

Microbial abundance in response to varied waste introduction methods in onsite sanitation systems

L. Astete Vasquez^{1,2}, B. Velazquez Benitez, N. Mladenov¹

¹San Diego State University Department of Civil, Construction and Environmental Engineering, ²University of California, San Diego Department of Mechanical & Aerospace Engineering

Hypothesis: Bacterial communities responsible for disease, the stabilization of organic matter, and generation of greenhouse gases in onsite sanitation systems change in response to time of use and modifications to how toilets are used.

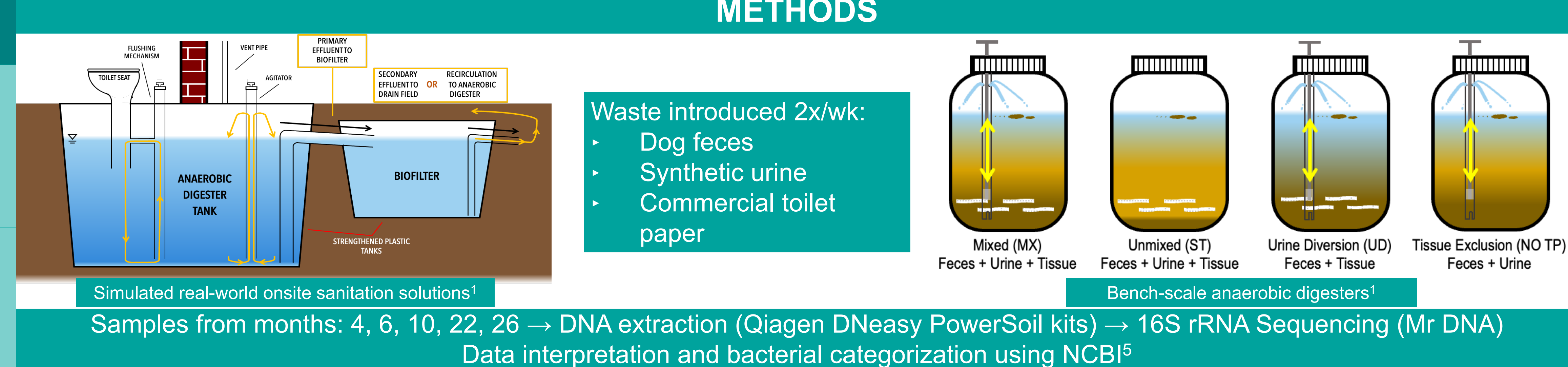
Background¹

Onsite sanitation systems used by 43% of global population:

- Unhoused encampments (use of 0-2 mo.)
- Refugee camps & disaster relief zones (use of 2-12 mo.)
- Individual households (use of ≥12 mo.)

Considers scientifically and culturally relevant modifications:

- Mixing of fecal waste (increased access to substrate)
- Urine diversion (reduced nutrient concentrations)
- Exclusion of toilet paper (lower C:N ratios)



Results

Bacterial roles

Most abundant bacteria perform important roles in the **process of anaerobic digestion**:

