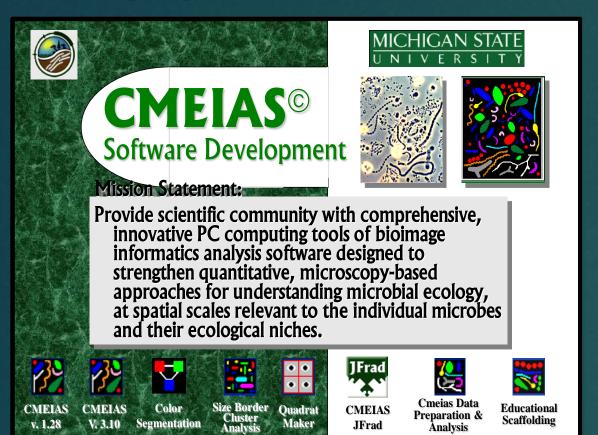
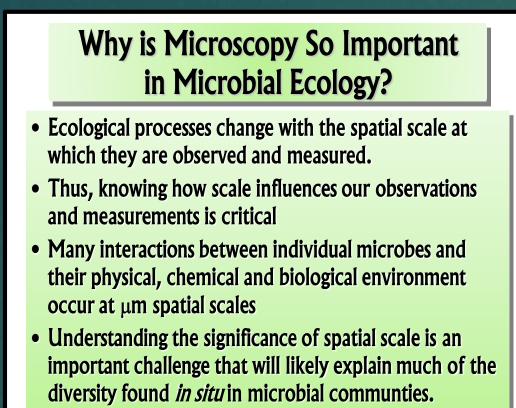


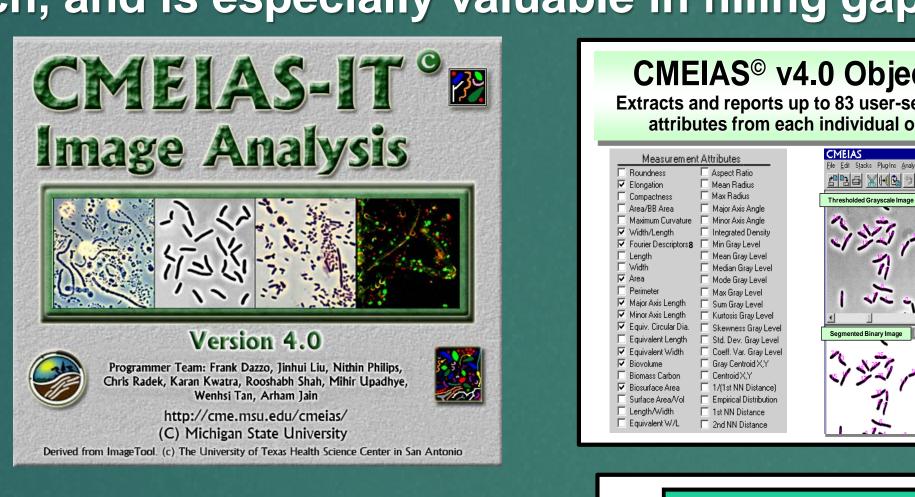
CMEIAS® v4.0: ADVANCED COMPUTATIONAL TOOLS OF BIOIMAGE INFORMATICS SOFTWARE DESIGNED TO STRENGTHEN MICROSCOPY-BASED APPROACHES FOR UNDERSTANDING MICROBIAL ECOLOGY

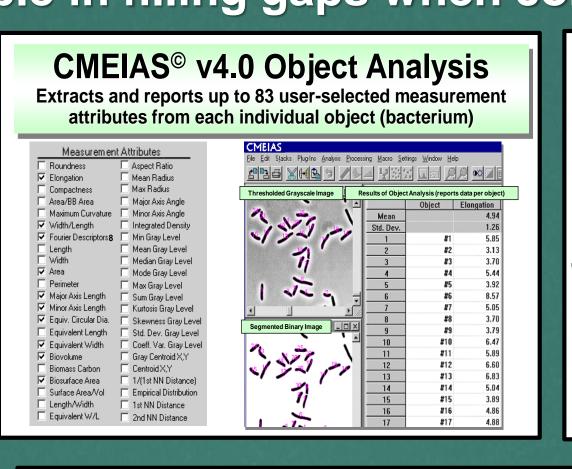
FRANK B DAZZO, Y YANNI, J LIU, K KWATRA, A JAIN, C GROSS, N PHILIPS, C MONOSMITH, K KLEMMER, Z JI, B NICCUM, N DESILVA, D MCGARRELL, I FOLLAND, P JHA, S LUNDBACK, W TAN, D STAWKEY, A JONES, D GUSFA, K PRATER, N BAKIR, R SEXTON, D. ONSAY, M SHEARS, A MAKHOUL, S HANDLESMAN. D ONSAY & L SONG MMG MSU EAST LANSING, MI 48824 USA

