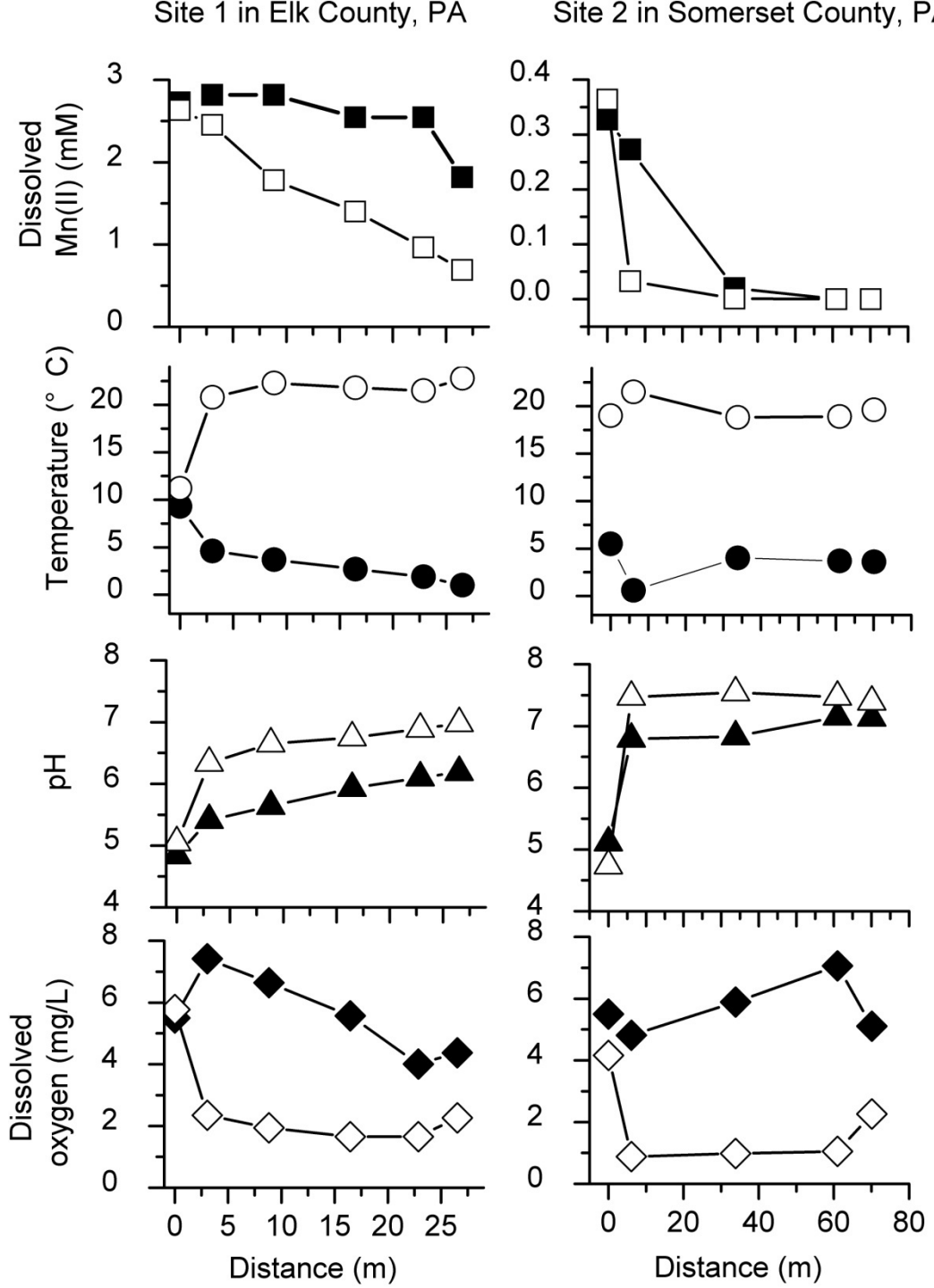
Circumneutral-pH Biological Mn(II) Oxidation

