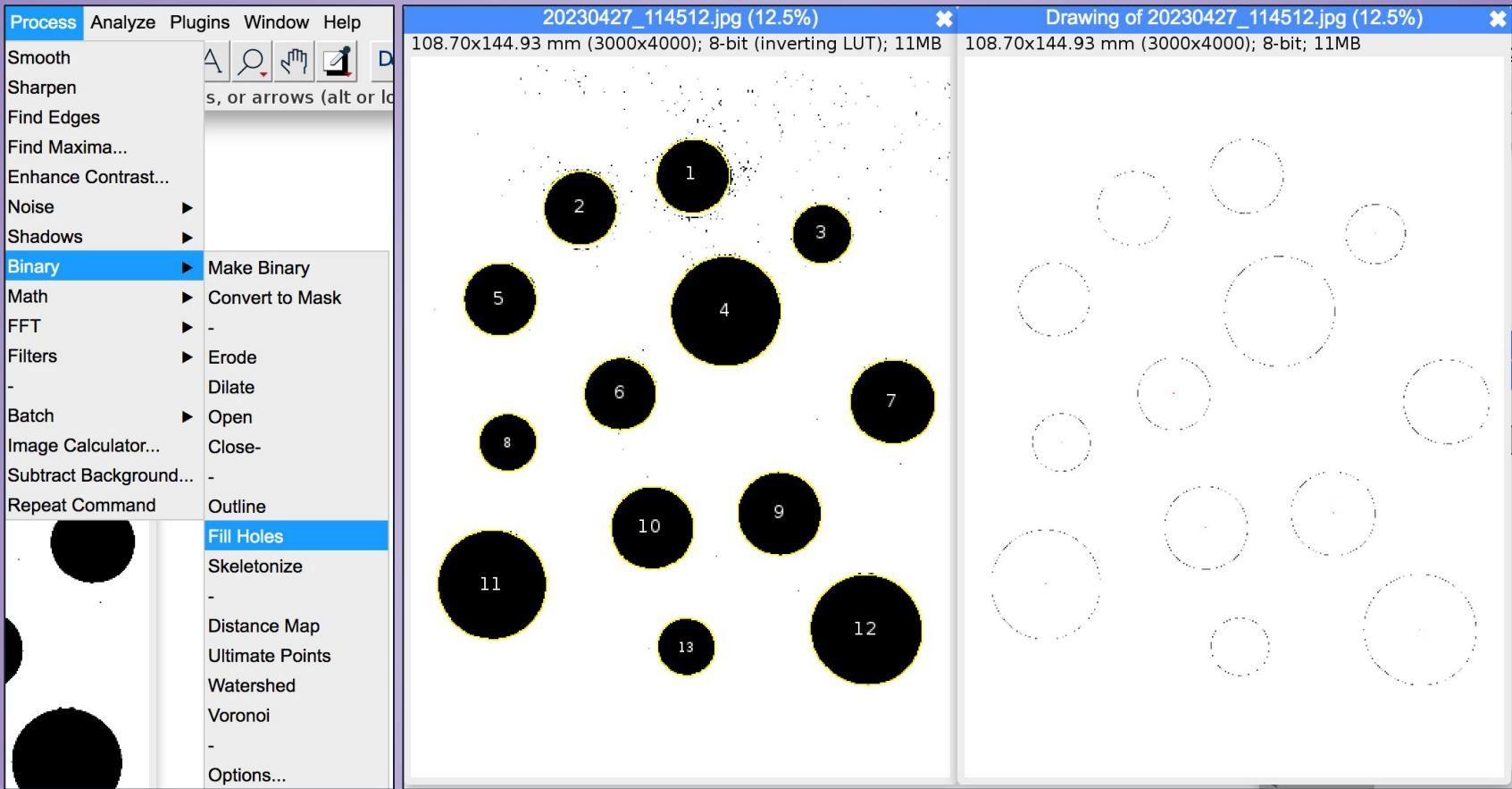
| Slice | Count | Total Area | Average Size | %Area | Circ. | Solidity |
|---------------------|-------|------------|--------------|--------|-------|----------|
| 20230427_114512.jpg | 13 | 2541.112 | 195.470 | 18.059 | 0.892 | 0.993 |

ROI Manager

- 0001-0662
- 0002-0841
- 0003-0984
- 0004-1413
- 0005-1347
- 0006-1871
- 0007-1915
- 0008-2140
- 0009-2535
- 0010-2615
- 0011-2929
- 0012-3180
- 0013-3274

Add [t]
Update
Delete
Rename...
Measure
Deselect
Properties...
Flatten [F]
More »
 Show All
 Labels

RESULTS (Initial)



RESULTS (After using Binary -> Fill Holes)

Results

File Edit Font Results

| | Label | Area | X | Y | XM | YM | Circ. | AR | Round | Solidity |
|----|---------------------|---------|--------|---------|--------|---------|-------|-------|-------|----------|
| 1 | 20230427_114512.jpg | 173.066 | 56.827 | 24.013 | 56.827 | 24.013 | 0.895 | 1.015 | 0.985 | 0.993 |
| 2 | 20230427_114512.jpg | 171.060 | 34.163 | 30.492 | 34.163 | 30.492 | 0.894 | 1.011 | 0.989 | 0.993 |
| 3 | 20230427_114512.jpg | 112.567 | 82.819 | 35.655 | 82.819 | 35.655 | 0.896 | 1.014 | 0.986 | 0.992 |
| 4 | 20230427_114512.jpg | 388.250 | 63.476 | 51.213 | 63.476 | 51.213 | 0.899 | 1.008 | 0.992 | 0.995 |
| 5 | 20230427_114512.jpg | 168.663 | 17.968 | 48.809 | 17.968 | 48.809 | 0.865 | 1.006 | 0.994 | 0.990 |
| 6 | 20230427_114512.jpg | 166.962 | 42.213 | 67.799 | 42.213 | 67.799 | 0.896 | 1.004 | 0.996 | 0.993 |
| 7 | 20230427_114512.jpg | 229.918 | 97.141 | 69.372 | 97.141 | 69.372 | 0.895 | 1.022 | 0.979 | 0.994 |
| 8 | 20230427_114512.jpg | 106.362 | 19.517 | 77.563 | 19.517 | 77.563 | 0.898 | 1.001 | 0.999 | 0.992 |
| 9 | 20230427_114512.jpg | 224.481 | 74.286 | 91.866 | 74.286 | 91.866 | 0.897 | 1.012 | 0.988 | 0.994 |
| 10 | 20230427_114512.jpg | 219.895 | 48.659 | 94.750 | 48.659 | 94.750 | 0.893 | 1.008 | 0.992 | 0.994 |
| 11 | 20230427_114512.jpg | 380.369 | 16.362 | 106.132 | 16.362 | 106.132 | 0.882 | 1.006 | 0.994 | 0.995 |
| 12 | 20230427_114512.jpg | 396.824 | 91.821 | 115.214 | 91.821 | 115.214 | 0.895 | 1.025 | 0.976 | 0.995 |
| 13 | 20230427_114512.jpg | 106.389 | 55.523 | 118.631 | 55.523 | 118.631 | 0.896 | 1.015 | 0.985 | 0.992 |