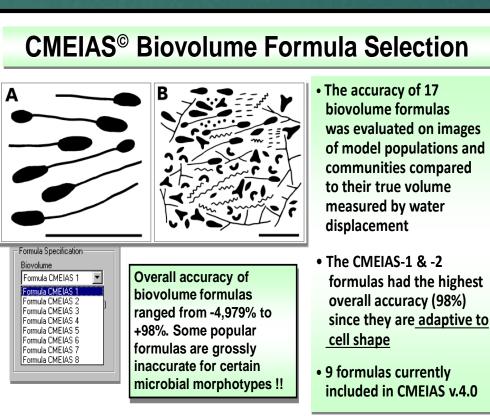
A major challenge in microbial ecology is to develop computing tools that can extract ecologically important information from digital images of microbial populations and communities at single cell resolution, and analyze their structure in situ without cultivation. Several microbial ecologists, mathematicians and computer scientists are addressing this challenge by developing a software package called CMEIAS (Center for Microbial Ecology Image Analysis System). CMEIAS applies pattern recognition algorithms to classify microbial morphotypes with 97% accuracy. A CMEIAS-IT upgrade is being developed to analyze microbial (i) morphological diversity related to the database of currently described bacteria; (ii) abundance (e.g., cell density, biovolume, biomass carbon, biosurface area, cumulative length); (iii) ecophysiology (e.g., metabolic activity, autecology and phylogeny using color segmentation of fluorescent molecular probes), and (iv) in situ spatial / landscape ecology. CMEIAS includes plugins with many new object analysis/classification features, new tools to help edit images before analysis (Object Separation, Color Segmentation), Excel add-Ins that prepare, compile & analyze CMEIAS ecological data, a fractal dimension analyzer, new exploratory cluster analysis tools to optimize the decision boundaries for classification of the operational morphological units with unlimited morphological diversity, and a Quadrat Maker tool for plot-based spatial distribution analyses of microbial colonization patterns. CMEIAS is currently being used to analyze microbial colonization patterns and intensity on plant roots, freshwater biofilm communities on surface polymers on glass, shifts in vaginal microflora in health and BV disease, and the in situ spatial scale of bacterial cell-to-cell interactions at single cell resolution. These CMEIAS-based applications can facilitate research designed to enhance our understanding of microbial ecology by providing well-documented, accurate, robust and user-friendly computing tools that extract important, quantitative information from digital images of microbes at multiple spatial scales relevant to their in situ ecological behavior in various habitats. CMEIAS bioimage informatics software is released at our project website http://cme.msu.edu/cmeias/, adds computational power to many types of quantitative microbial ecology research, and is especially valuable in filling gaps when combined with molecular-based and other methods of polyphasic community analysis.