Fairview, PA
150 mg/L Mn(II)! influent
10 gal/min
Limestone treatment system

MS2 - Figure 1

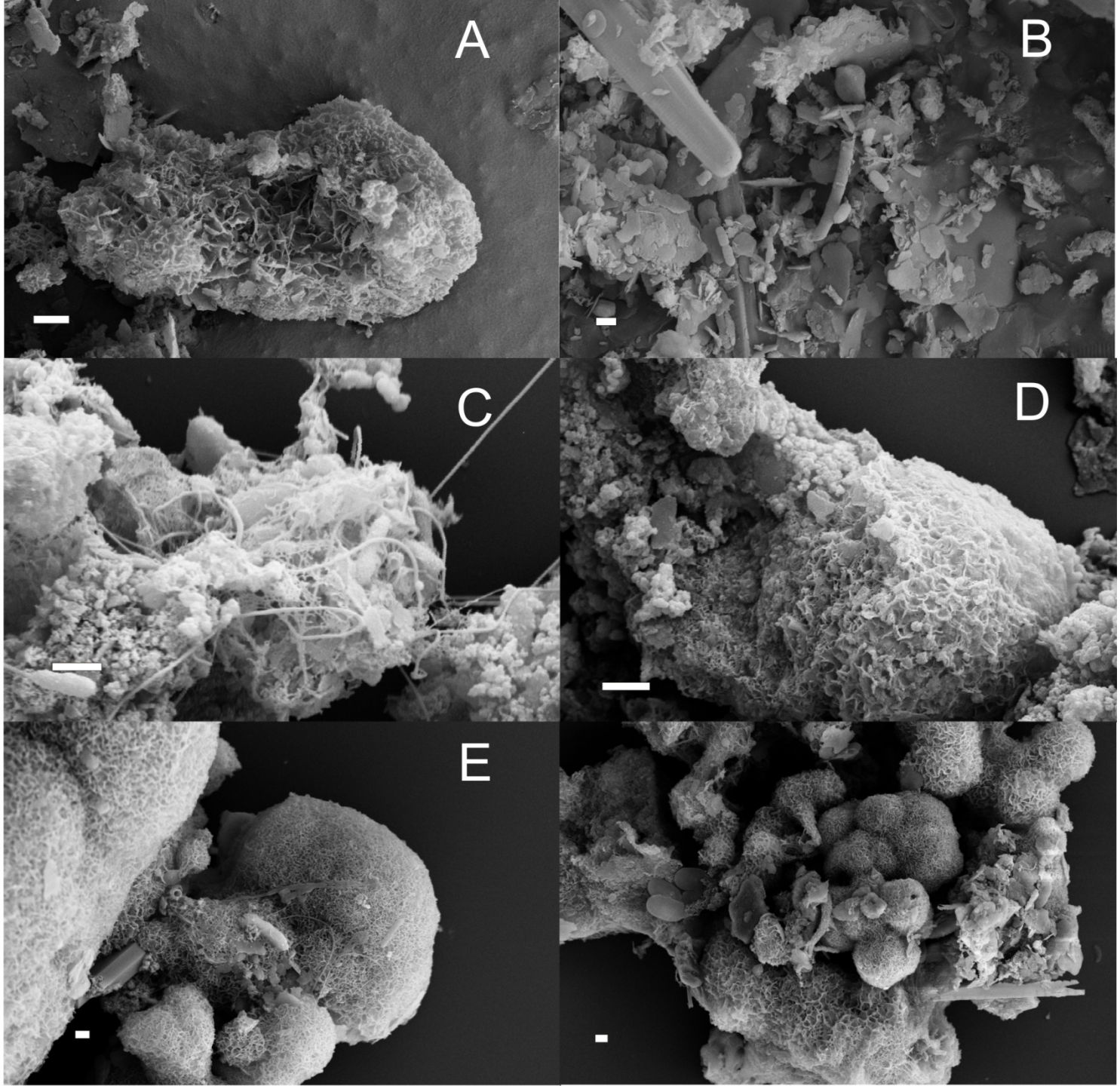

Site 1 in Elk County, PA
Site 2 in Somerset County, PA
Dissolved Mn(II) (mM)
Temperature (° C)
pH
Dissolved oxygen (mg/L)
Distance (m)
Distance (m)