Summary

File Edit Font

| Slice | Count | Total Area | Average Size | %Area | Circ. | Solidity |
|---------------------|-------|------------|--------------|--------|-------|----------|
| 20230427_114512.jpg | 13 | 2844.807 | 218.831 | 18.059 | 0.892 | 0.993 |

ROI Manager

- 0001-0662
- 0002-0841
- 0003-0984
- 0004-1413
- 0005-1347
- 0006-1871
- 0007-1915
- 0008-2140
- 0009-2535
- 0010-2615
- 0011-2929
- 0012-3180
- 0013-3274

- Add [I]
- Update
- Delete
- Rename...
- Measure
- Deselect
- Properties...
- Flatten [F]
- More »
- Show All
- Labels

RESULTS (After using Binary -> Fill Holes)

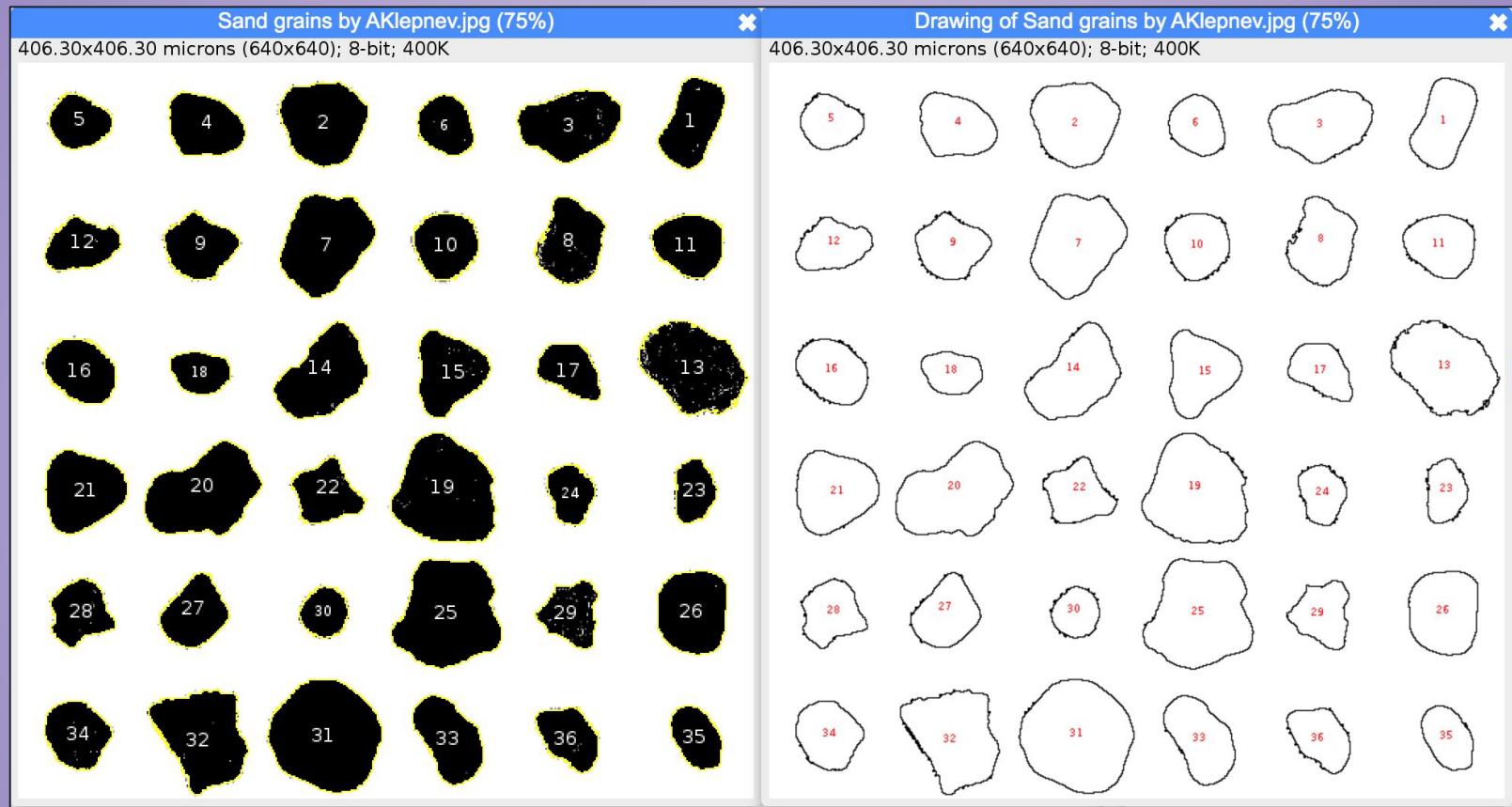
Results & Analysis

Sand Grains

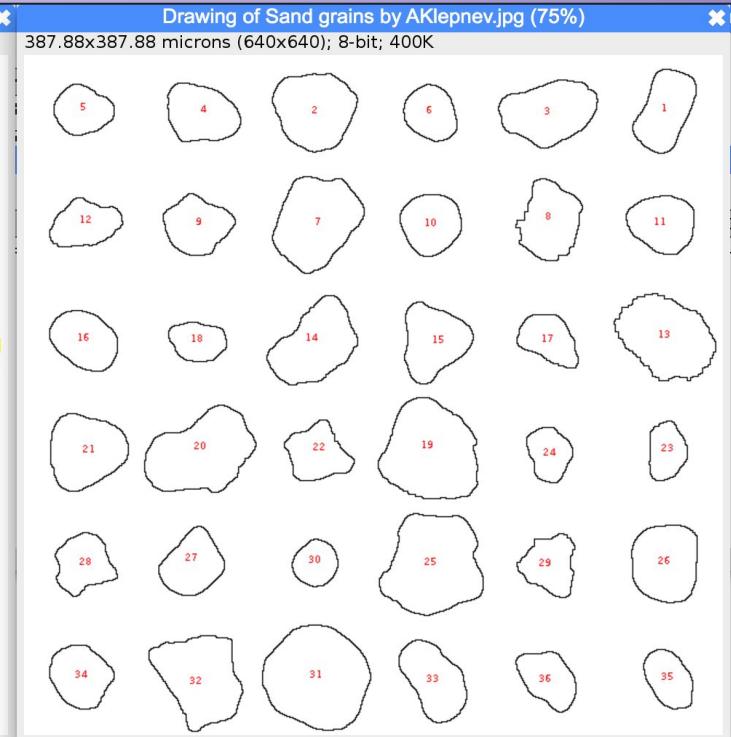
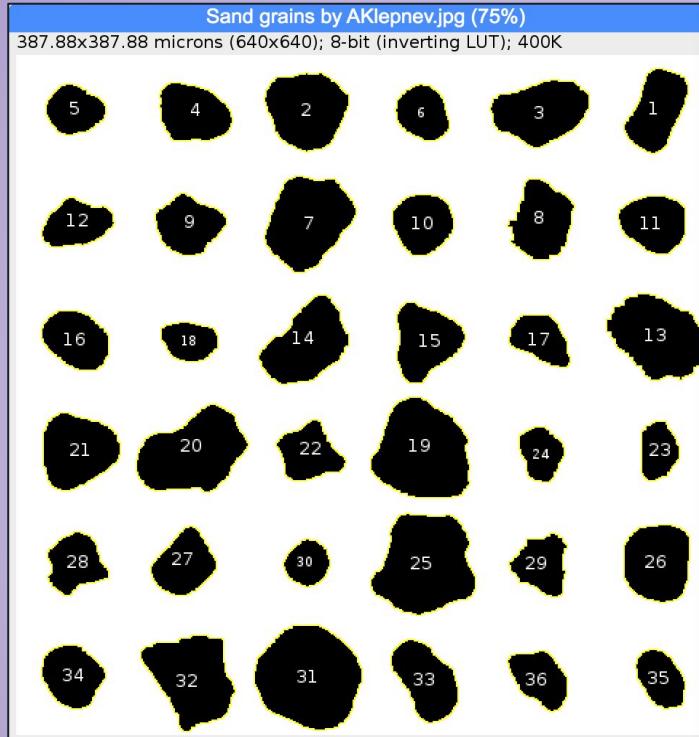
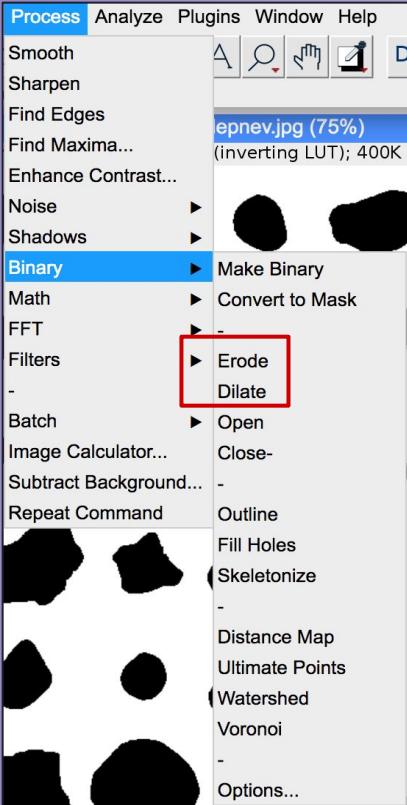