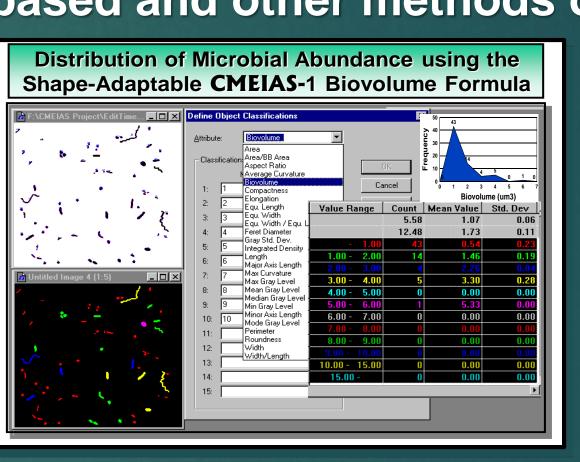


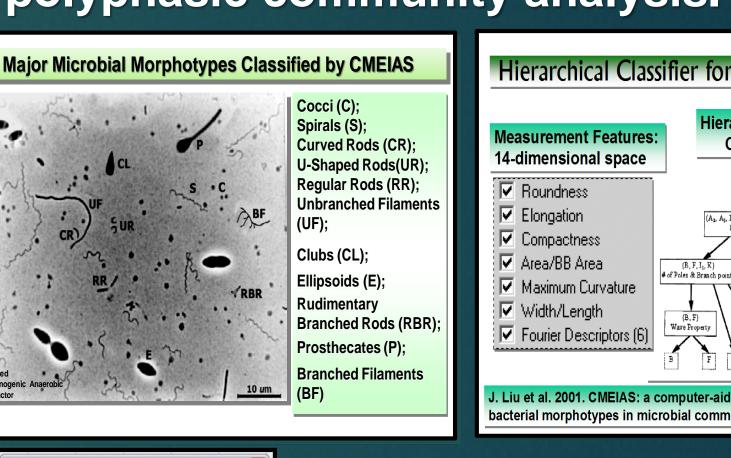












iis CMEIAS Add-in prepares data for statistical analysis o

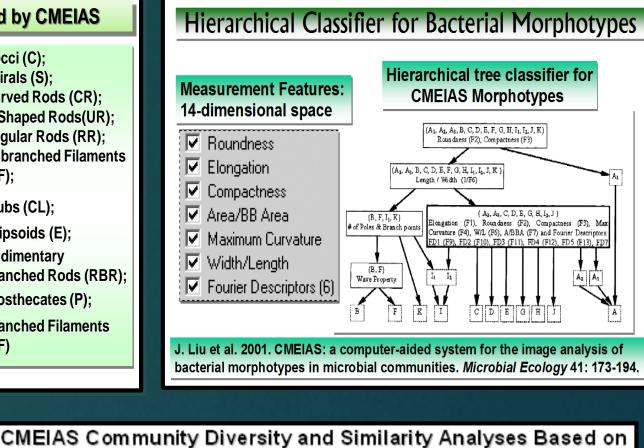
oject analysis and classification data extracted from imag sing CMEIAS. Requirements for the input worksheet are

according to the format design indicated in the CMEIAS User Manual. The lengths of the dataset title (entered below

% Coverage 4.29%

Mass Radius (Short)

Pixels on the traced borders: 31



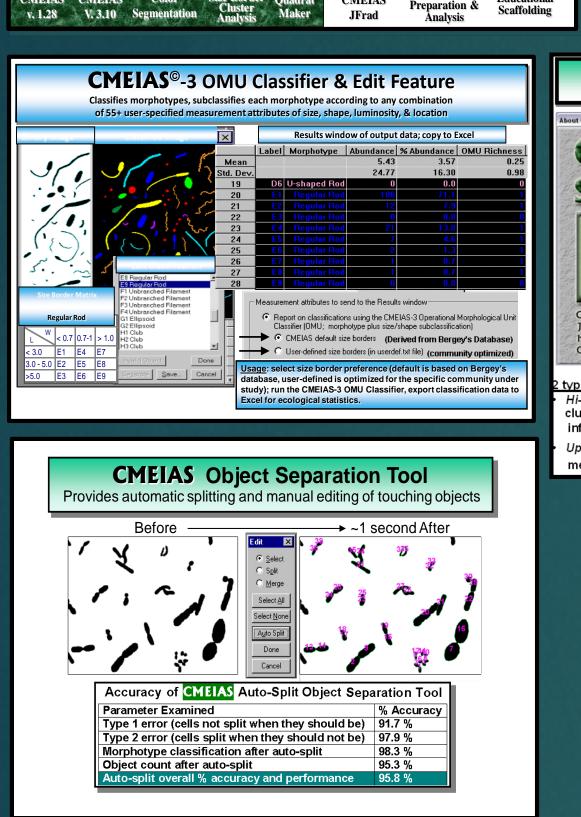
Frequency Distribution Data for Optimized Size-Range Clusters