MS1 - Figure 1

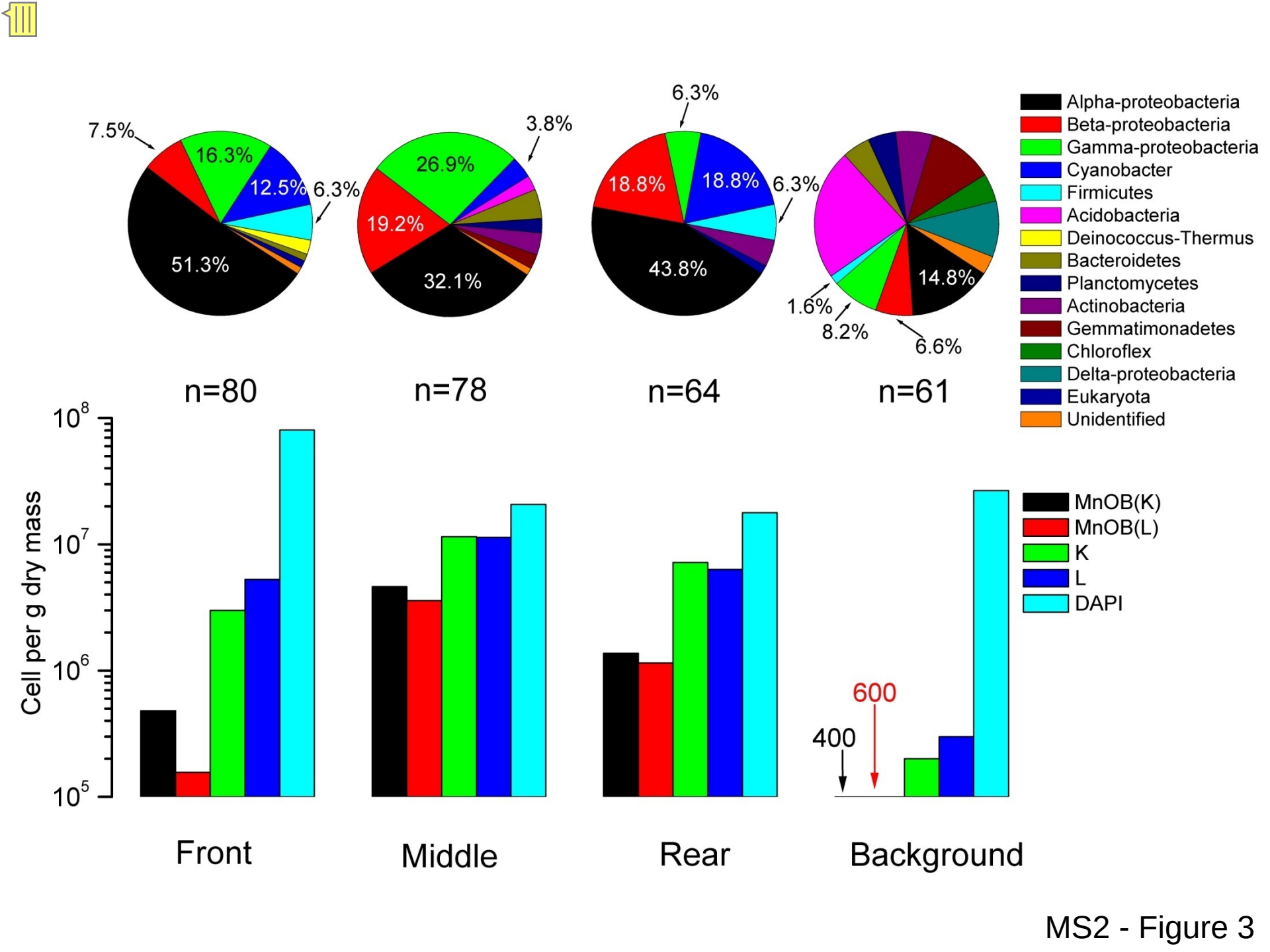
Ditch in limestone bed provides passive aeration. Manganese oxide (MnO_x) precipitates coat ditch bottom.

