

# Food or a free ride?

## The ability of a marine microbial community to degrade plastics

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SLS Symposium 2019  
 @RobynJWright



# INTRODUCTION – PLASTICS IN THE OCEAN



# WHAT HAPPENS TO A PLASTIC BOTTLE IN THE OCEANS?

## IS IT BEING DEGRADED? WHO IS DEGRADING IT?

### OBJECTIVES:

1. Fundamental understanding of marine microbial communities
2. Are plastics degraded?
3. Are the additives and contaminants of plastics being degraded?



# OBJECTIVE 1: UNDERSTANDING MARINE MICROBIAL COMMUNITY DYNAMICS

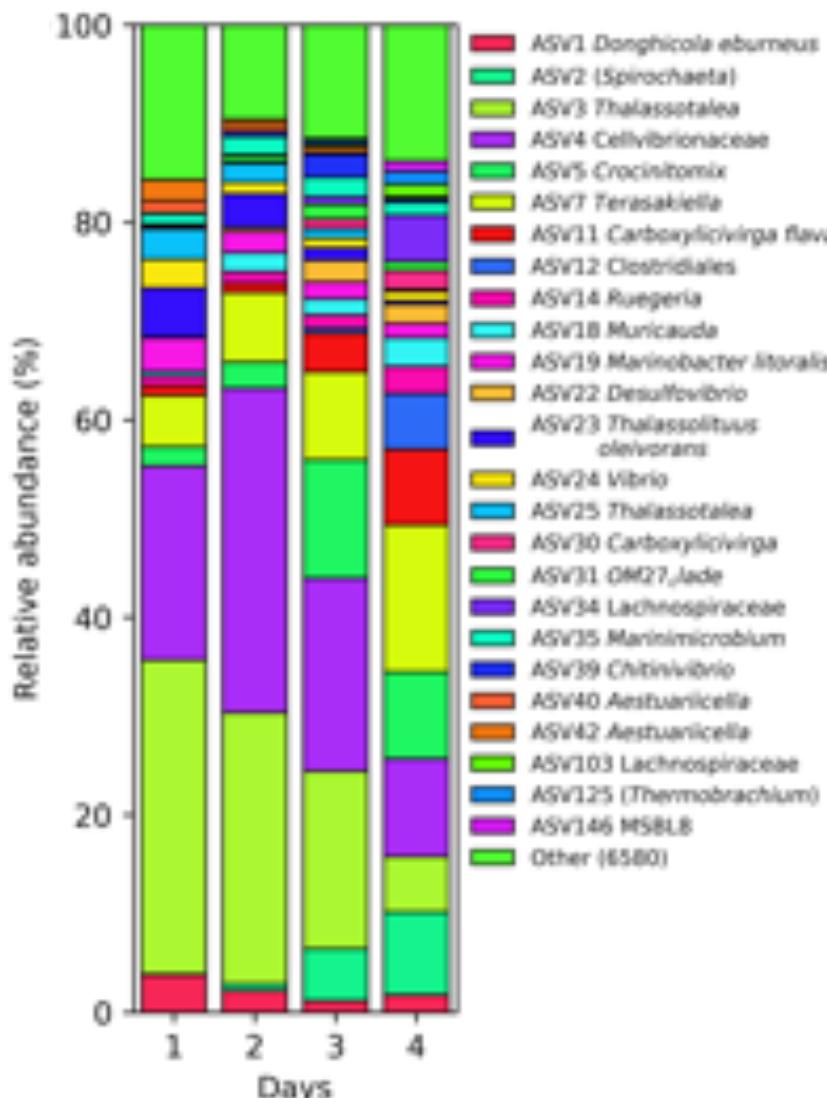