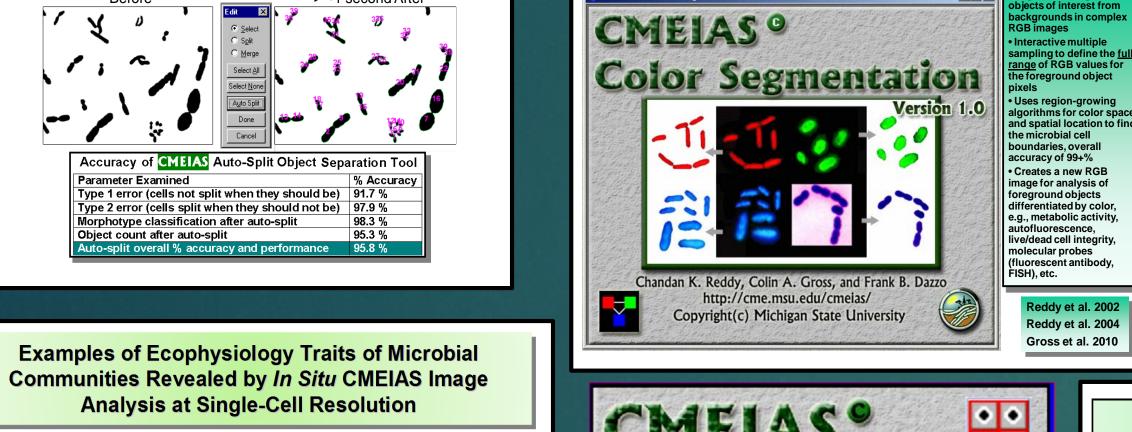
Graph Type

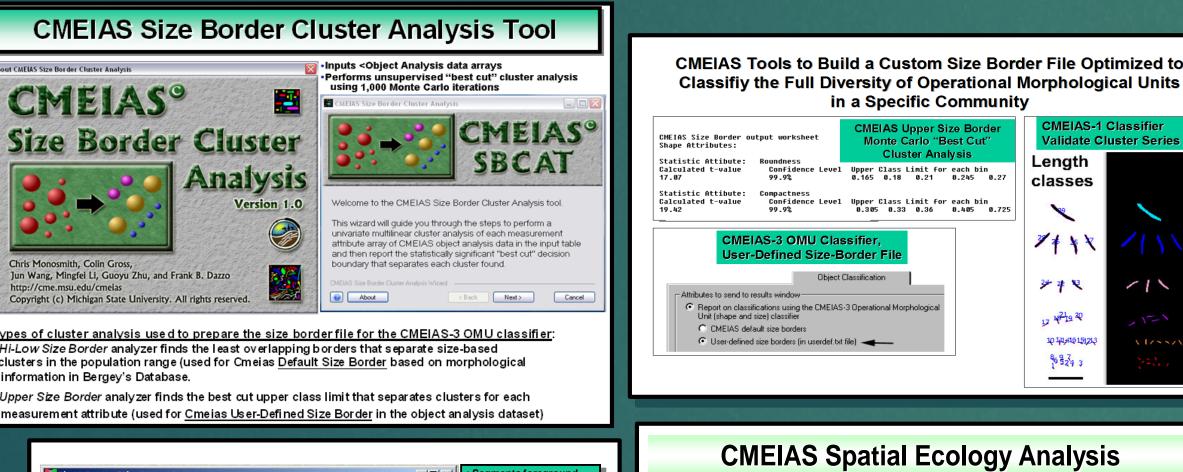
% Prequency distribution

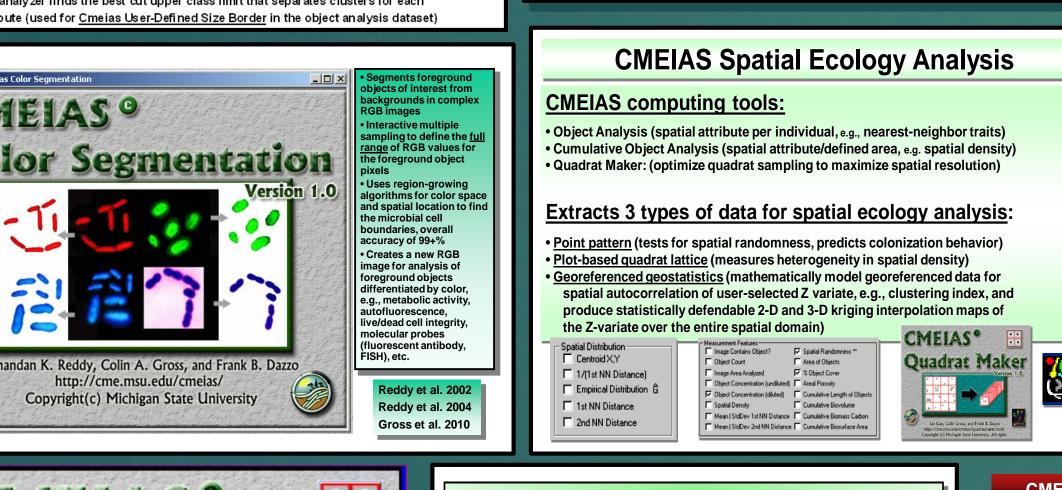