SAND GRAINS

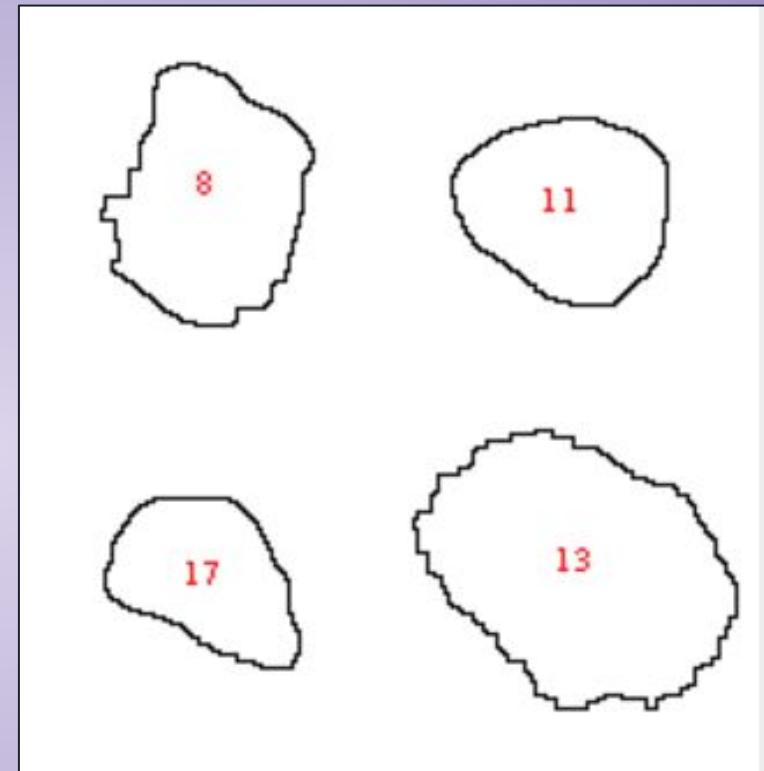
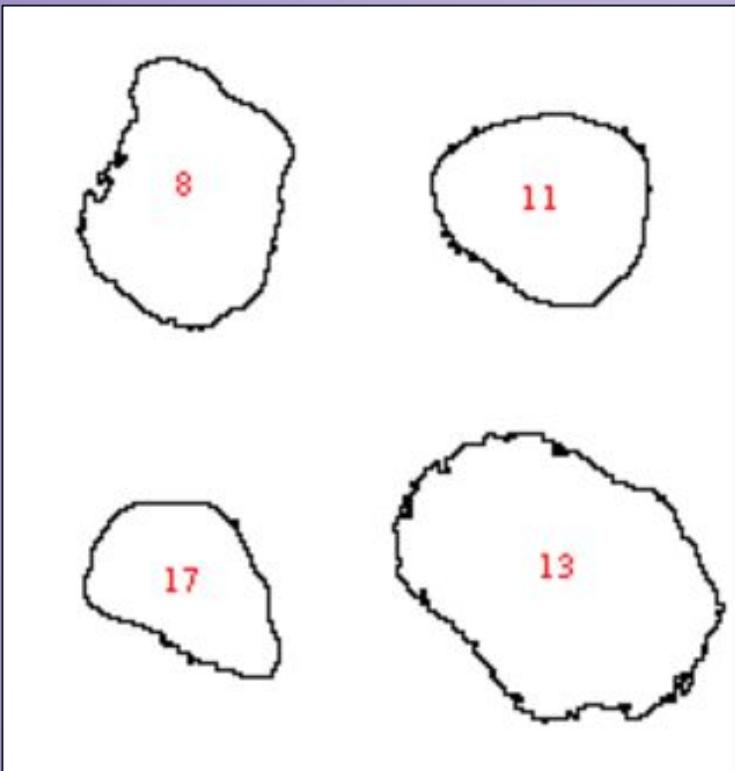