CHITIN



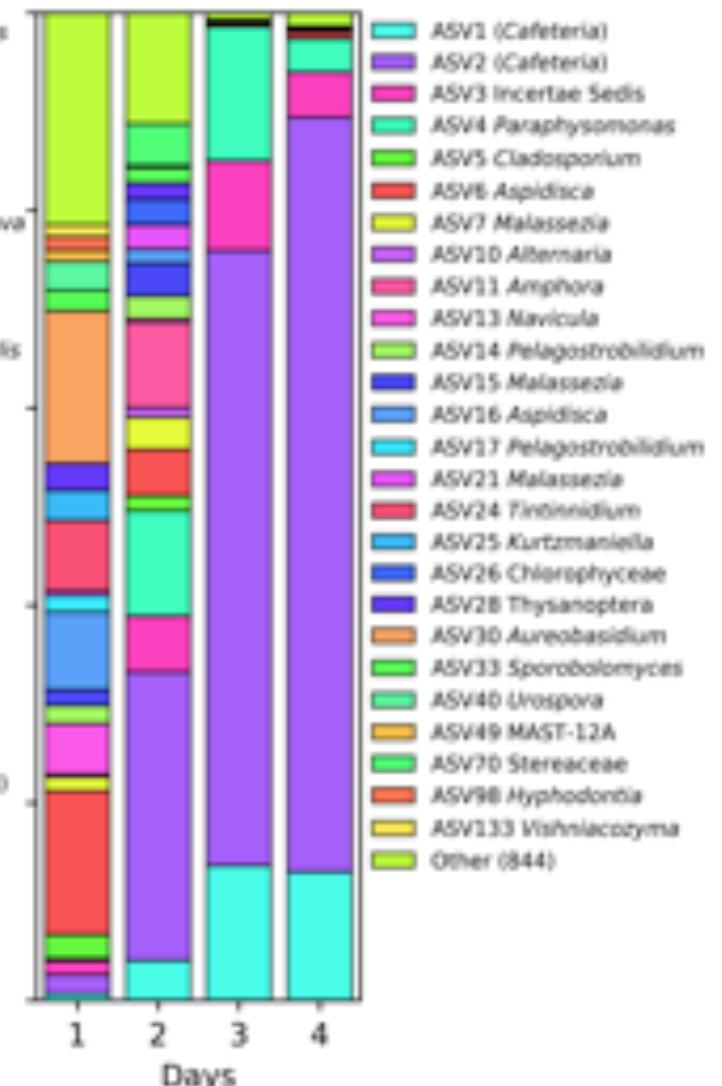
16S rRNA gene

Prokaryotes



18S rRNA gene

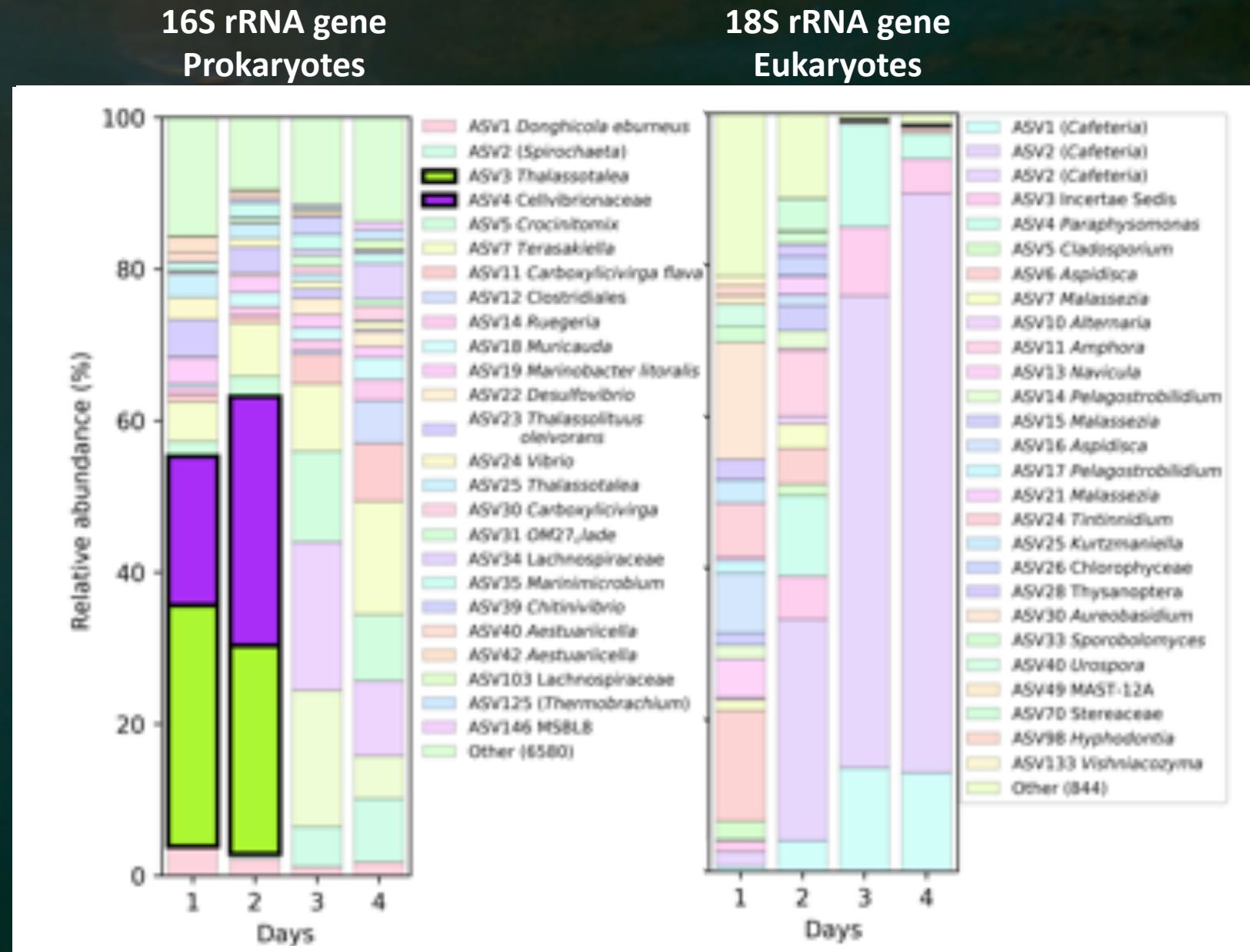
Eukaryotes



# OBJECTIVE 1: UNDERSTANDING MARINE MICROBIAL COMMUNITY DYNAMICS



CHITIN



# OBJECTIVE 1: UNDERSTANDING MARINE MICROBIAL COMMUNITY DYNAMICS

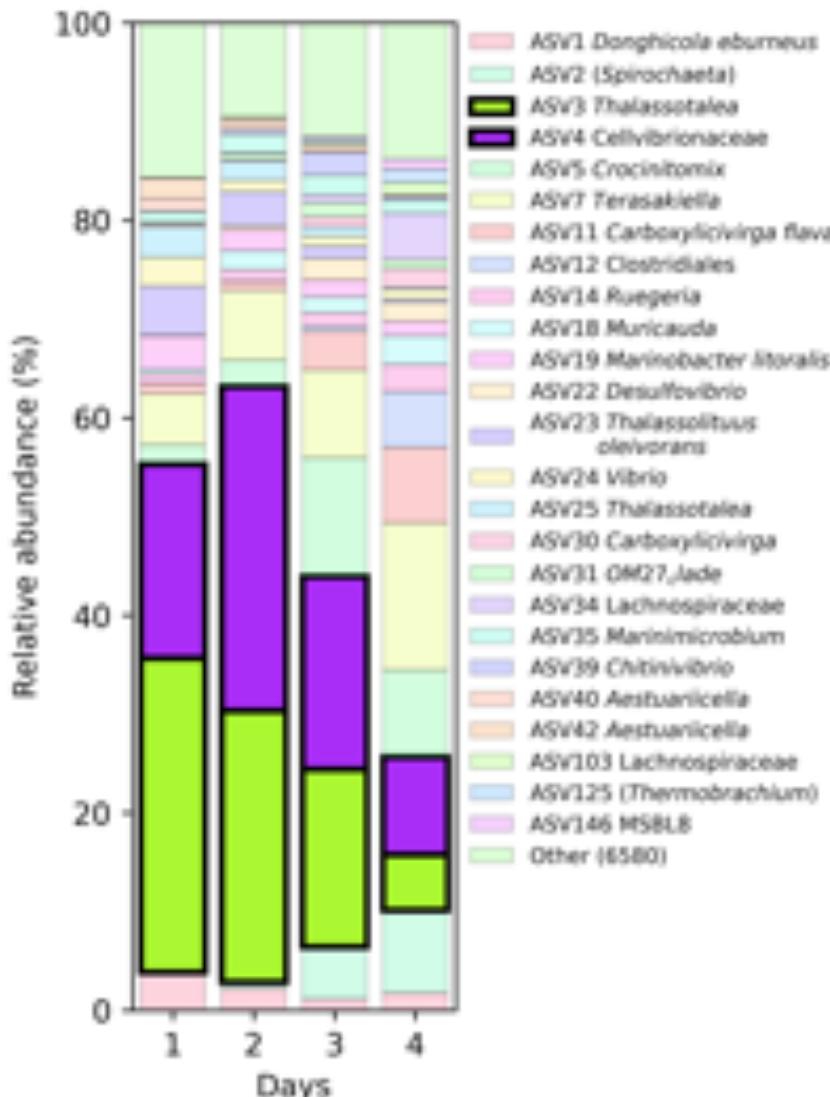


CHITIN



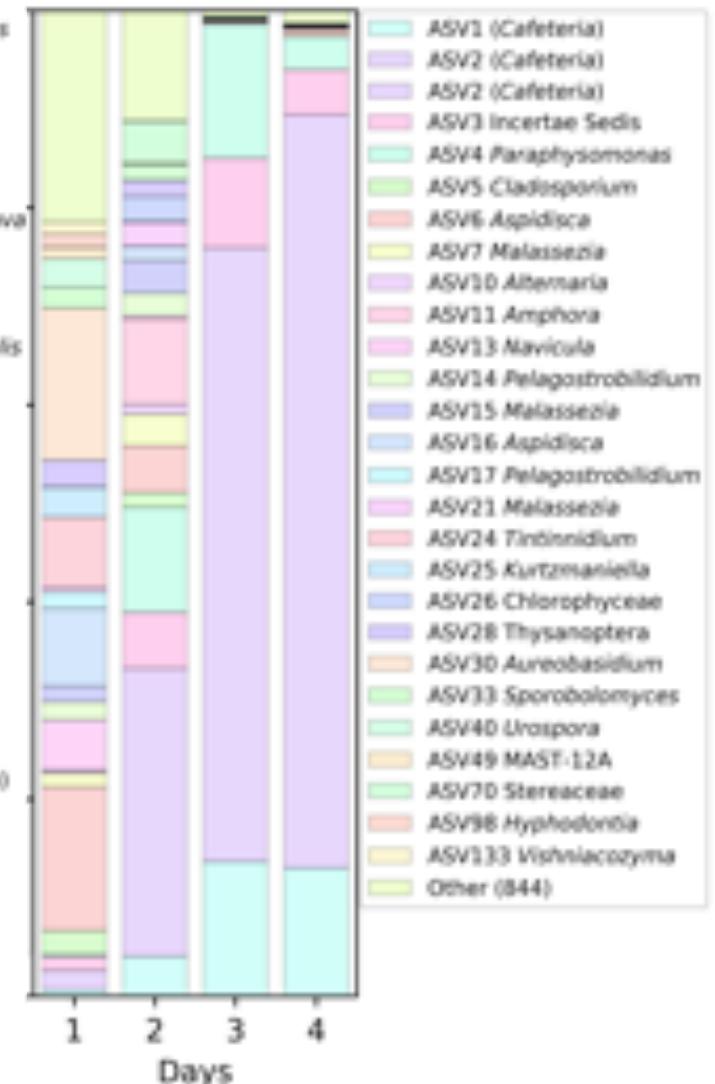
16S rRNA gene

Prokaryotes



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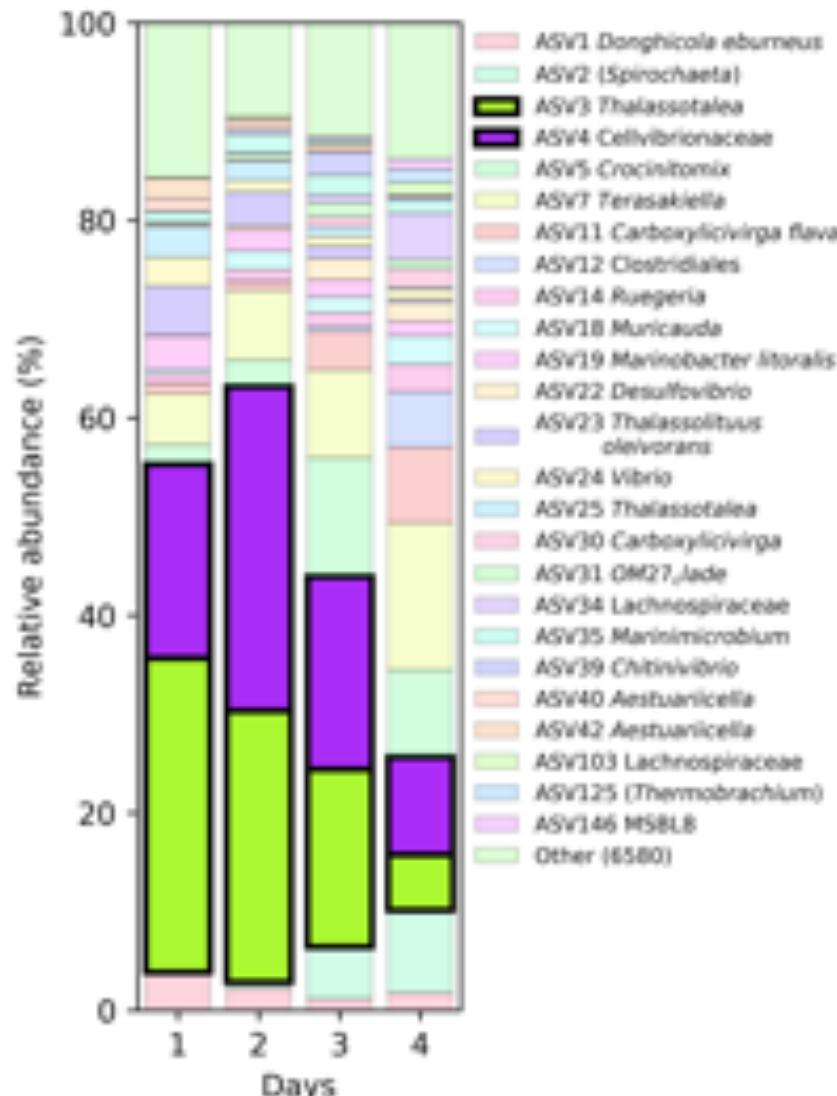