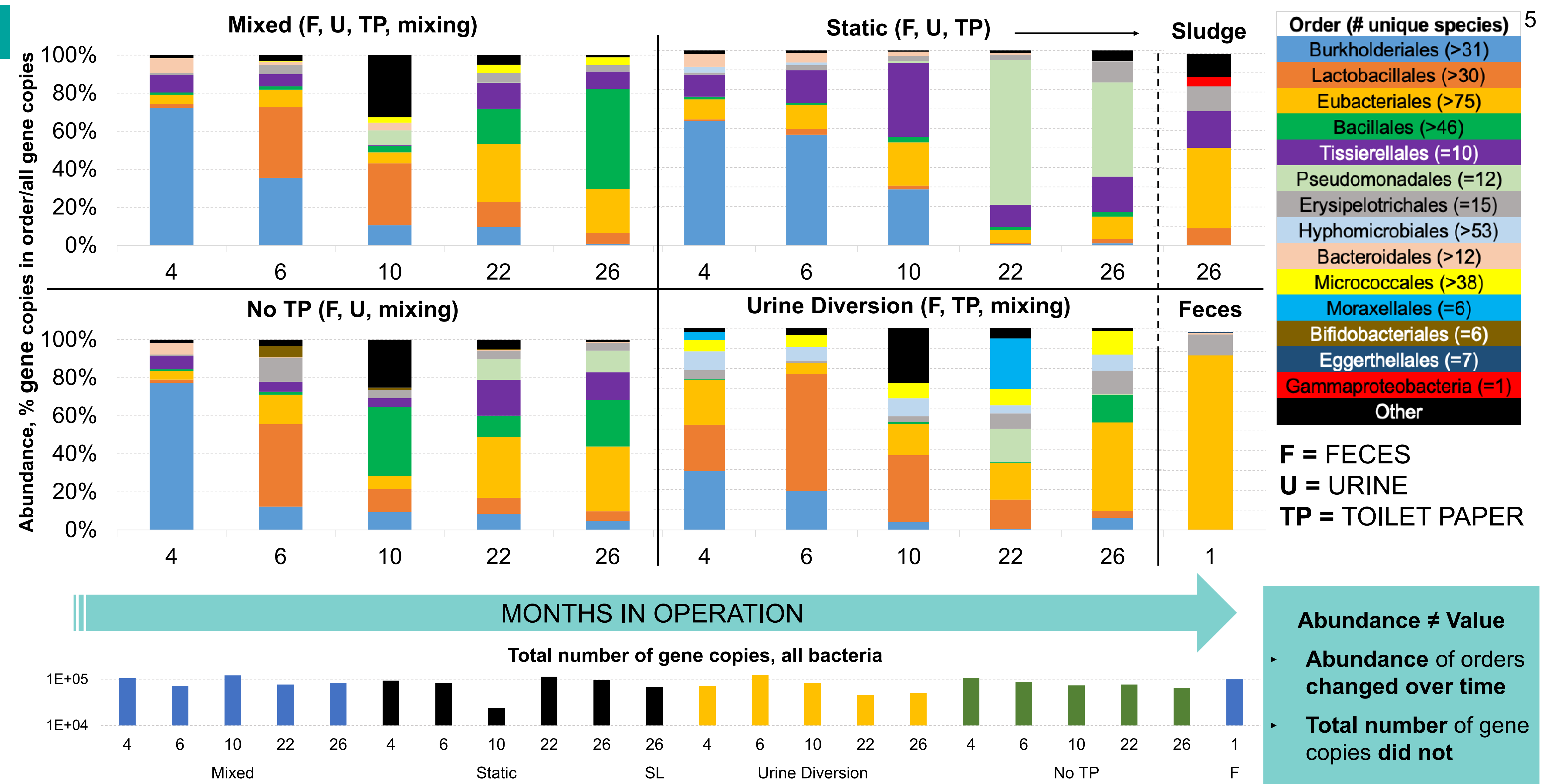
- Metabolism & fermentation of organic materials
 - Hydrolysis** organic polymers → sugars (monomers)
 - Acidogenesis** monomers → volatile fatty acids (VFAs)
 - Acetogenesis** VFAs → acetic acid, CO₂, H₂

Other important functions:

- Oxidation of H₂S (odorous gas)
- Transformation of pharmaceuticals, hormones, pesticides