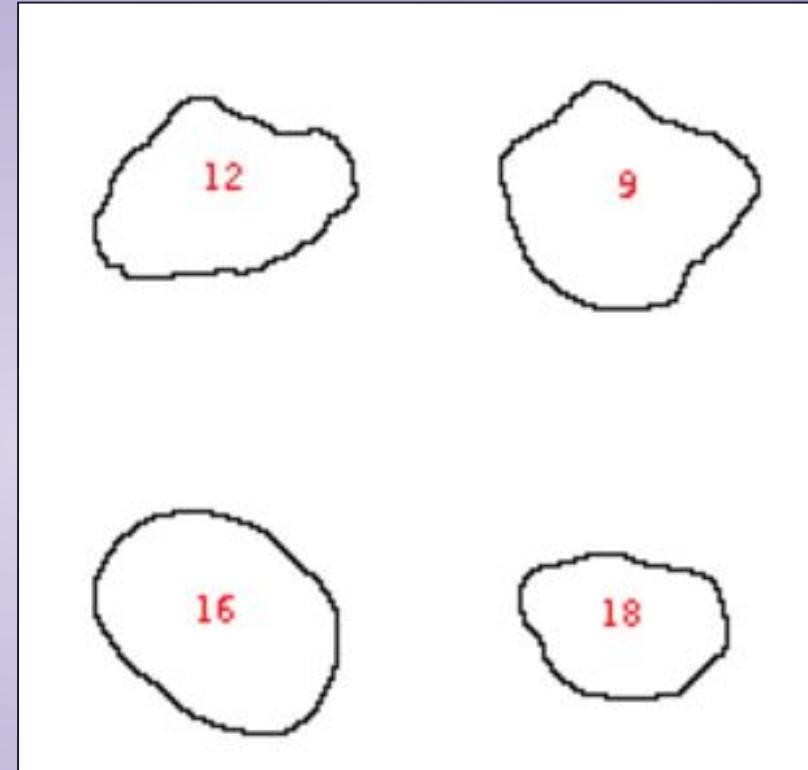
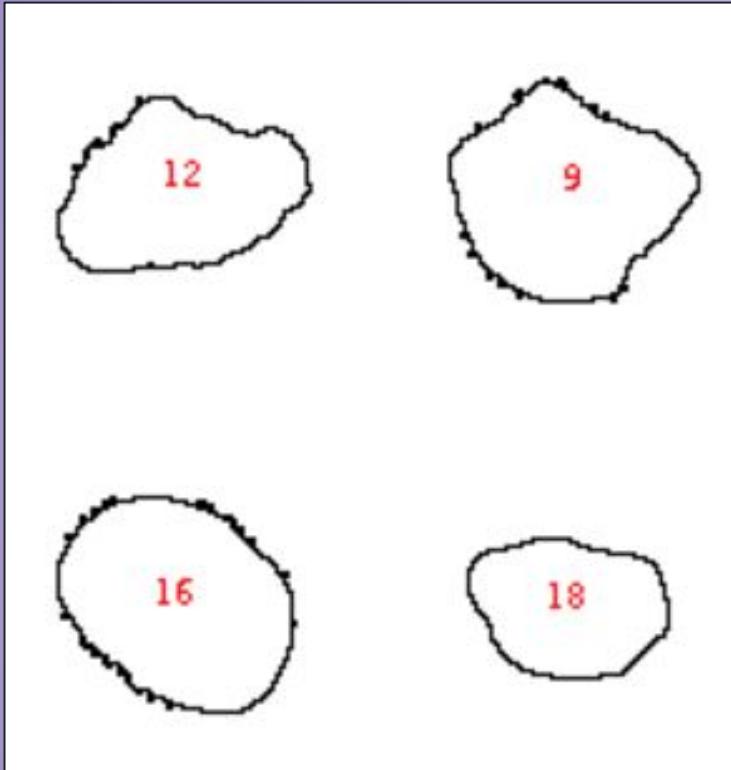
RESULTS (Initial)



RESULTS (After using Binary -> Erode-Dilate)



RESULTS (Without vs With Erosion-Dilation)



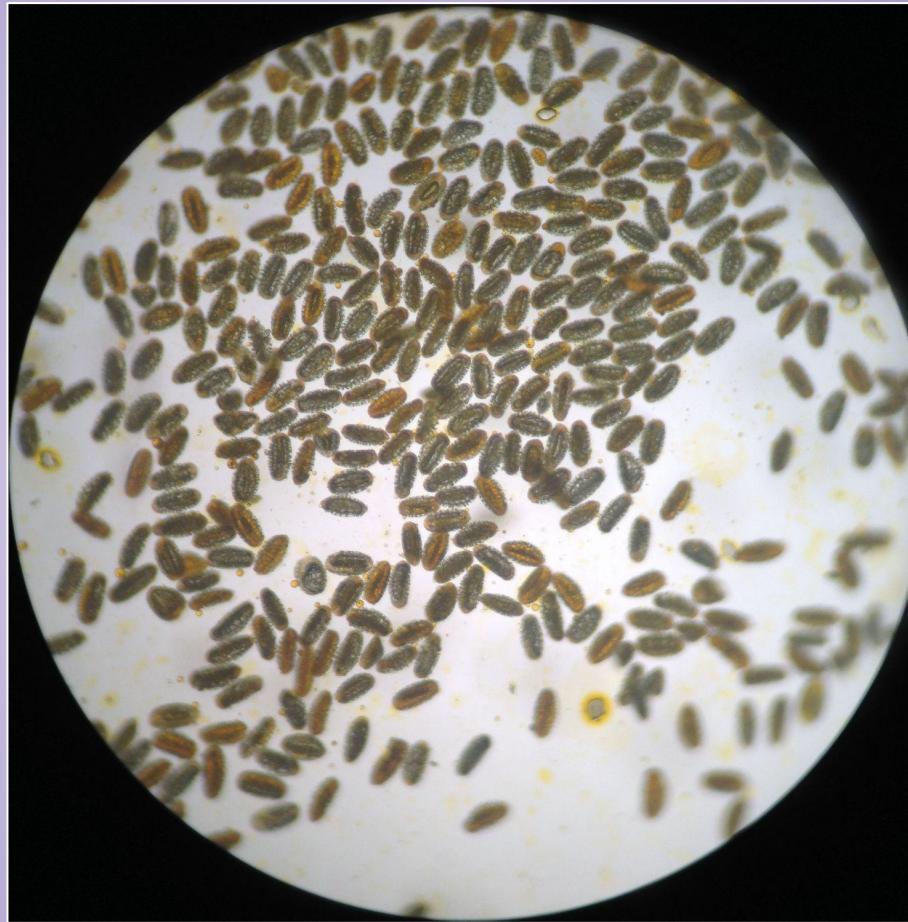
RESULTS (Without vs With Erosion-Dilation)