CHITIN



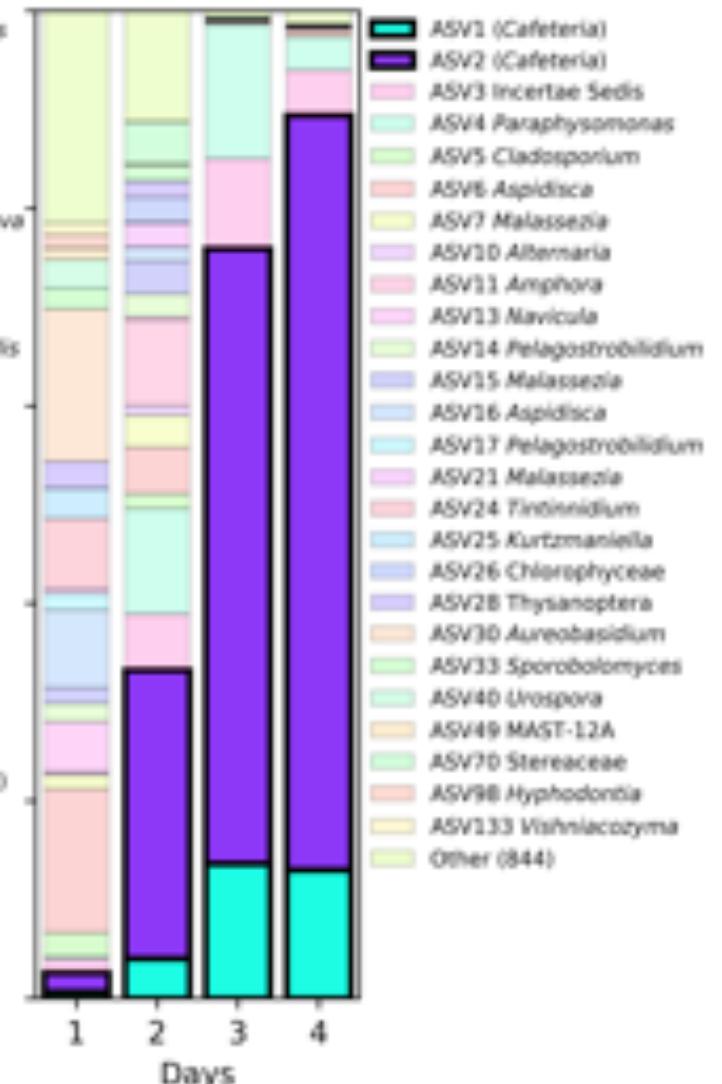
16S rRNA gene

Prokaryotes



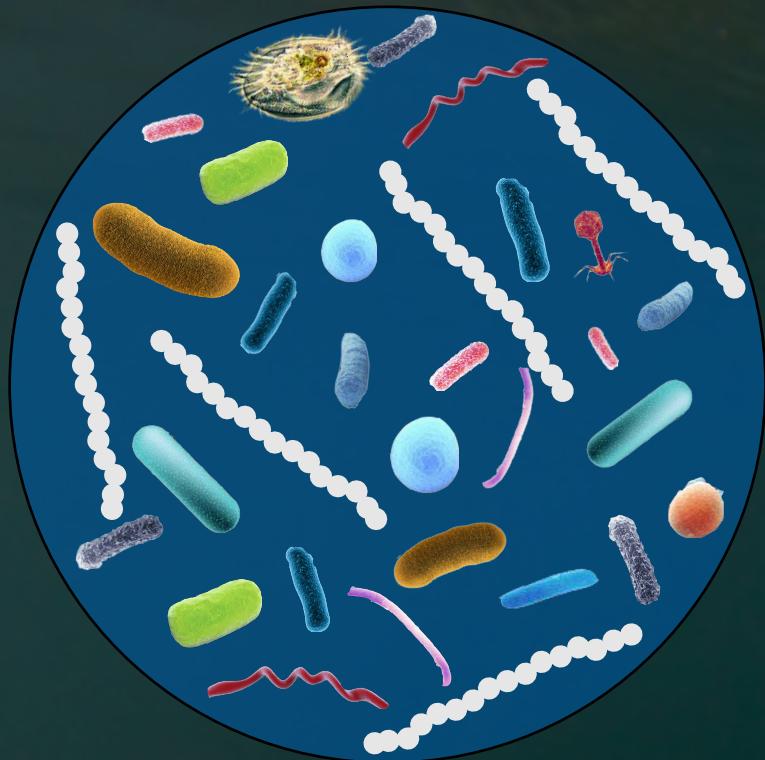
18S rRNA gene

Eukaryotes

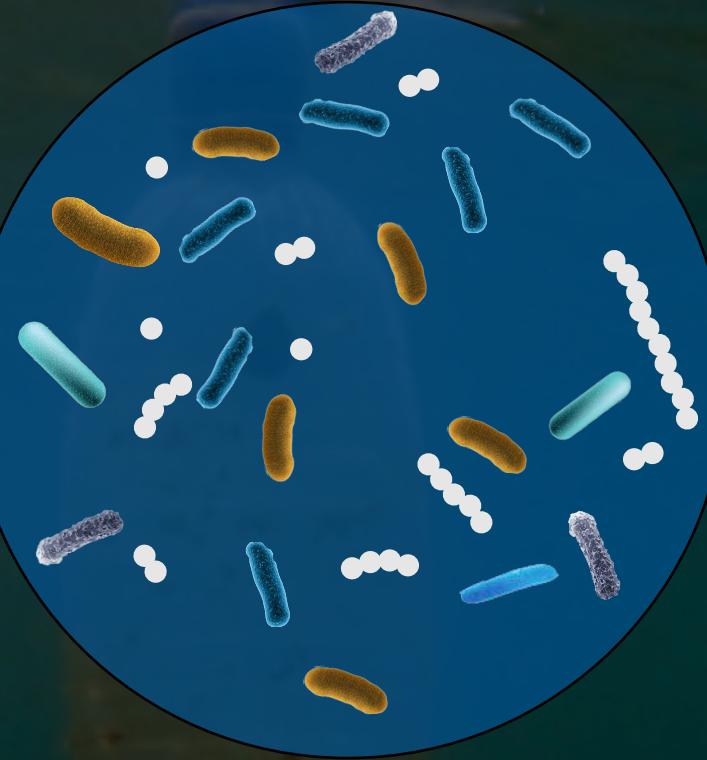


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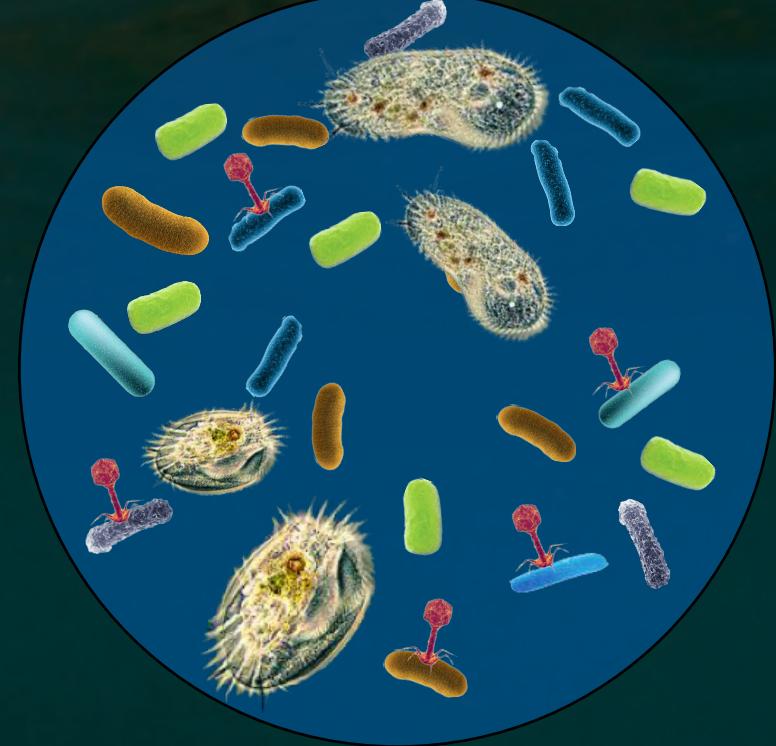
COLONISATION