MS2 - Figure 1

MnO_x-coated limestone

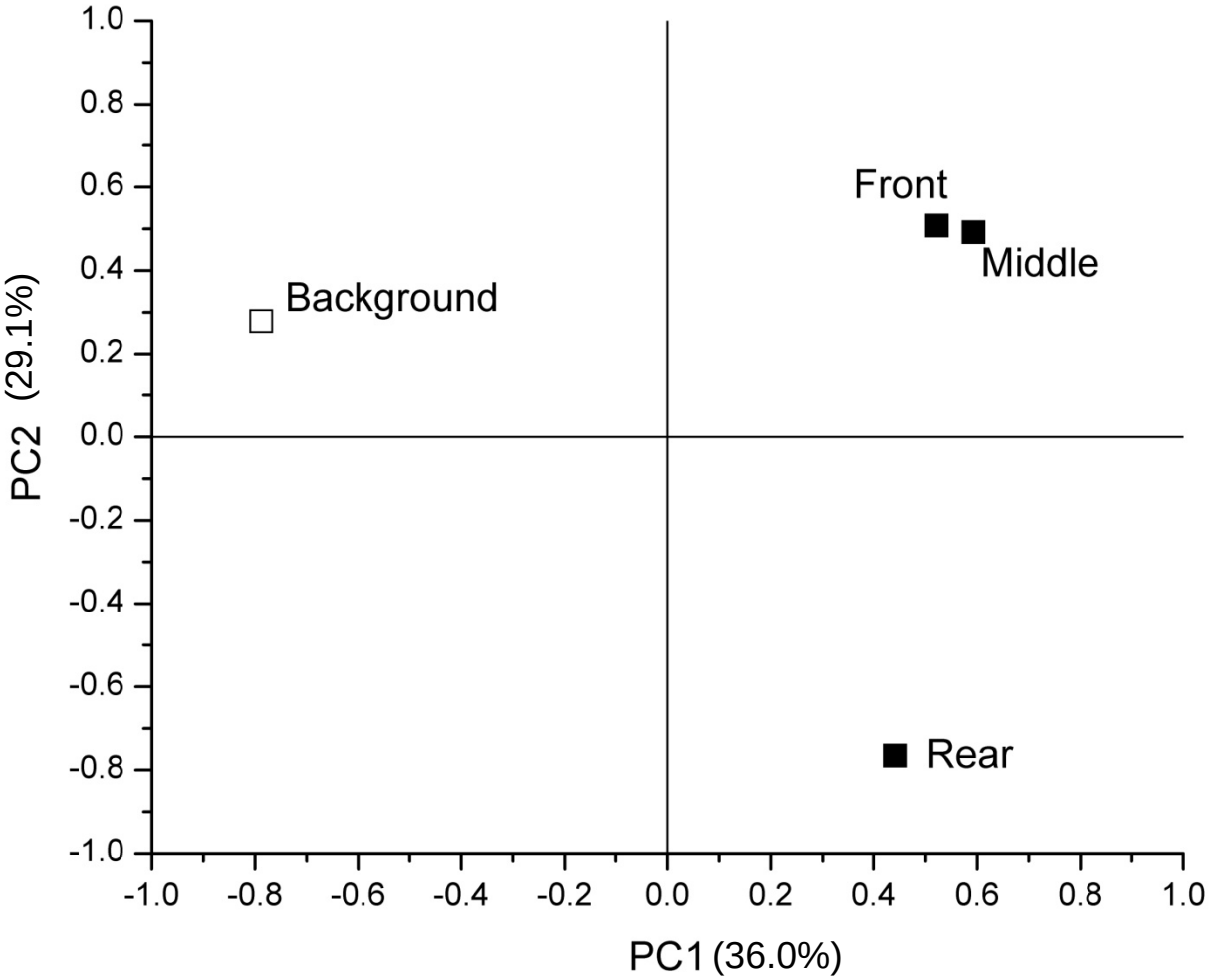


MS1 - Figure 3

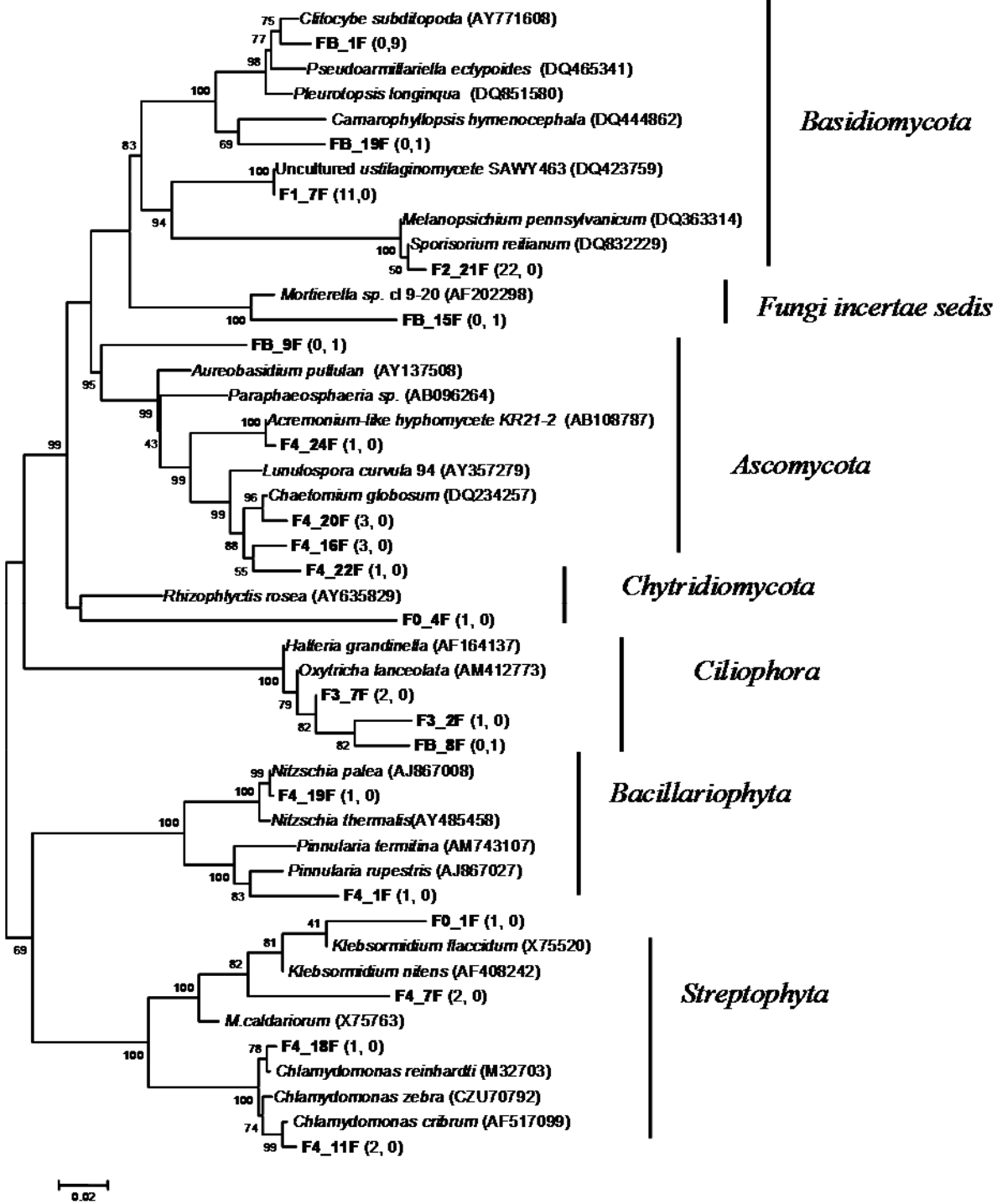

7.5%
16.3%
12.5%
6.3%
51.3%
3.8%
26.9%
19.2%
32.1%
6.3%
18.8%
18.8%
6.3%
43.8%
14.8%
1.6%
8.2%
6.6%
Alpha-proteobacteria
Beta-proteobacteria
Gamma-proteobacteria
Cyanobacter
Firmicutes
Acidobacteria
Deinococcus-Thermus
Bacteroidetes
Planctomycetes
Actinobacteria
Gemmatimonadetes
Chloroflex
Delta-proteobacteria
Eukaryota
Unidentified
n=80
n=78
n=64
n=61
Cell per g dry mass
10^8
10^7
10^6
10^5
MnOB(K)
MnOB(L)
K
L
DAPI
600
400
Front
Middle
Rear
Background