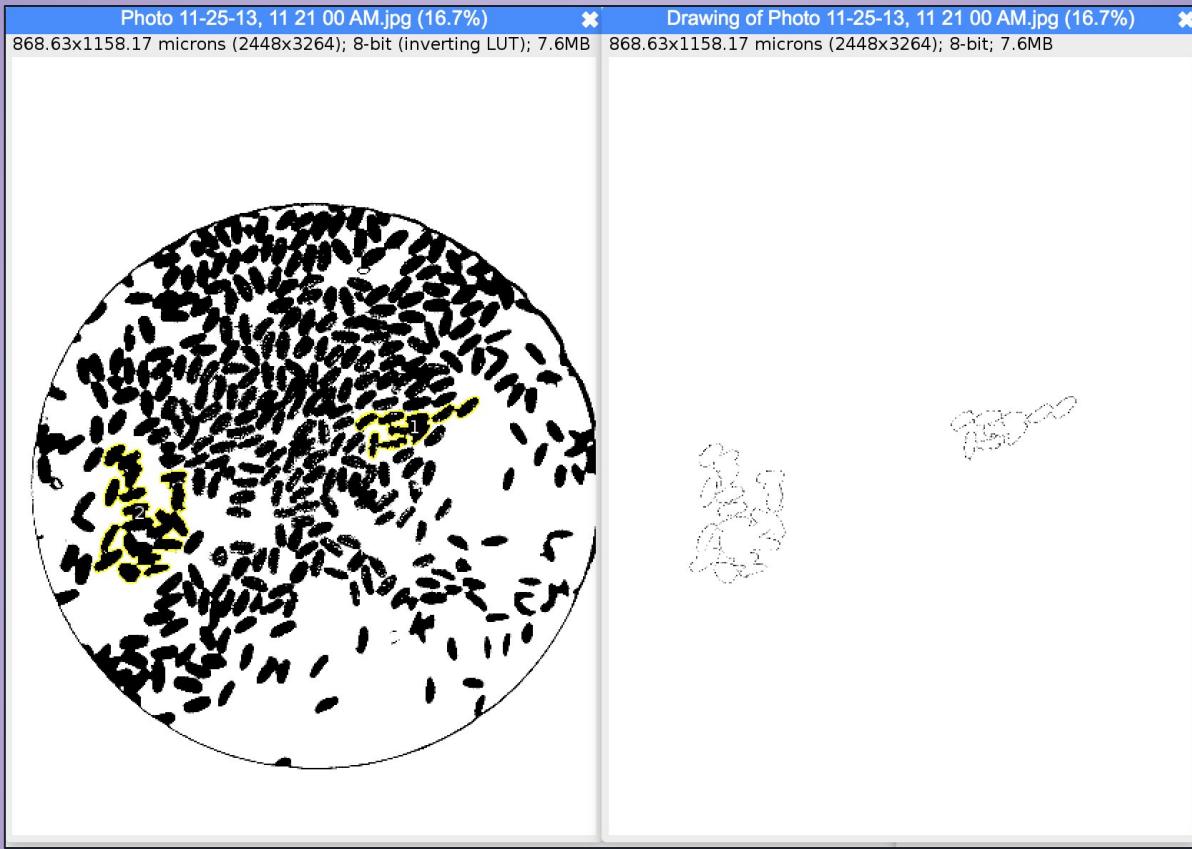
Results & Analysis

Pollen Grains



POLLEN GRAINS





RESULTS (Initial)

Results

File Edit Font Results

| | Label | Area | X | Y | XM | YM | Circ. | AR | Round | Solidity |
|---|---------------------------------|-----------|---------|---------|---------|---------|-------|-------|-------|----------|
| 1 | Photo 11-25-13, 11 21 00 AM.jpg | 5177.211 | 591.242 | 547.296 | 591.254 | 547.147 | 0.057 | 3.266 | 0.306 | 0.565 |
| 2 | Photo 11-25-13, 11 21 00 AM.jpg | 13935.788 | 191.378 | 687.471 | 191.115 | 686.822 | 0.045 | 1.512 | 0.662 | 0.593 |

Summary

File Edit Font

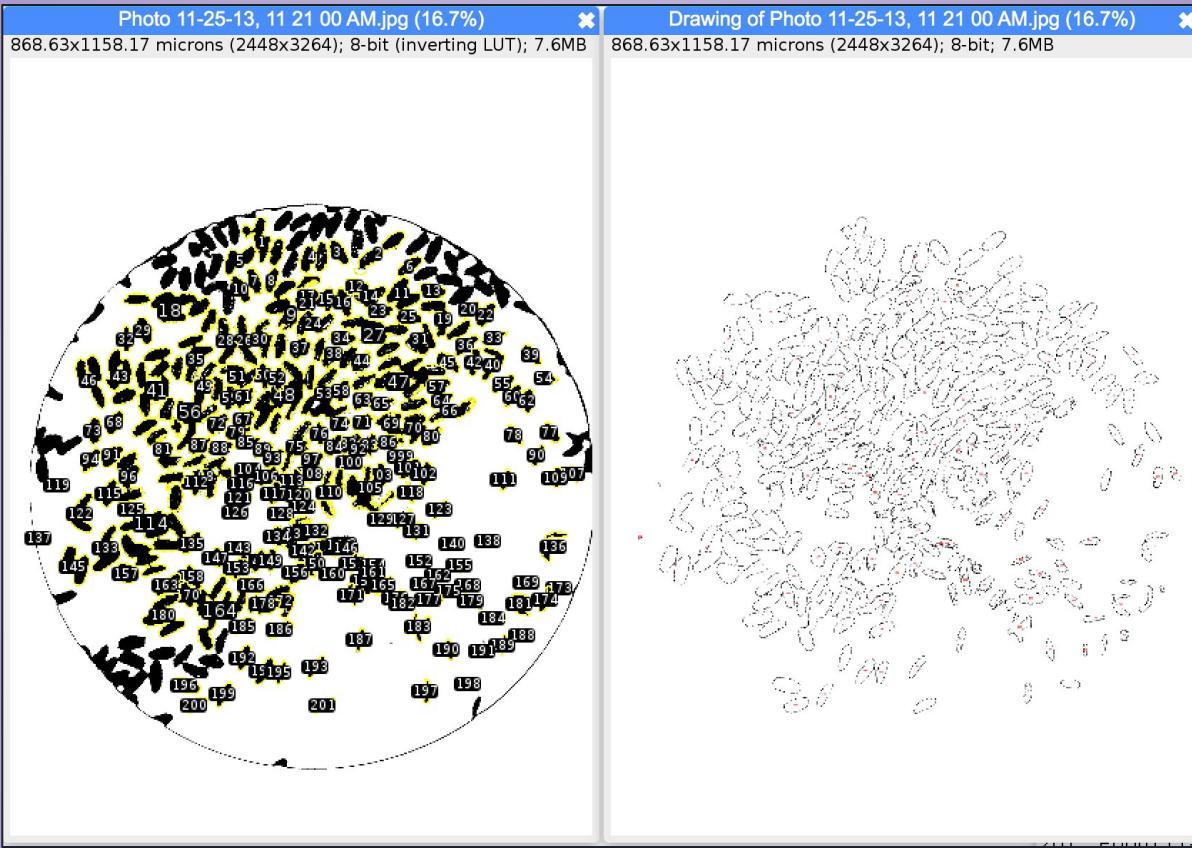
| Slice | Count | Total Area | Average Size | %Area | Circ. | Solidity |
|---------------------------------|-------|------------|--------------|-------|-------|----------|
| Photo 11-25-13, 11 21 00 AM.jpg | 2 | 19113.000 | 9556.500 | 1.900 | 0.051 | 0.579 |

ROI Manager

0001-1555
0002-1914

- Add [t]
- Update
- Delete
- Rename...
- Measure
- Deselect
- Properties...
- Flatten [F]
- More »
- Show All
- Labels

RESULTS (Initial)



RESULTS (After adjusting threshold)