SELECTION



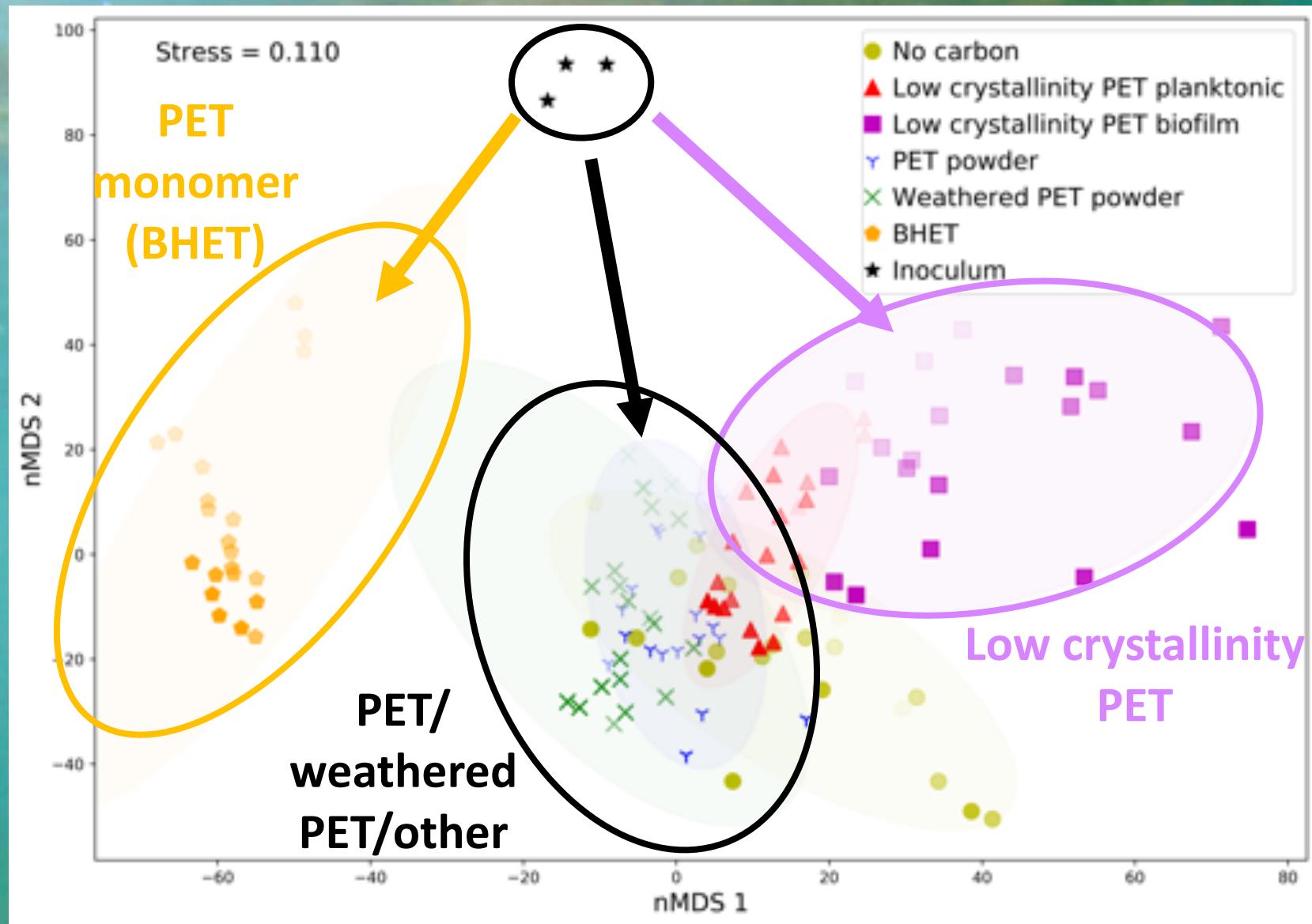
SUCCESSION



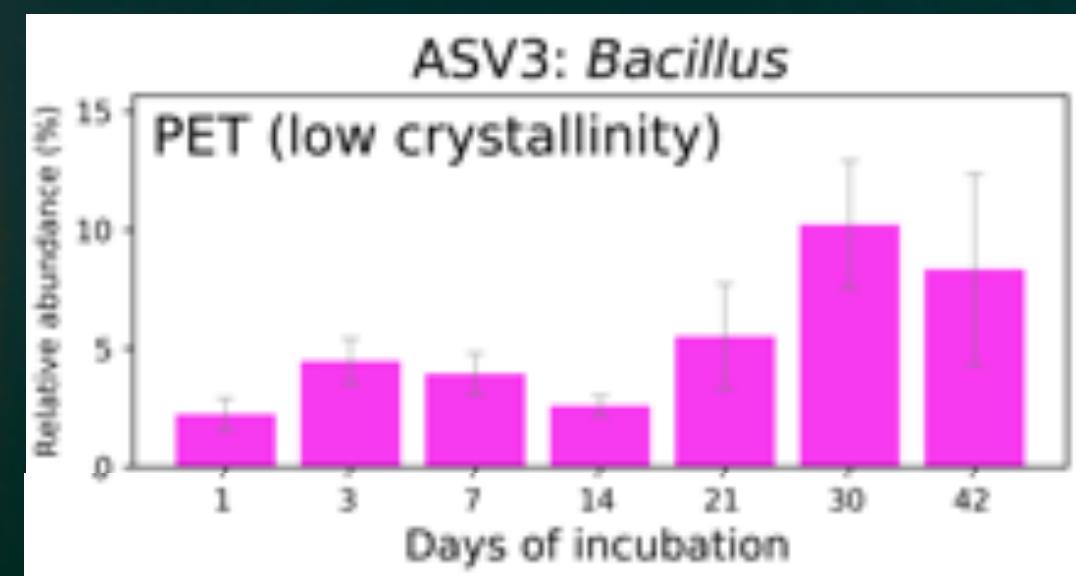
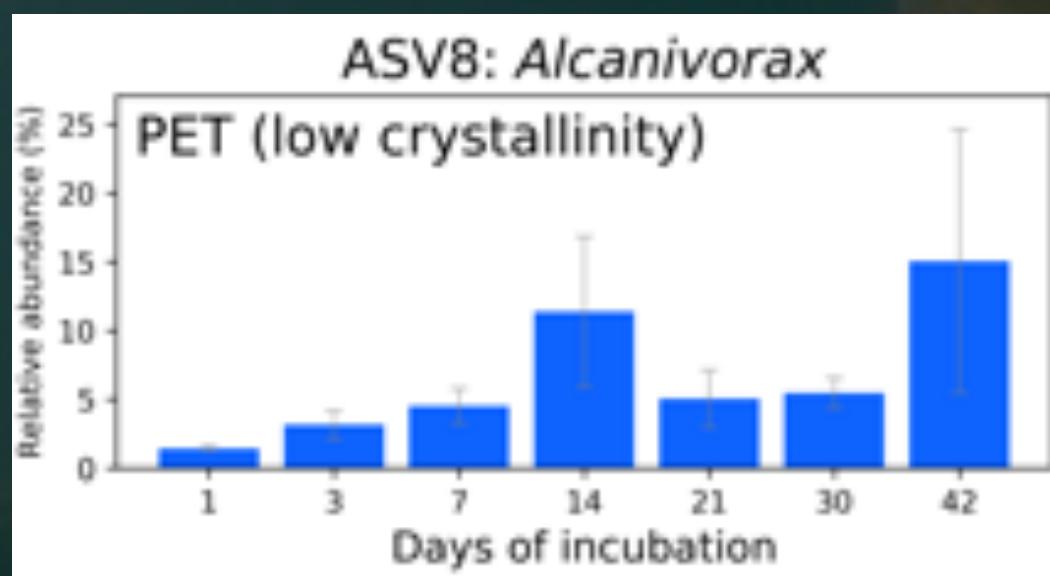
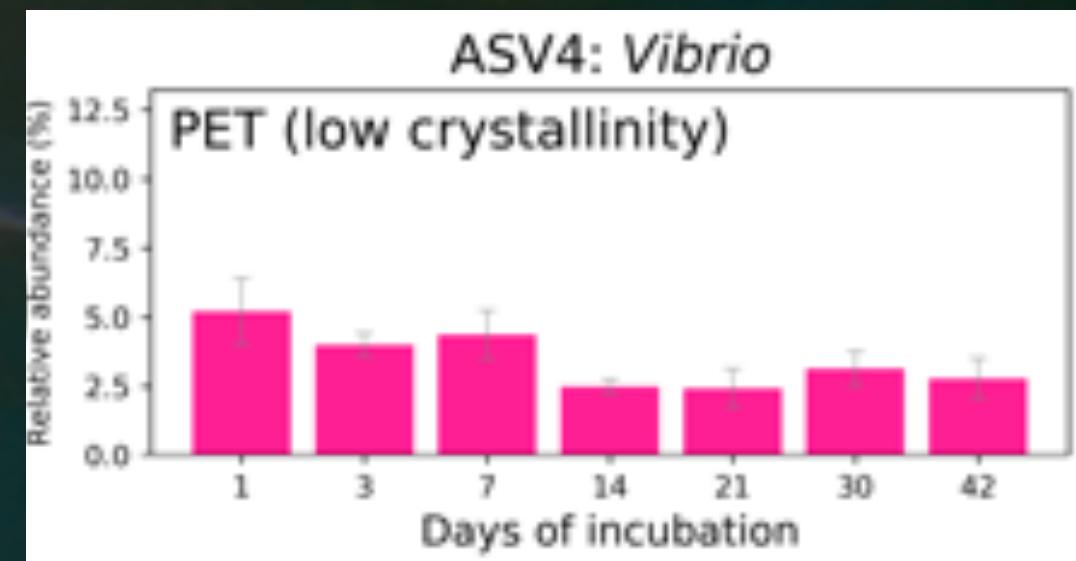
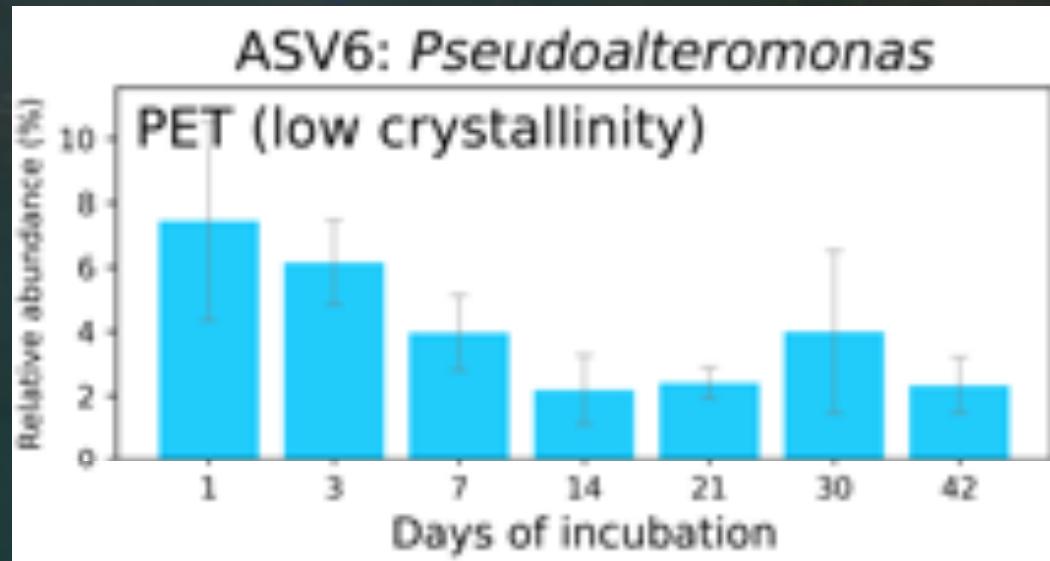