MS2 - Figure 3

Principle Component Analysis

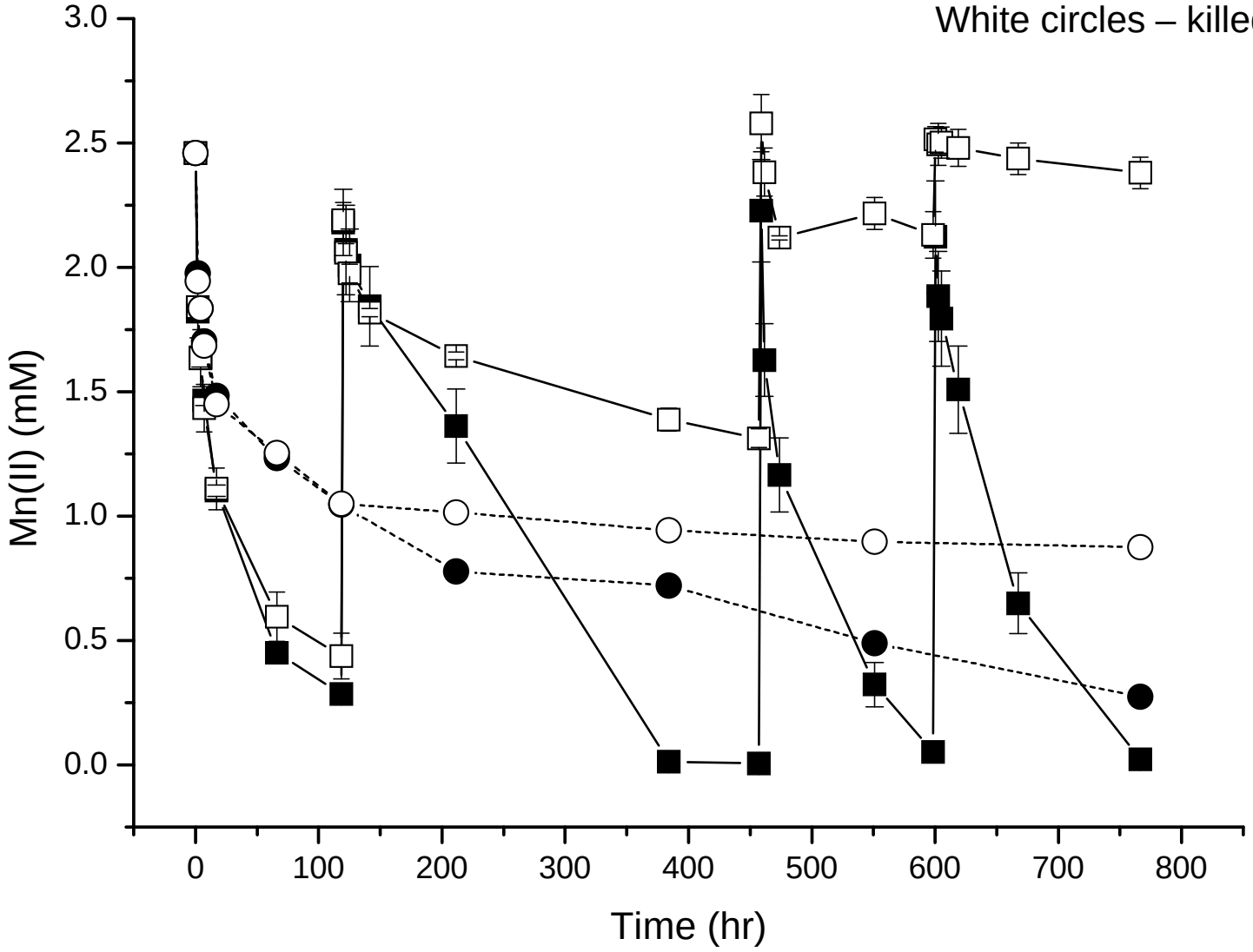


MS2 - Figure 7


Clitocybe subditopoda (AY771608)
FB_1F (0,9)
Pseudoarmillariella ectypoides (DQ465341)
Pleurotopsis longinqua (DQ851580)
Camarophyllopsis hymenocephala (DQ444862)
FB_19F (0,1)
Uncultured ustilaginomycete SAWY463 (DQ423759)
F1_7F (11,0)
Melanopsichium pennsylvanicum (DQ363314)
Sporisorium reilianum (DQ832229)
F2_21F (22, 0)
Basidiomycota
Mortierella sp. cl 9-20 (AF202298)
FB_15F (0, 1)
Fungi incertae sedis
FB_9F (0, 1)
Aureobasidium pullulan (AY137508)
Paraphaeosphaeria sp. (AB096264)
Acremonium-like hyphomycete KR21-2 (AB108787)
F4_24F (1, 0)
Lunulospora curvula 94 (AY357279)
Chaetomium globosum (DQ234257)
F4_20F (3, 0)
F4_16F (3, 0)
F4_22F (1, 0)
Ascomycota
Rhizophlyctis rosea (AY635829)
F0_4F (1, 0)
Chytridiomycota
Halteria grandinella (AF164137)
Oxytricha lanceolata (AM412773)
F3_7F (2, 0)
F3_2F (1, 0)
FB_8F (0,1)
Ciliophora
Nitzschia palea (AJ867008)
F4_19F (1, 0)
Nitzschia thermalis(AY485458)
Pinnularia termitina (AM743107)
Pinnularia rupestris (AJ867027)
F4_1F (1, 0)
Bacillariophyta
F0_1F (1, 0)
Klebsormidium flaccidum (X75520)
Klebsormidium nitens (AF408242)
F4_7F (2, 0)
M.caldariorum (X75763)
F4_18F (1, 0)
Chlamydomonas reinhardti (M32703)
Chlamydomonas zebra (CZU70792)
Chlamydomonas cribrum (AF517099)
F4_11F (2, 0)
Streptophyta
0.02