Results

File Edit Font Results

| | Label | Area | X | Y | XM | YM | Circ. | AR | Round | Solidity |
|-----|---------------------------------|---------|---------|---------|---------|---------|-------|-------|-------|----------|
| 186 | Photo 11-25-13, 11 21 00 AM.jpg | 523.009 | 403.624 | 850.915 | 403.547 | 850.840 | 0.314 | 2.485 | 0.402 | 0.894 |
| 187 | Photo 11-25-13, 11 21 00 AM.jpg | 261.505 | 522.378 | 865.906 | 522.365 | 865.960 | 0.197 | 3.838 | 0.261 | 0.746 |
| 188 | Photo 11-25-13, 11 21 00 AM.jpg | 147.309 | 765.683 | 859.712 | 765.673 | 859.747 | 0.257 | 1.346 | 0.743 | 0.797 |
| 189 | Photo 11-25-13, 11 21 00 AM.jpg | 158.137 | 735.934 | 872.907 | 735.938 | 872.876 | 0.264 | 4.579 | 0.218 | 0.821 |
| 190 | Photo 11-25-13, 11 21 00 AM.jpg | 254.454 | 655.176 | 881.518 | 655.185 | 881.522 | 0.385 | 2.967 | 0.337 | 0.878 |
| 191 | Photo 11-25-13, 11 21 00 AM.jpg | 83.853 | 707.720 | 881.572 | 707.716 | 881.543 | 0.327 | 3.260 | 0.307 | 0.813 |
| 192 | Photo 11-25-13, 11 21 00 AM.jpg | 455.902 | 349.460 | 892.456 | 349.461 | 892.457 | 0.467 | 2.797 | 0.358 | 0.915 |
| 193 | Photo 11-25-13, 11 21 00 AM.jpg | 356.437 | 456.847 | 906.558 | 456.857 | 906.560 | 0.371 | 3.613 | 0.277 | 0.885 |
| 194 | Photo 11-25-13, 11 21 00 AM.jpg | 572.364 | 379.903 | 913.059 | 379.902 | 913.068 | 0.419 | 2.891 | 0.346 | 0.906 |
| 195 | Photo 11-25-13, 11 21 00 AM.jpg | 375.700 | 403.677 | 914.789 | 403.829 | 914.968 | 0.289 | 2.466 | 0.405 | 0.826 |
| 196 | Photo 11-25-13, 11 21 00 AM.jpg | 749.764 | 262.161 | 934.569 | 262.155 | 934.563 | 0.505 | 2.075 | 0.482 | 0.942 |
| 197 | Photo 11-25-13, 11 21 00 AM.jpg | 265.785 | 622.060 | 944.354 | 622.051 | 944.434 | 0.281 | 3.433 | 0.291 | 0.836 |
| 198 | Photo 11-25-13, 11 21 00 AM.jpg | 289.455 | 685.910 | 932.141 | 685.903 | 932.134 | 0.526 | 2.283 | 0.438 | 0.926 |
| 199 | Photo 11-25-13, 11 21 00 AM.jpg | 417.753 | 318.562 | 947.708 | 318.574 | 947.699 | 0.405 | 3.222 | 0.310 | 0.900 |
| 200 | Photo 11-25-13, 11 21 00 AM.jpg | 569.846 | 276.852 | 963.721 | 276.867 | 963.711 | 0.482 | 2.083 | 0.480 | 0.921 |
| 201 | Photo 11-25-13, 11 21 00 AM.jpg | 408.687 | 467.901 | 963.799 | 467.902 | 963.801 | 0.435 | 2.566 | 0.390 | 0.909 |

Summary

File Edit Font

| Slice | Count | Total Area | Average Size | %Area | Circ. | Solidity |
|---------------------------------|-------|------------|--------------|--------|-------|----------|
| Photo 11-25-13, 11 21 00 AM.jpg | 201 | 144513.314 | 718.972 | 14.365 | 0.288 | 0.783 |

ROI Manager

- 0001-0770
- 0002-0818
- 0003-0816
- 0004-0837
- 0005-0851
- 0006-0874
- 0007-0937
- 0008-0934
- 0009-1088
- 0010-0969
- 0011-0989
- 0012-0956
- 0013-0976

- Add [t]
- Update
- Delete
- Rename...
- Measure
- Deselect
- Properties...
- Flatten [F]
- More »
- Show All
- Labels

RESULTS (After adjusting threshold)

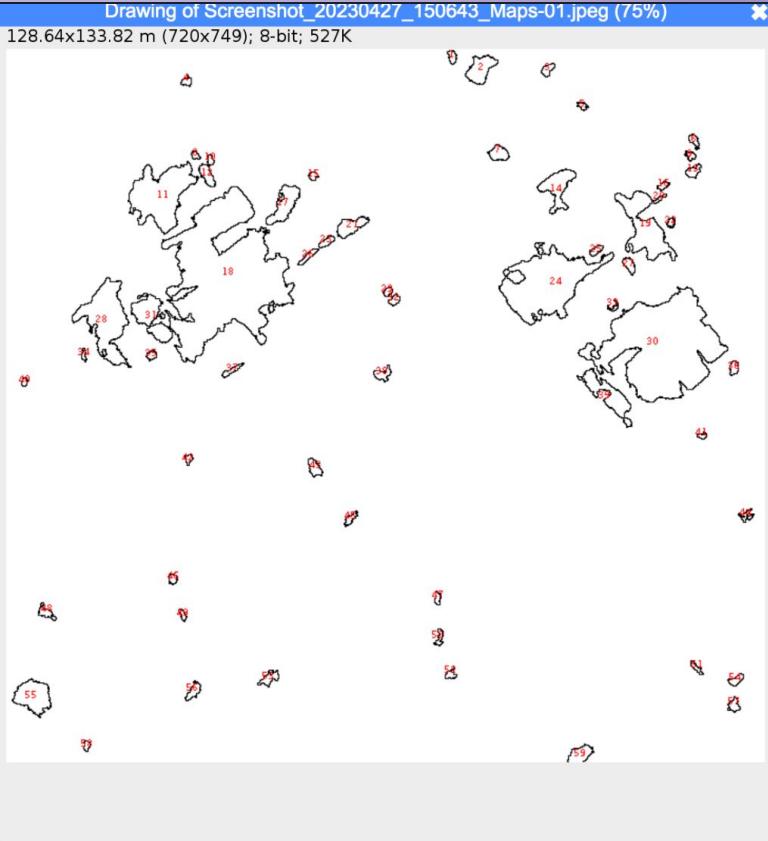
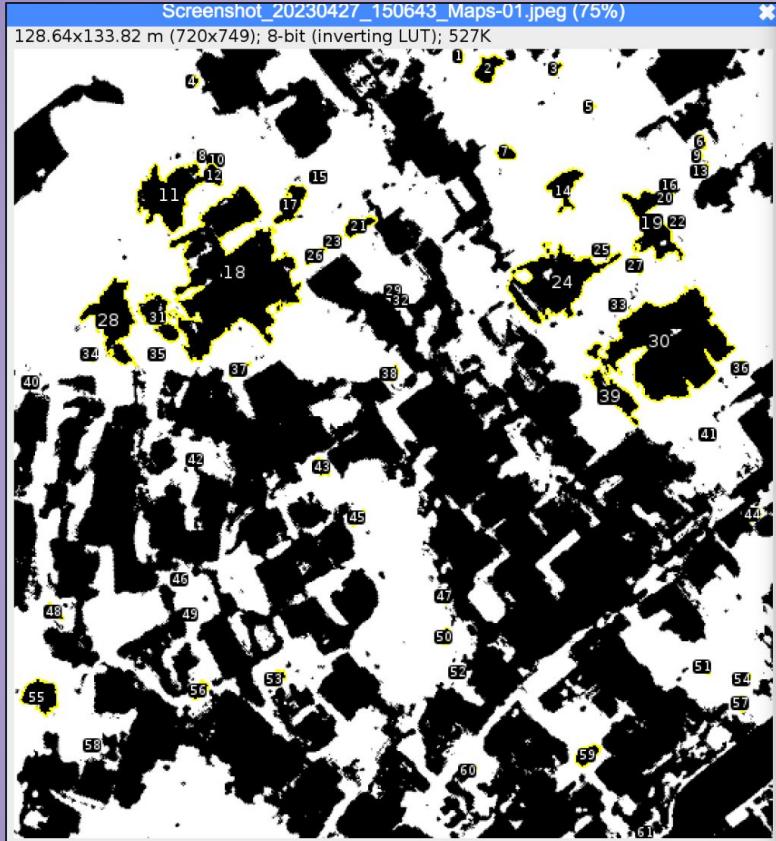
Results & Analysis