Enrichment of members that can  
degrade

Community succeeded by:  
Cheaters  
Grazers  
Viruses

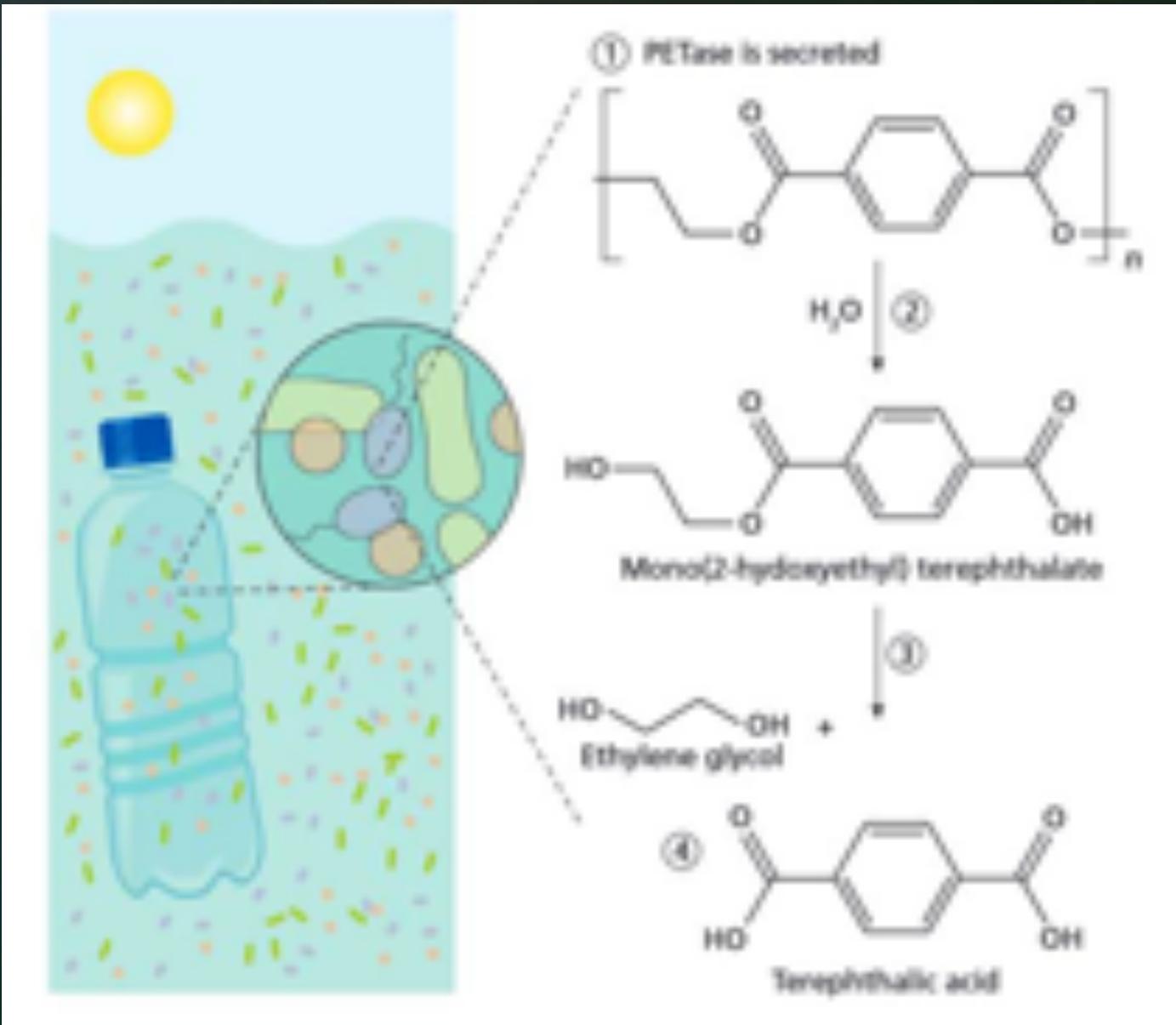
# OBJECTIVE 2: APPLY FINDINGS TO PET (PLASTIC) DEGRADATION