Each pair of populations or communit

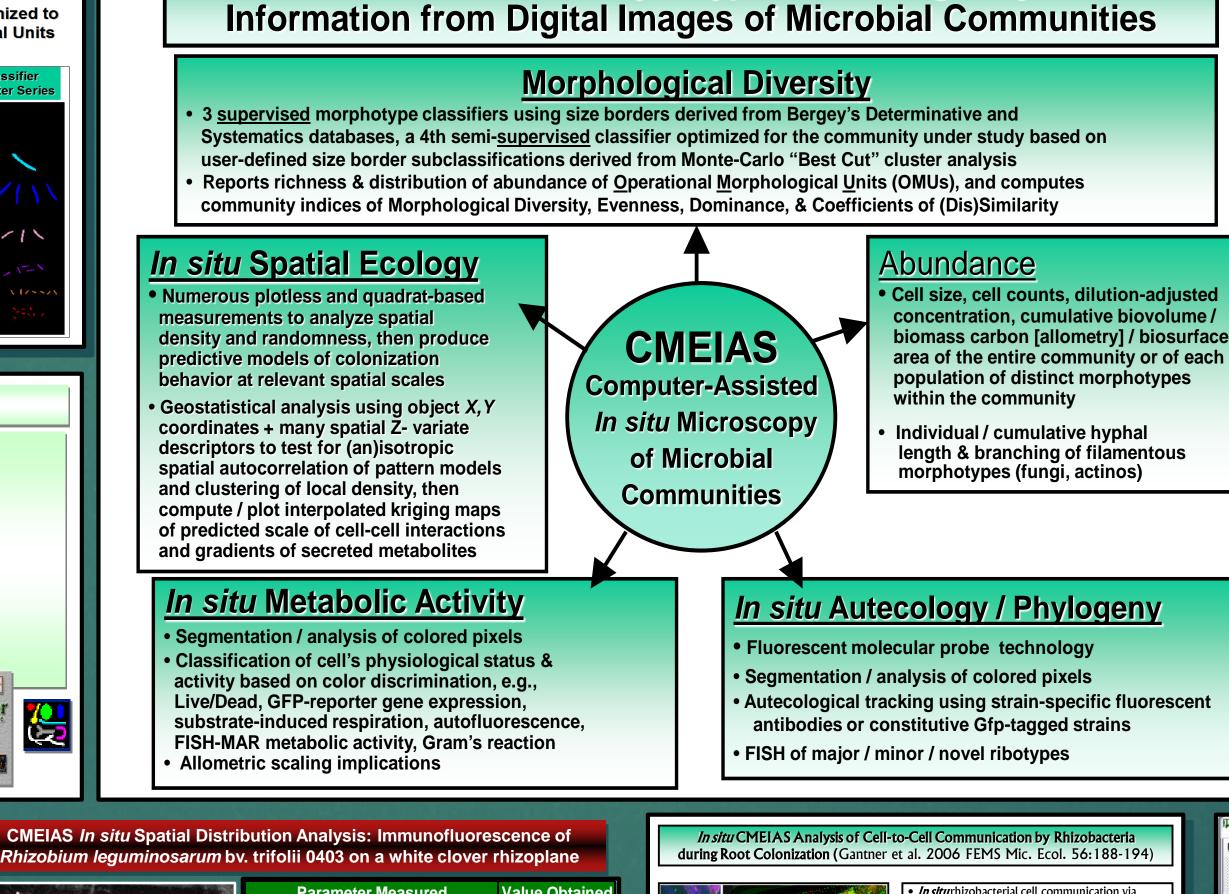
F 1st vs. all others (ecological succession