Google Maps



GOOGLE MAPS





RESULTS (Initial)

Results

File Edit Font Results

| | Label | Area | X | Y | XM | YM | Circ. | AR | Round | Solidity |
|----|---|--------|---------|---------|---------|---------|-------|-------|-------|----------|
| 46 | Screenshot_20230427_150643_Maps-01.jpeg | 1.915 | 28.154 | 89.614 | 28.154 | 89.614 | 0.674 | 1.248 | 0.801 | 0.833 |
| 47 | Screenshot_20230427_150643_Maps-01.jpeg | 1.660 | 73.056 | 92.901 | 73.056 | 92.901 | 0.527 | 2.289 | 0.437 | 0.794 |
| 48 | Screenshot_20230427_150643_Maps-01.jpeg | 3.511 | 6.667 | 95.344 | 6.674 | 95.341 | 0.352 | 2.157 | 0.464 | 0.679 |
| 49 | Screenshot_20230427_150643_Maps-01.jpeg | 1.468 | 29.829 | 95.697 | 29.829 | 95.697 | 0.584 | 2.518 | 0.397 | 0.786 |
| 50 | Screenshot_20230427_150643_Maps-01.jpeg | 2.075 | 73.379 | 99.574 | 73.379 | 99.574 | 0.343 | 2.821 | 0.354 | 0.602 |
| 51 | Screenshot_20230427_150643_Maps-01.jpeg | 1.724 | 116.878 | 104.646 | 116.878 | 104.646 | 0.438 | 3.861 | 0.259 | 0.701 |
| 52 | Screenshot_20230427_150643_Maps-01.jpeg | 2.043 | 75.267 | 105.793 | 75.267 | 105.793 | 0.517 | 1.264 | 0.791 | 0.719 |
| 53 | Screenshot_20230427_150643_Maps-01.jpeg | 4.501 | 44.537 | 106.429 | 44.544 | 106.427 | 0.336 | 2.091 | 0.478 | 0.667 |
| 54 | Screenshot_20230427_150643_Maps-01.jpeg | 2.905 | 123.661 | 106.719 | 123.661 | 106.719 | 0.669 | 2.106 | 0.475 | 0.791 |
| 55 | Screenshot_20230427_150643_Maps-01.jpeg | 25.408 | 4.510 | 109.508 | 4.518 | 109.490 | 0.514 | 1.200 | 0.834 | 0.854 |
| 56 | Screenshot_20230427_150643_Maps-01.jpeg | 3.990 | 31.678 | 108.633 | 31.674 | 108.644 | 0.444 | 2.428 | 0.412 | 0.733 |
| 57 | Screenshot_20230427_150643_Maps-01.jpeg | 3.128 | 123.281 | 111.011 | 123.281 | 111.011 | 0.513 | 1.222 | 0.818 | 0.731 |
| 58 | Screenshot_20230427_150643_Maps-01.jpeg | 1.404 | 13.570 | 117.848 | 13.576 | 117.861 | 0.794 | 1.752 | 0.571 | 0.838 |
| 59 | Screenshot_20230427_150643_Maps-01.jpeg | 9.768 | 97.117 | 119.523 | 97.117 | 119.523 | 0.642 | 1.734 | 0.577 | 0.857 |
| 60 | Screenshot_20230427_150643_Maps-01.jpeg | 2.266 | 77.088 | 121.909 | 77.124 | 121.908 | 0.656 | 2.024 | 0.494 | 0.826 |
| 61 | Screenshot_20230427_150643_Maps-01.jpeg | 1.053 | 107.178 | 132.640 | 107.178 | 132.640 | 0.747 | 1.226 | 0.816 | 0.846 |

Summary

File Edit Font

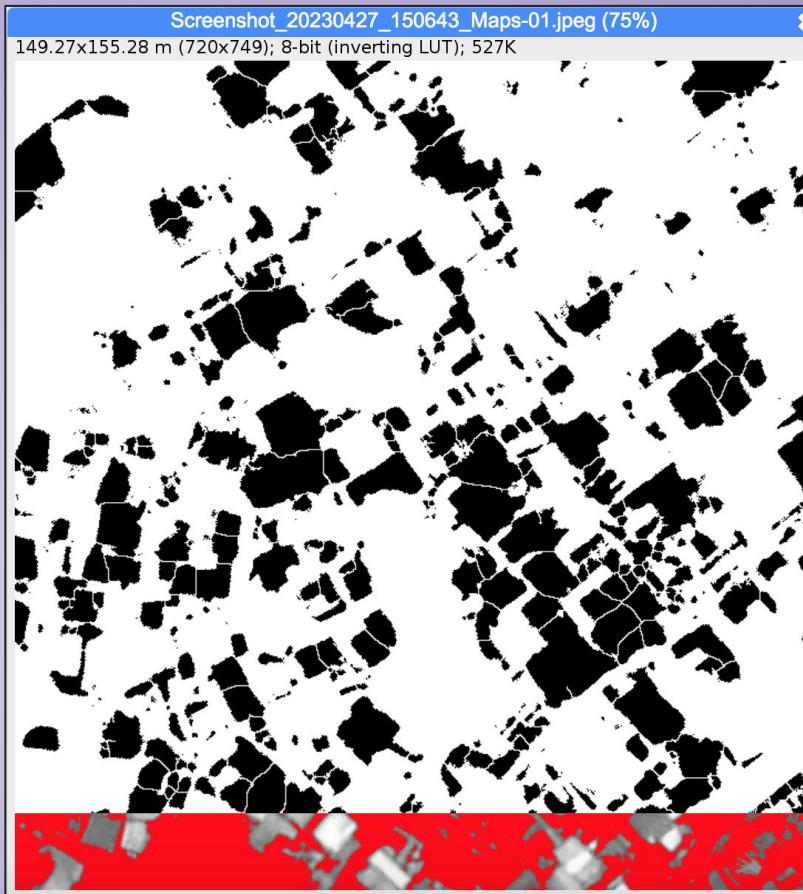
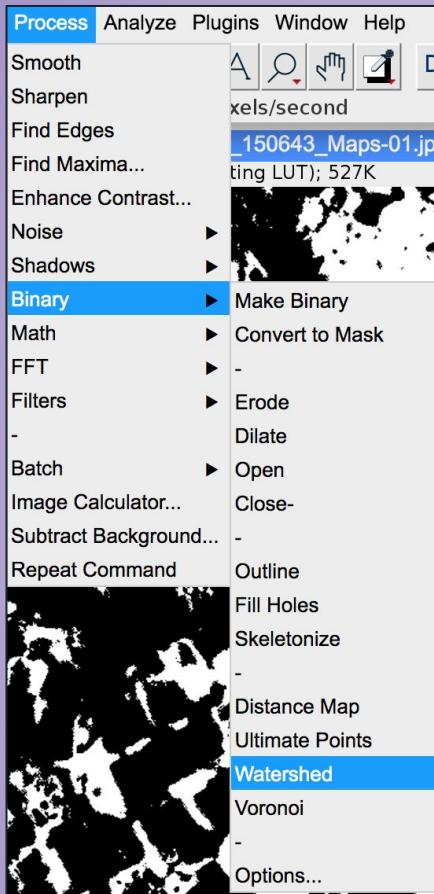
| Slice | Count | Total Area | Average Size | %Area | Circ. |
|---|-------|------------|--------------|-------|-------|
| Screenshot_20230427_150643_Maps-01.jpeg | 61 | 1170.737 | 19.192 | 6.801 | 0.506 |

