Unlocking Microbial Dark Matter with Single Cell Genomics

From Environment to Insight - One Cell at a Time

Highly diverse and spatially complex ecosystems



The Challenge

Unculturable organisms (>90%)



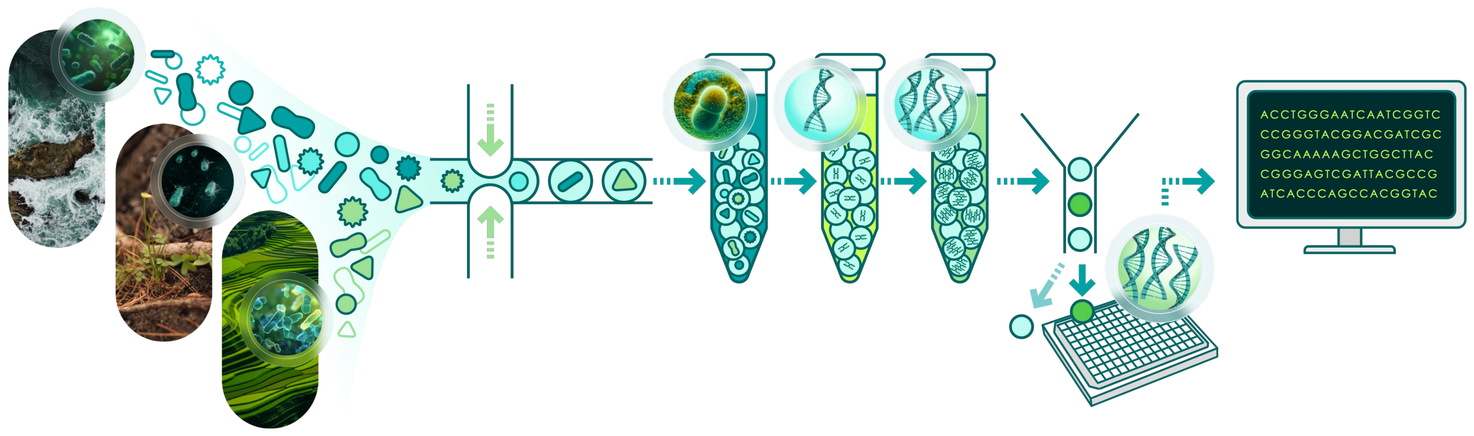
Low resolution



Result: Critical functional biology remains hidden.

The bit-MAP platform

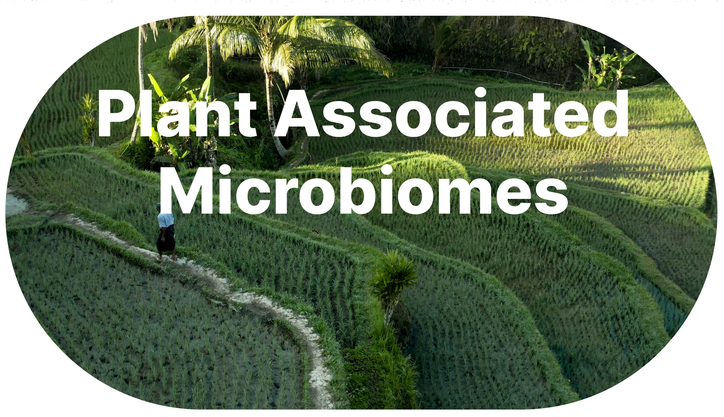
- A massively parallel microfluidics approach
- Physically isolates individual microbial cells
- Generates Single Amplified Genomes (SAGs)
- Links taxonomy ⟶ function ⟶ phenotype at *strain level resolution*





- ~1,900 single-cell genomes recovered from Japan Trench
- Revealed previously unresolvable diversity in dominant *Atribacterota* lineages
- Identified genes linked to:
- Organic carbon degradation
- Methanogenesis-associated pathways
- Demonstrated biogeochemical roles in extreme environments

➡️ Single-cell genomics expanded phylogenetic resolution beyond metagenomics alone



- Integrated single-cell genomics + 16S sequencing
- ~600 high-quality SAGs recovered
- Identified plant growth-promoting bacteria (PGPR) candidates
- Resolved spatial dynamics between:
- Rhizosphere
- Rhizoplane
- Endosphere

➡️ Enabled direct linkage of microbial identity to function in crop systems



- First application of SCG at individual soil aggregate level
- Demonstrated:
- Microbial functional redundancy across aggregates
- Presence of complete nitrogen cycling pathways within microhabitats
- Highlighted importance of cell extraction methodology for accurate recovery

➡️ Revealed soil as a heterogeneous network of functional micro-environments

Applications

Agriculture

- Soil health and nutrient cycling
- Discovery of biopesticides and biofertilizers
- Plant-microbe interaction mapping

Environmental Science

- Carbon and nitrogen cycling
- Climate-relevant microbial pathways
- Extreme environment microbiology

Biotechnology

- Novel enzyme and natural product discovery
- Microbial chassis identification
- Biomanufacturing innovation

Key Takeaway

Single-cell genomics transforms how we see microbial ecosystems:
From fragmented community signals → to complete, functional genomes of individual organisms

Partner with bitBiome and
discover what your microbiome has been hiding.

📩 Contact us to learn more about bit-MAP®
🌐 www.bitbiome.bio

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