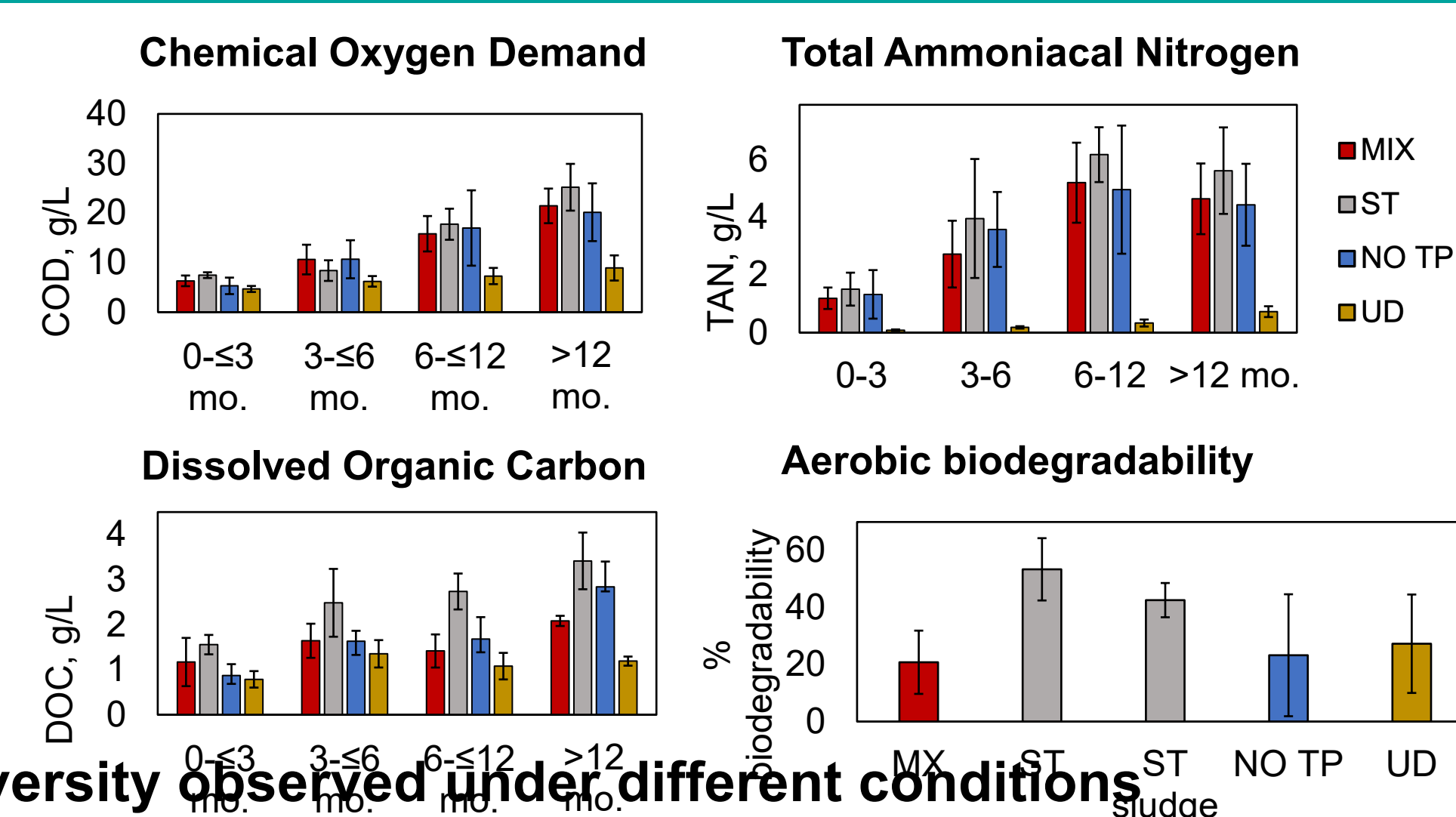
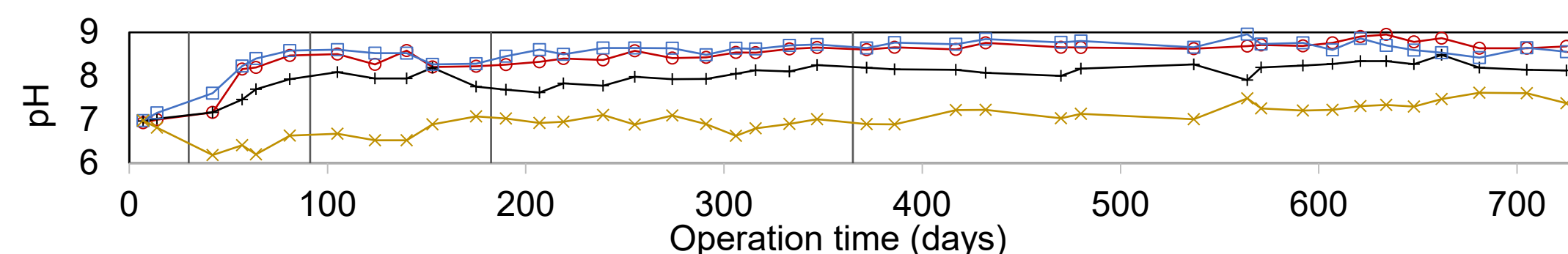
Dynamics

- Burkholderiales** decreased over time associated with treatment-resistant pathogens⁶
- “Other” orders (diversity) higher in mixed tanks, confined to sludge in Static tank dominant populations strengthened with time
- Pseudomonadales** development No TP, Static some species perform denitrification⁷
- Development of **Bacillales** in mixed systems organics degradation, BOD reduction⁸
- Eubacteriales** consistent presence in all samples associated with anaerobic digestion process⁹