ROI Manager

- 0001-0007
- 0002-0019
- 0003-0019
- 0004-0029
- 0005-0054
- 0006-0087
- 0007-0097
- 0008-0100
- 0009-0101
- 0010-0104
- 0011-0140
- 0012-0119
- 0013-0115

- Add [t]
- Update
- Delete
- Rename...
- Measure
- Deselect
- Properties...
- Flatten [F]
- More »
- Show All
- Labels

RESULTS (Initial)



Results

File Edit Font Results

| | Label | Area | X | Y | XM | YM | Circ. | AR | Round | Solidity |
|-----|---|--------|---------|---------|---------|---------|-------|-------|-------|----------|
| 137 | Screenshot_20230427_150643_Maps-01.jpeg | 6.326 | 68.882 | 113.751 | 68.881 | 113.755 | 0.351 | 2.717 | 0.368 | 0.658 |
| 138 | Screenshot_20230427_150643_Maps-01.jpeg | 51.962 | 20.196 | 118.503 | 20.175 | 118.567 | 0.268 | 3.204 | 0.312 | 0.798 |
| 139 | Screenshot_20230427_150643_Maps-01.jpeg | 12.837 | 100.441 | 114.039 | 100.441 | 114.039 | 0.549 | 2.321 | 0.431 | 0.790 |
| 140 | Screenshot_20230427_150643_Maps-01.jpeg | 6.449 | 51.298 | 113.795 | 51.295 | 113.815 | 0.617 | 1.172 | 0.853 | 0.845 |
| 141 | Screenshot_20230427_150643_Maps-01.jpeg | 7.555 | 26.299 | 115.869 | 26.299 | 115.869 | 0.483 | 2.930 | 0.341 | 0.816 |
| 142 | Screenshot_20230427_150643_Maps-01.jpeg | 4.422 | 30.135 | 114.646 | 30.135 | 114.646 | 0.658 | 1.754 | 0.570 | 0.852 |
| 143 | Screenshot_20230427_150643_Maps-01.jpeg | 1.321 | 111.012 | 114.110 | 111.012 | 114.110 | 0.659 | 1.397 | 0.716 | 0.796 |
| 144 | Screenshot_20230427_150643_Maps-01.jpeg | 6.111 | 85.502 | 117.509 | 85.502 | 117.509 | 0.604 | 2.331 | 0.429 | 0.850 |
| 145 | Screenshot_20230427_150643_Maps-01.jpeg | 1.075 | 90.478 | 116.865 | 90.478 | 116.865 | 0.357 | 4.670 | 0.214 | 0.598 |
| 146 | Screenshot_20230427_150643_Maps-01.jpeg | 1.075 | 61.763 | 118.036 | 61.763 | 118.036 | 0.692 | 2.239 | 0.447 | 0.778 |
| 147 | Screenshot_20230427_150643_Maps-01.jpeg | 44.069 | 50.730 | 123.262 | 50.725 | 123.263 | 0.251 | 1.957 | 0.511 | 0.651 |
| 148 | Screenshot_20230427_150643_Maps-01.jpeg | 1.413 | 96.414 | 123.276 | 96.425 | 123.291 | 0.666 | 2.947 | 0.339 | 0.836 |
| 149 | Screenshot_20230427_150643_Maps-01.jpeg | 2.211 | 94.889 | 124.320 | 94.933 | 124.325 | 0.266 | 1.535 | 0.652 | 0.623 |
| 150 | Screenshot_20230427_150643_Maps-01.jpeg | 1.259 | 105.494 | 125.322 | 105.494 | 125.322 | 0.683 | 2.184 | 0.458 | 0.804 |
| 151 | Screenshot_20230427_150643_Maps-01.jpeg | 3.685 | 47.532 | 126.125 | 47.532 | 126.125 | 0.544 | 1.610 | 0.621 | 0.757 |
| 152 | Screenshot_20230427_150643_Maps-01.jpeg | 3.624 | 116.666 | 127.463 | 116.666 | 127.468 | 0.490 | 1.900 | 0.526 | 0.717 |

Summary

File Edit Font

| | Count | Total Area | Average Size | %Area | Circ. |
|---|-------|------------|--------------|--------|-------|
| Screenshot_20230427_150643_Maps-01.jpeg | 152 | 2428.284 | 15.976 | 14.662 | 0.476 |

ROI Manager

- 0001-0025
- 0002-0041
- 0003-0038
- 0004-0040
- 0005-0040
- 0006-0045
- 0007-0048
- 0008-0045
- 0009-0081
- 0010-0080
- 0011-0062
- 0012-0099
- 0013-0119

- Add [i]
- Update
- Delete
- Rename...
- Measure
- Deselect
- Properties...
- Flatten [F]
- More »
- Show All
- Labels

RESULTS (After using Binary -> Watershed)

Reflection



Self Grade



| CRITERIA | QUALIFICATIONS | SCORE |
|-----------------------|--|-------|
| Technical Correctness | <ul style="list-style-type: none"> <input type="checkbox"/> Met all objectives <input type="checkbox"/> Results are complete <input type="checkbox"/> Results are verifiably correct <input type="checkbox"/> Understood the lesson | 35 |
| Presentation Quality | <ul style="list-style-type: none"> <input type="checkbox"/> All text and images are good quality <input type="checkbox"/> Code has sufficient comments/guides <input type="checkbox"/> Plots are properly labeled and visually understandable <input type="checkbox"/> Report is clear | 35 |
| Self Reflection | <ul style="list-style-type: none"> <input type="checkbox"/> Explained validity of results <input type="checkbox"/> Discussed what went wrong/right in activity <ul style="list-style-type: none"> <input type="checkbox"/> Justified self score <input type="checkbox"/> Acknowledged sources | 30 |
| Initiative | <ul style="list-style-type: none"> <input type="checkbox"/> Experimented beyond what was required <input type="checkbox"/> Made significant improvements to existing code | 10 |

References

- [1] ImageJ Introduction. (n.d.). *National Institutes of Health*. Retrieved from <https://imagej.nih.gov/ij/docs/intro.html>

Warm thanks to a high school classmate for her microscope picture of the pollen grains.