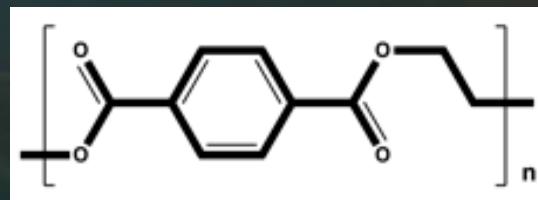
# OBJECTIVE 2: PET COMMUNITY CHANGES



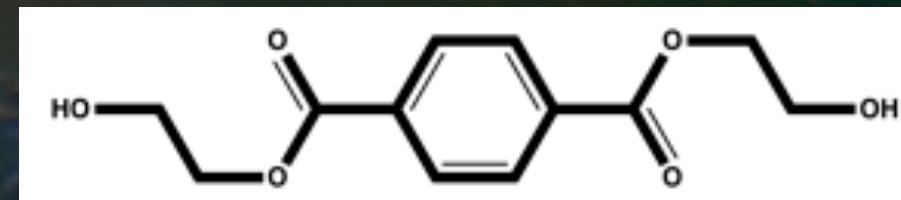
# OBJECTIVE 2: PET DEGRADATION



# OBJECTIVE 2: PET-DEGRADING ISOLATES



PET



PET monomer (BHET)

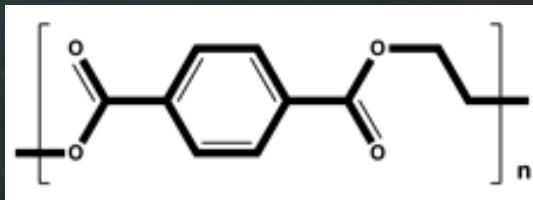
Enrich  
Isolate



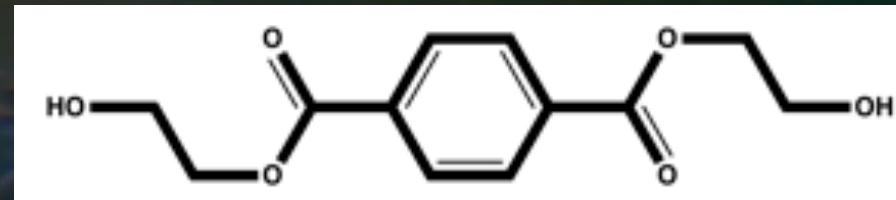
Characterise degradation



# OBJECTIVE 2: PET-DEGRADING ISOLATES



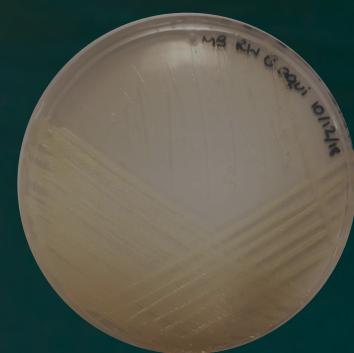
PET



PET monomer (BHET)



*Thioclava* sp.  
(Alphaproteobacteria)



*Bacillus* sp.  
(Firmicutes)

## Proteogenomic characterisation

Genomes sequenced



Proteomics



Analysis of proteomics



## OBJECTIVE 3: TOXIC CHEMICALS ASSOCIATED WITH PLASTICS - PLASTICIZERS



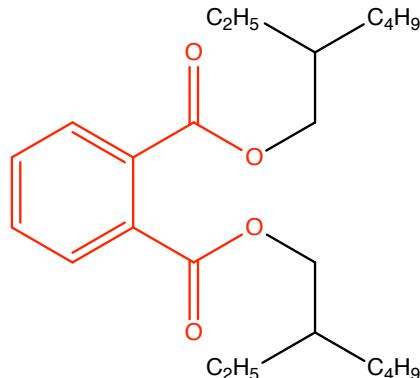
## OBJECTIVE 3: TOXIC CHEMICALS ASSOCIATED WITH PLASTICS - PLASTICIZERS



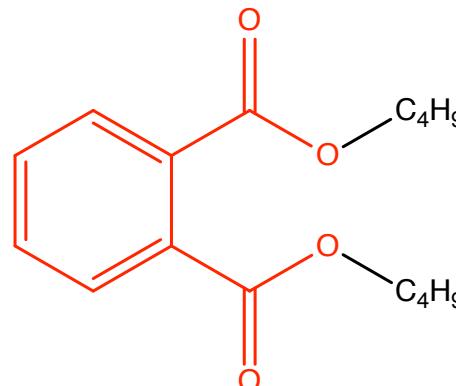
# OBJECTIVE 3: PLASTICIZERS EXPERIMENTAL SETUP

Phthalic acid esters  
Toxic

Bis(2-ethylhexyl phthalate (DEHP)

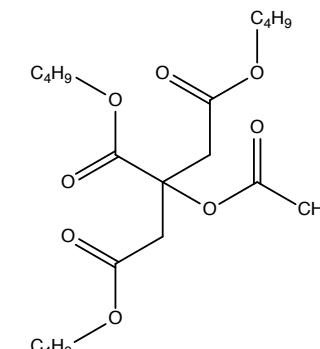


Dibutyl phthalate (DBP)



Citrate  
Biodegradable

Acetyl tributyl citrate (ATBC)