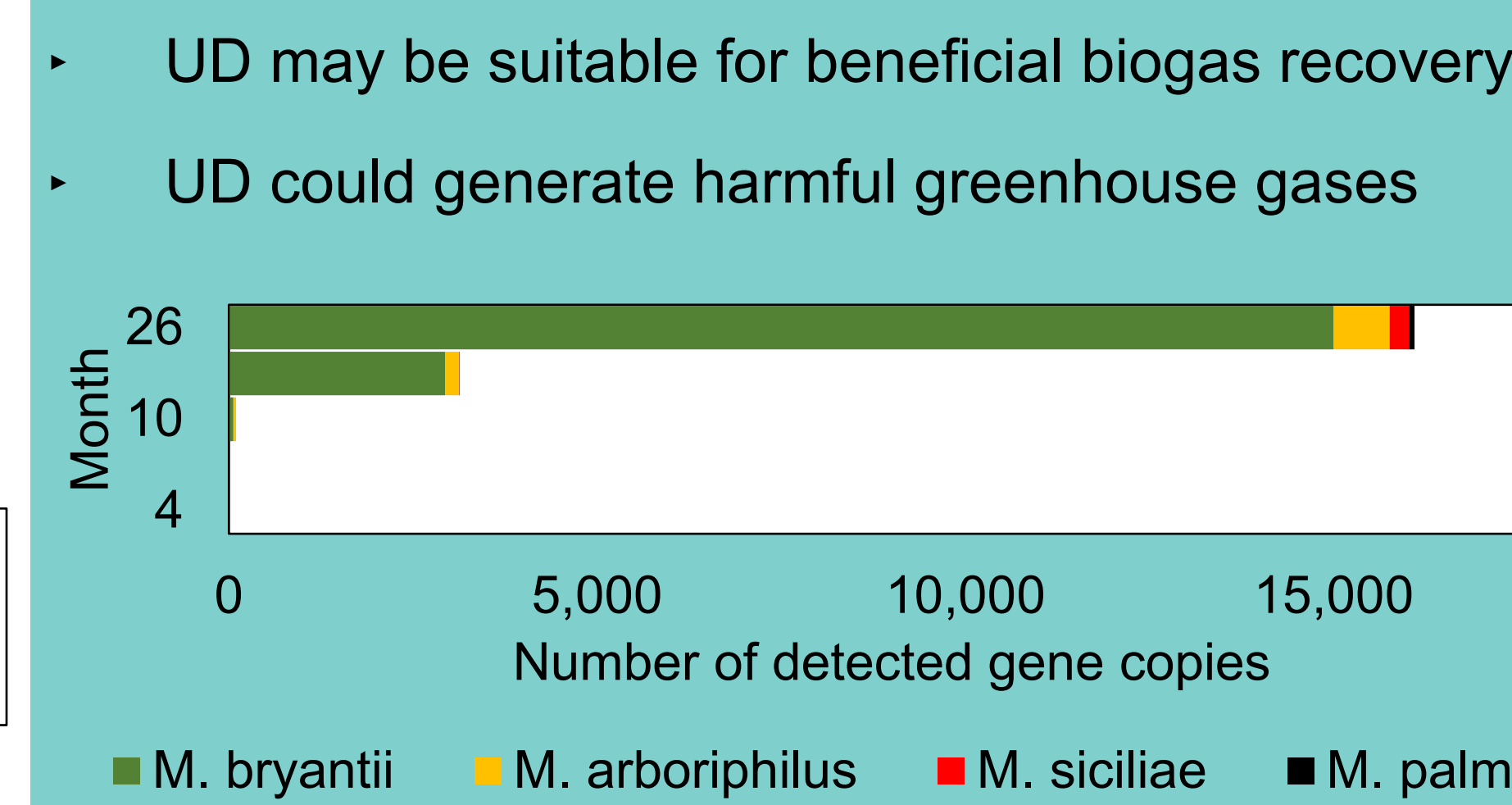


Chemical characteristics¹

- O₂ depletion → gradual **Burkholderiales** reduction²
- Pseudomonas** impacted by phosphorus (competition) pH levels (inhibition) which differ in Mixed, Static & NO TP tanks³
- Bacillales** may be impacted by breakdown of N-containing compounds in mixed systems (with urine)⁴



Development of methane-producing archaea in UD



CONCLUSIONS

Fecal waste introduced differently to onsite sanitation systems results in varied composition of microbial community, which in turn impact their function (organics degradation, pathogen accumulation, biogas production).

References

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