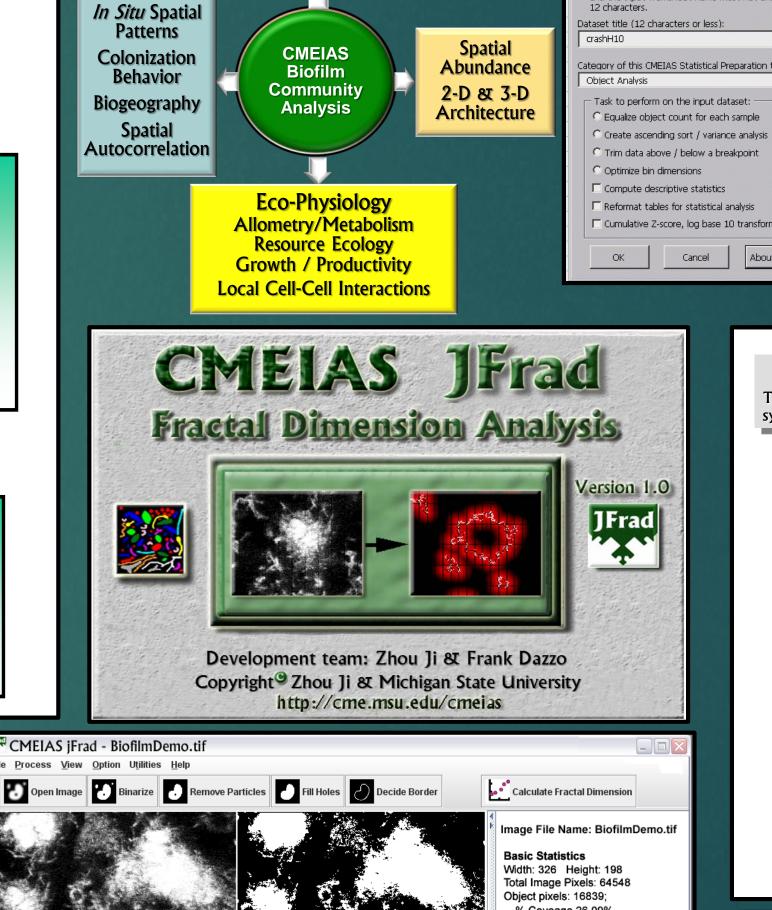








CMEIAS v.4.0 Extracts 5 Major Types of Ecologically Relevant

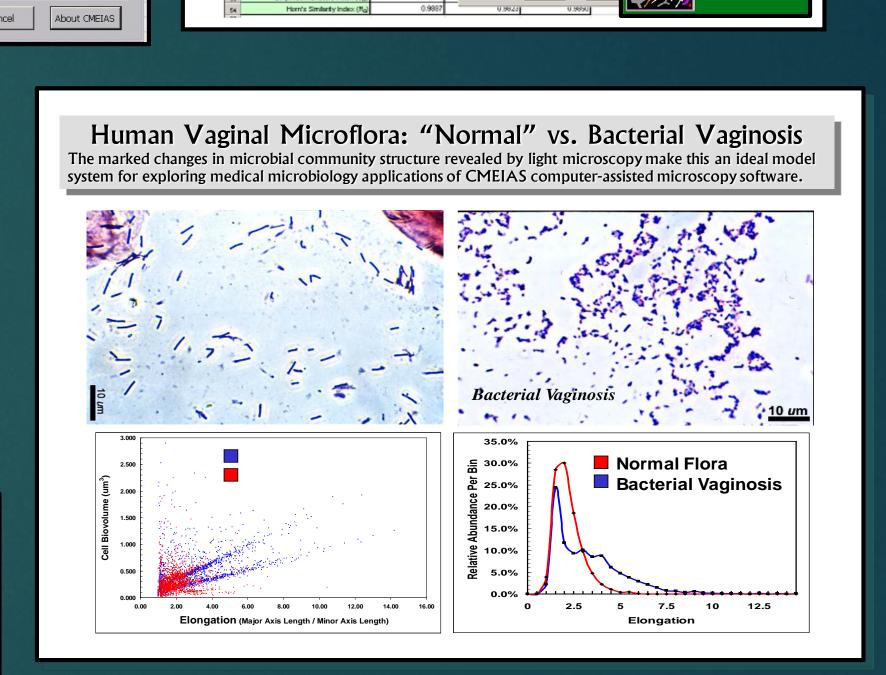


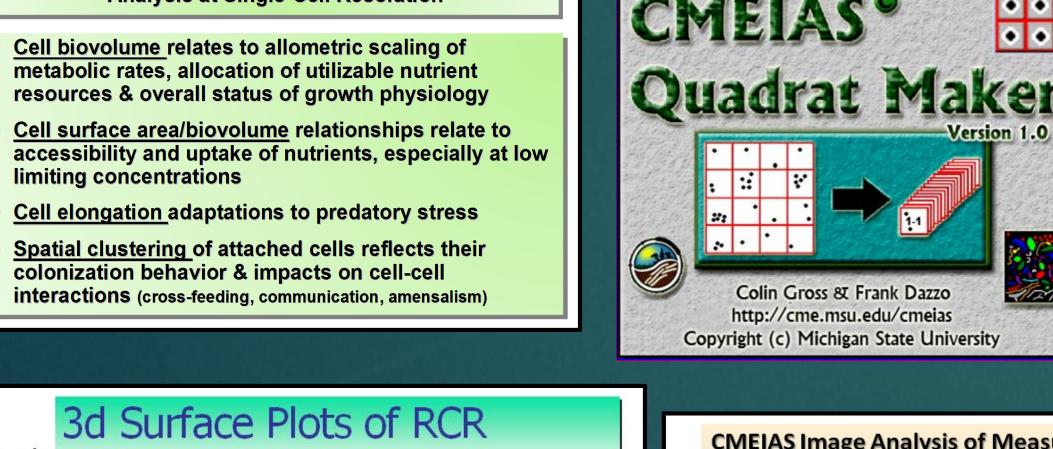
Morphological Diversity/Adaptations