ISOLATES

42

10

2

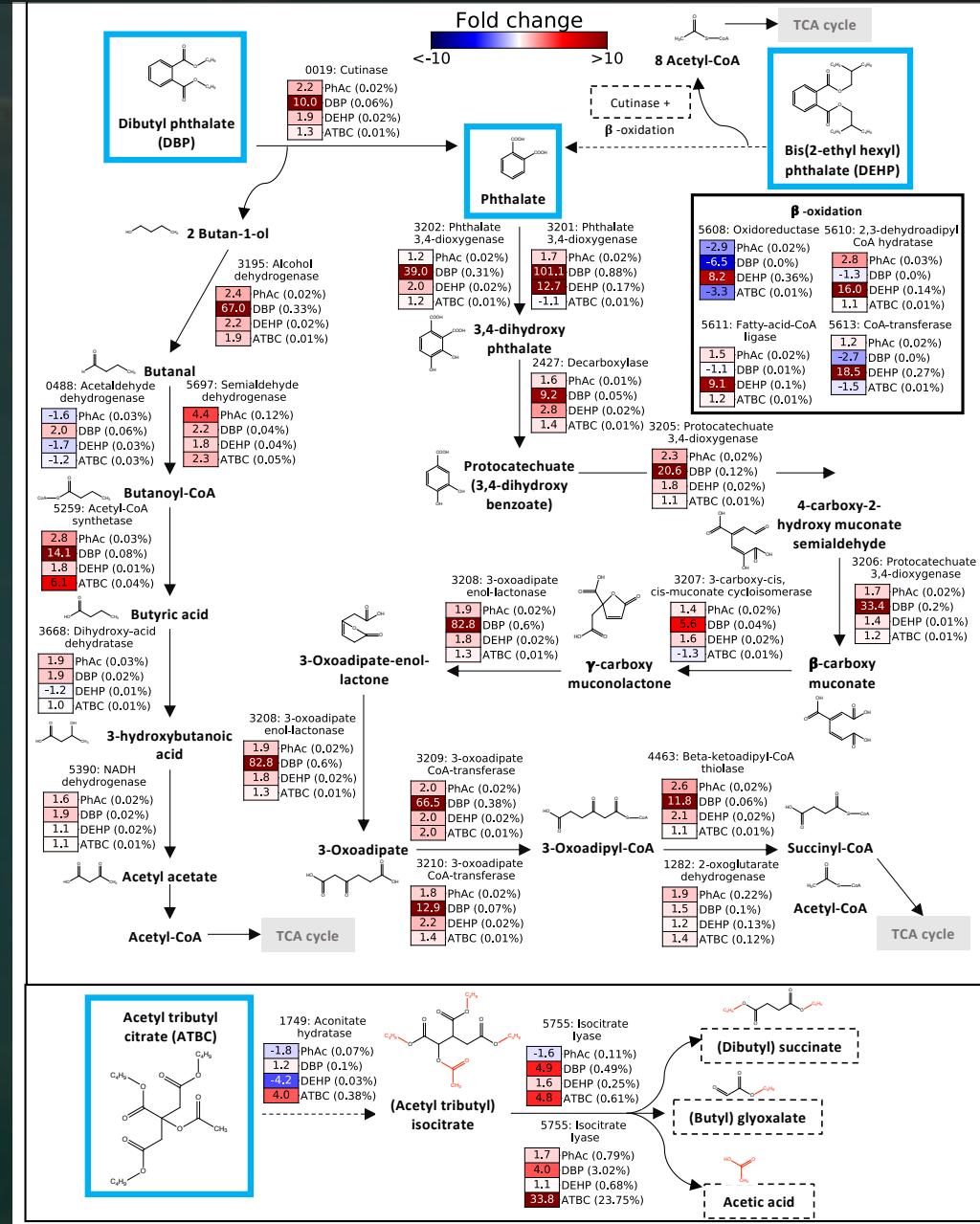
*Halomonas* sp. ATBC28

*Mycobacterium* sp. DBP42

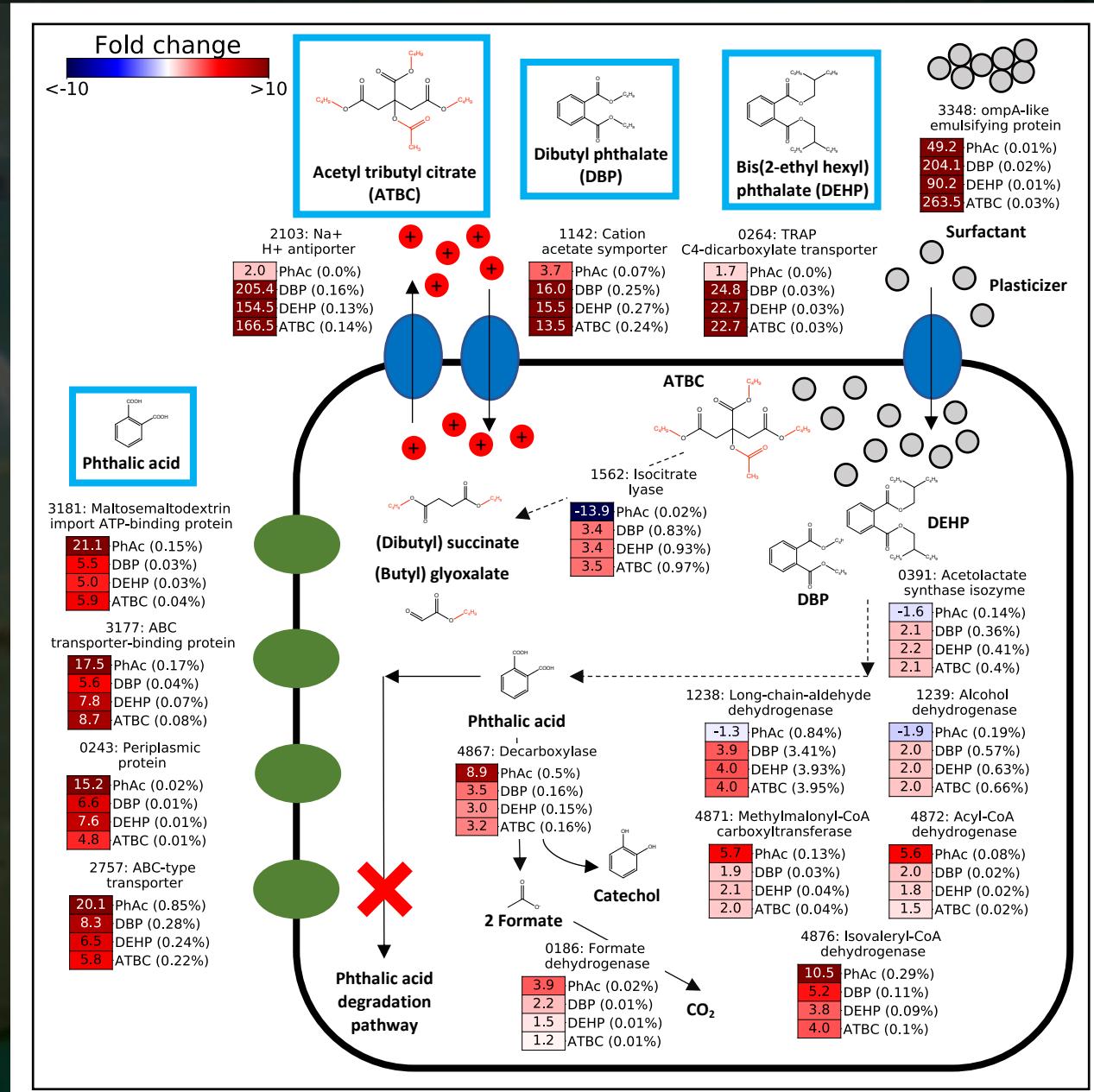


Proteogenomic  
analysis

# Mycobacterium sp. DBP42

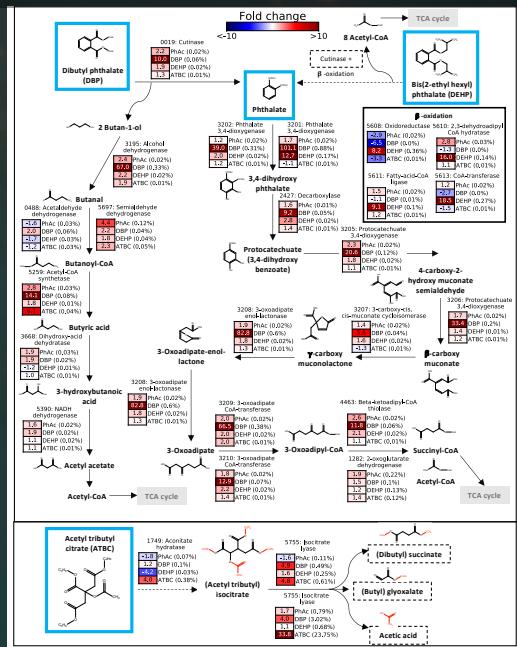


# Halomonas sp. ATBC28

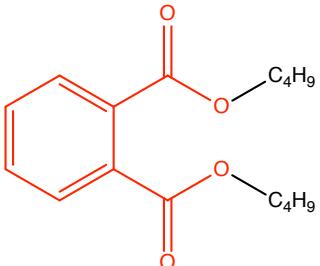


# OBJECTIVE 3: *MYCOBACTERIUM SP. DBP42* PLASTICIZER DEGRADATION

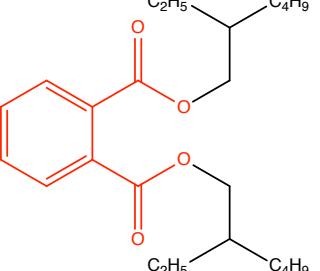
*Mycobacterium sp. DBP42*



**Dibutyl phthalate (DBP)**

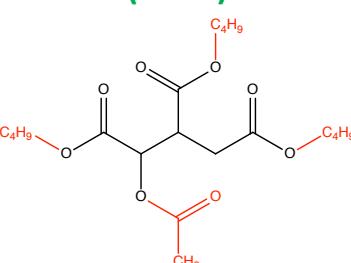
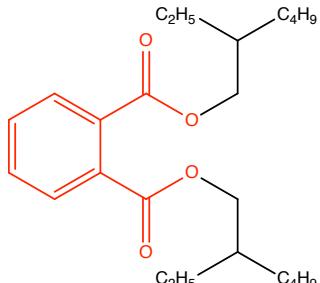
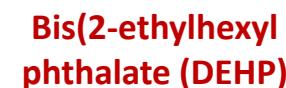
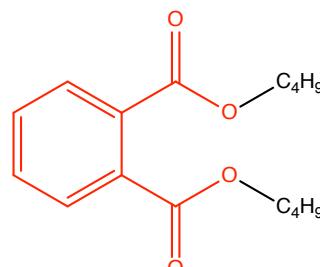
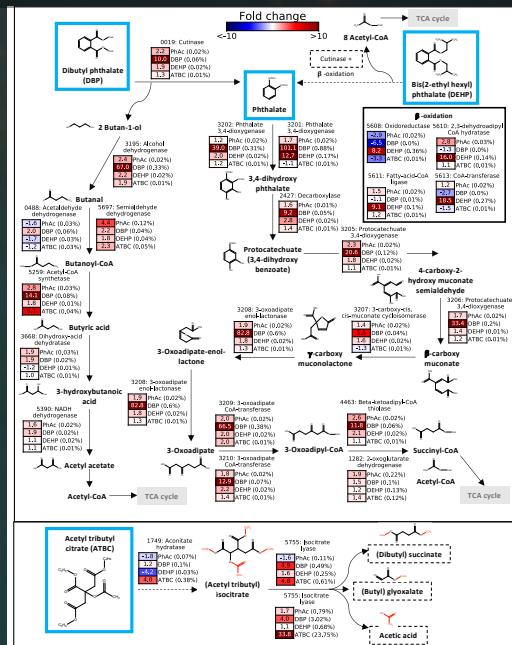


**Bis(2-ethylhexyl phthalate (DEHP))**



# OBJECTIVE 3: *MYCOBACTERIUM* SP. DBP42 PLASTICIZER DEGRADATION

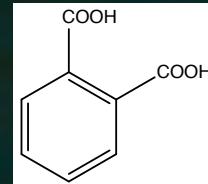
Mycobacterium sp. DBP42



# Cutinase

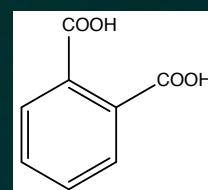
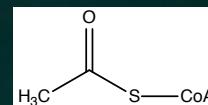


## Butanol



## Phthalic acid

Acetyl-CoA



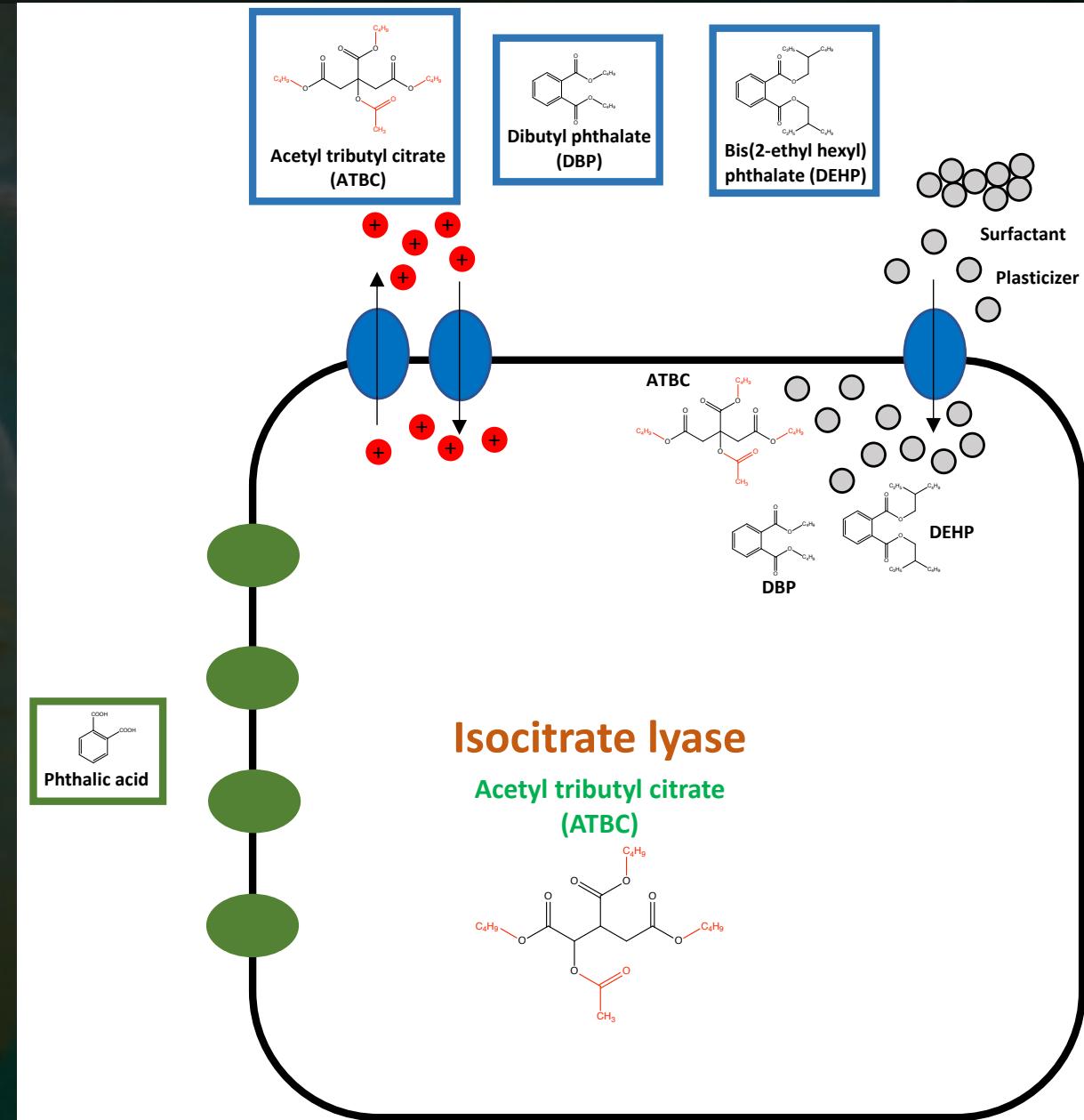
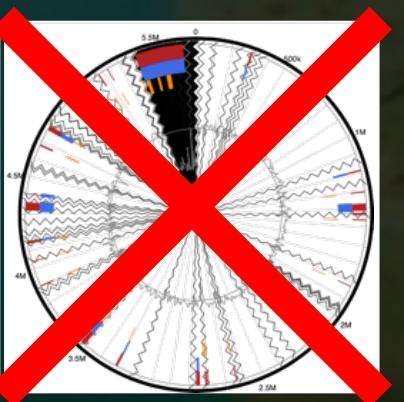
## Phthalic acid

## **Isocitrate lyase 25% exoproteome**

# OBJECTIVE 3: HALOMONAS SP. ATBC28 PLASTICIZER DEGRADATION



???



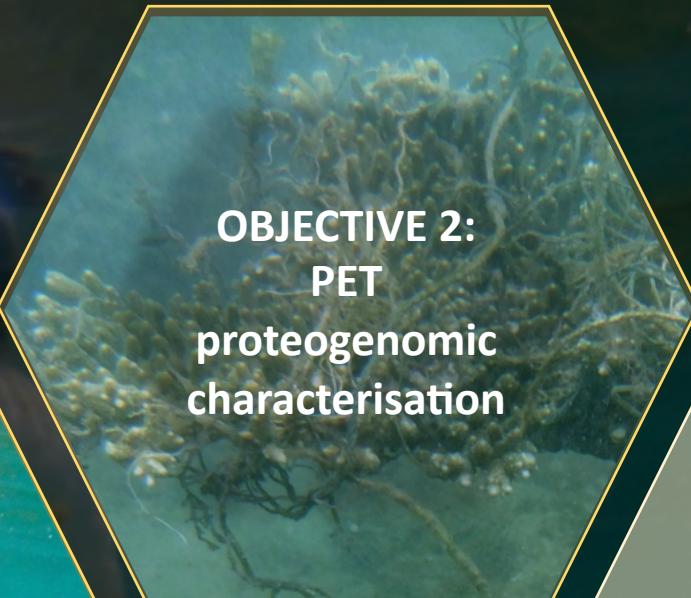
# SUMMARY



**OBJECTIVE 1:**  
Community  
succession on  
chitin



**OBJECTIVE 2:**  
PET community  
succession



**OBJECTIVE 2:**  
PET  
proteogenomic  
characterisation



**OBJECTIVE 3:**  
Plasticizer  
proteogenomics



Are plastics  
being  
biodegraded?

# ACKNOWLEDGEMENTS

**Supervisors:** Joseph Christie-Oleza  
Matthew Gibson

**Christie-Oleza group:**



A photograph of a clear plastic bottle with a dark cap, floating horizontally in a vast, blue-green ocean. The water has small white caps, suggesting a slightly choppy sea. The bottle is positioned vertically in the center of the frame.

Thanks for listening!

QUESTIONS?