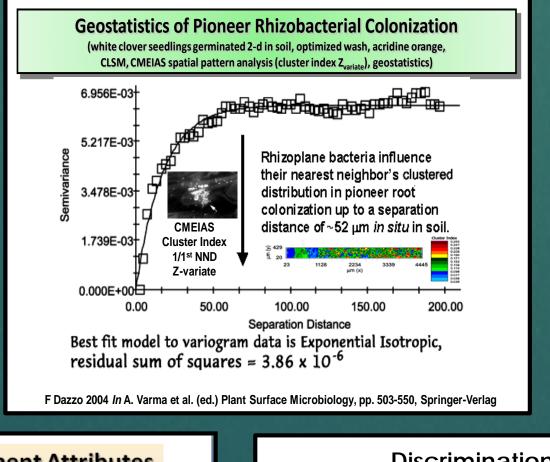
Local Community Dynamics

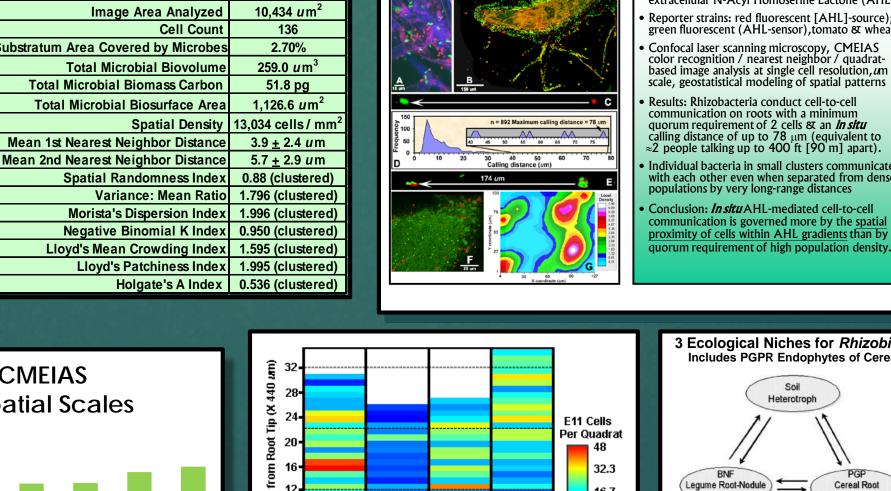
Bacteriovory Stress / Refuge

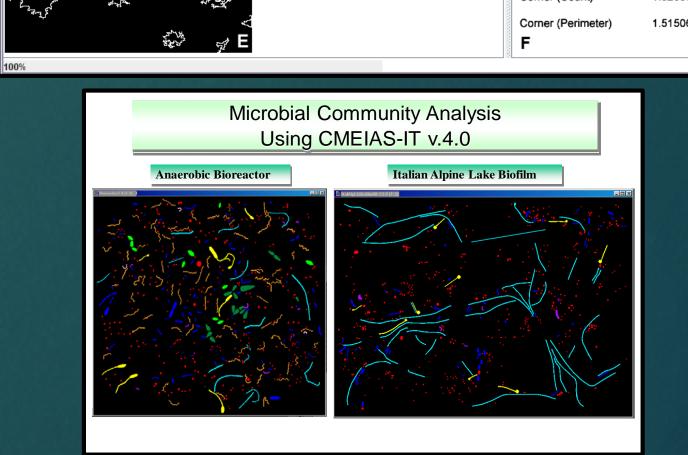
Perturbation / Succession / Stability

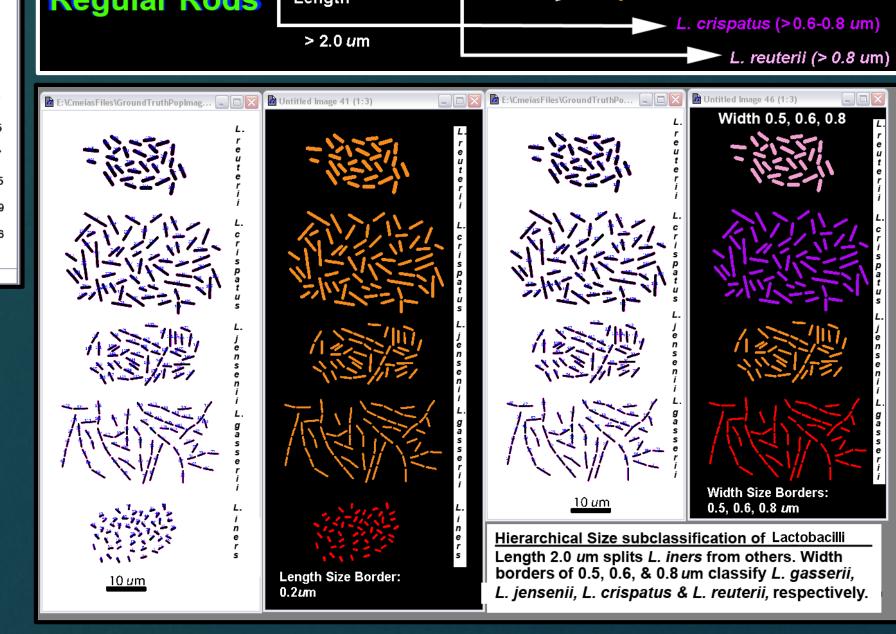




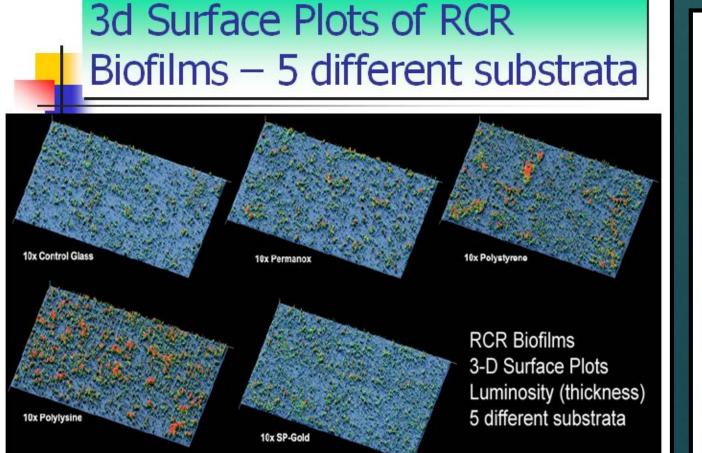


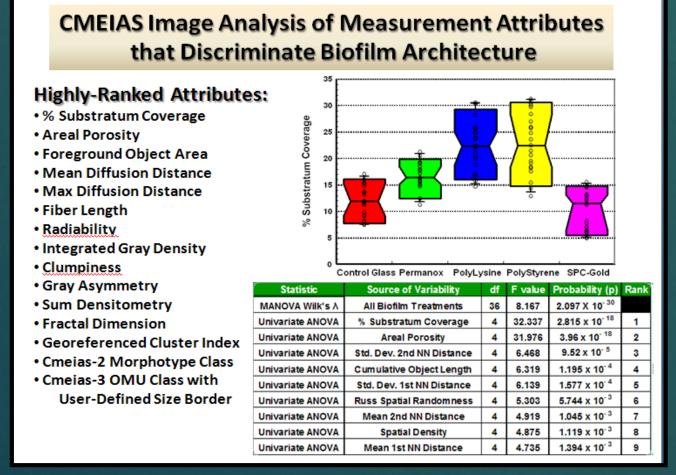


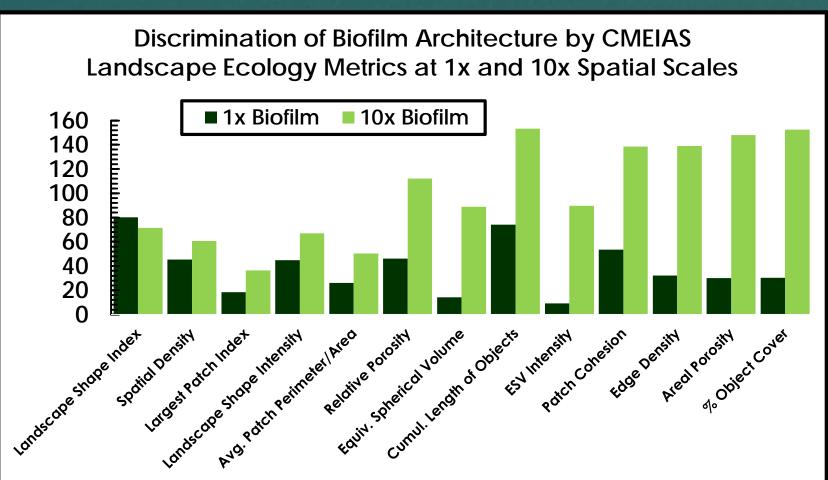




≤ 2.0 *u*m







o 1 . Tite an one w

20 um

1 1000