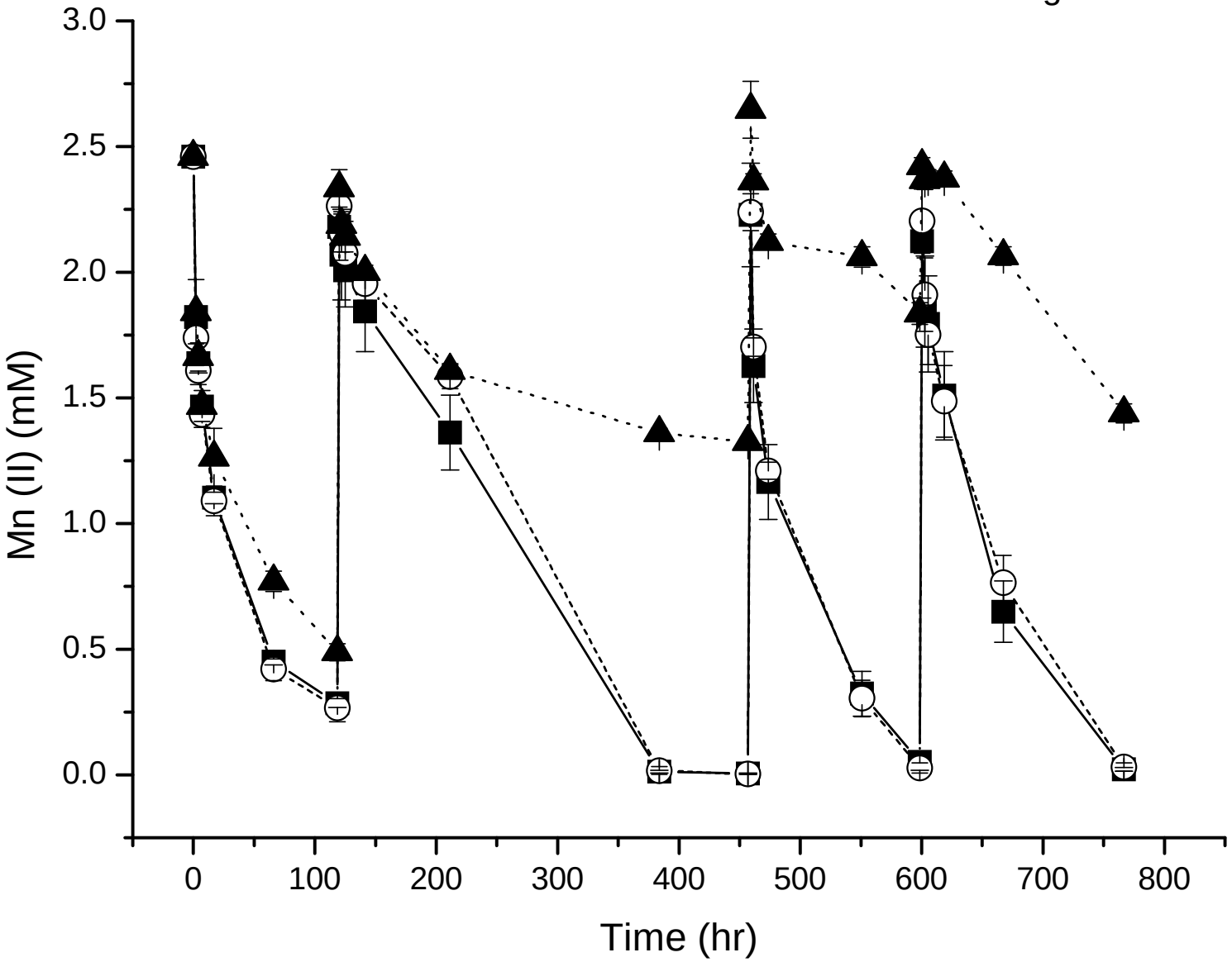
MS2 - Figure 5

Black squares – live under air
White squares – live under N2
Black circles – killed under air
White circles – killed under N2



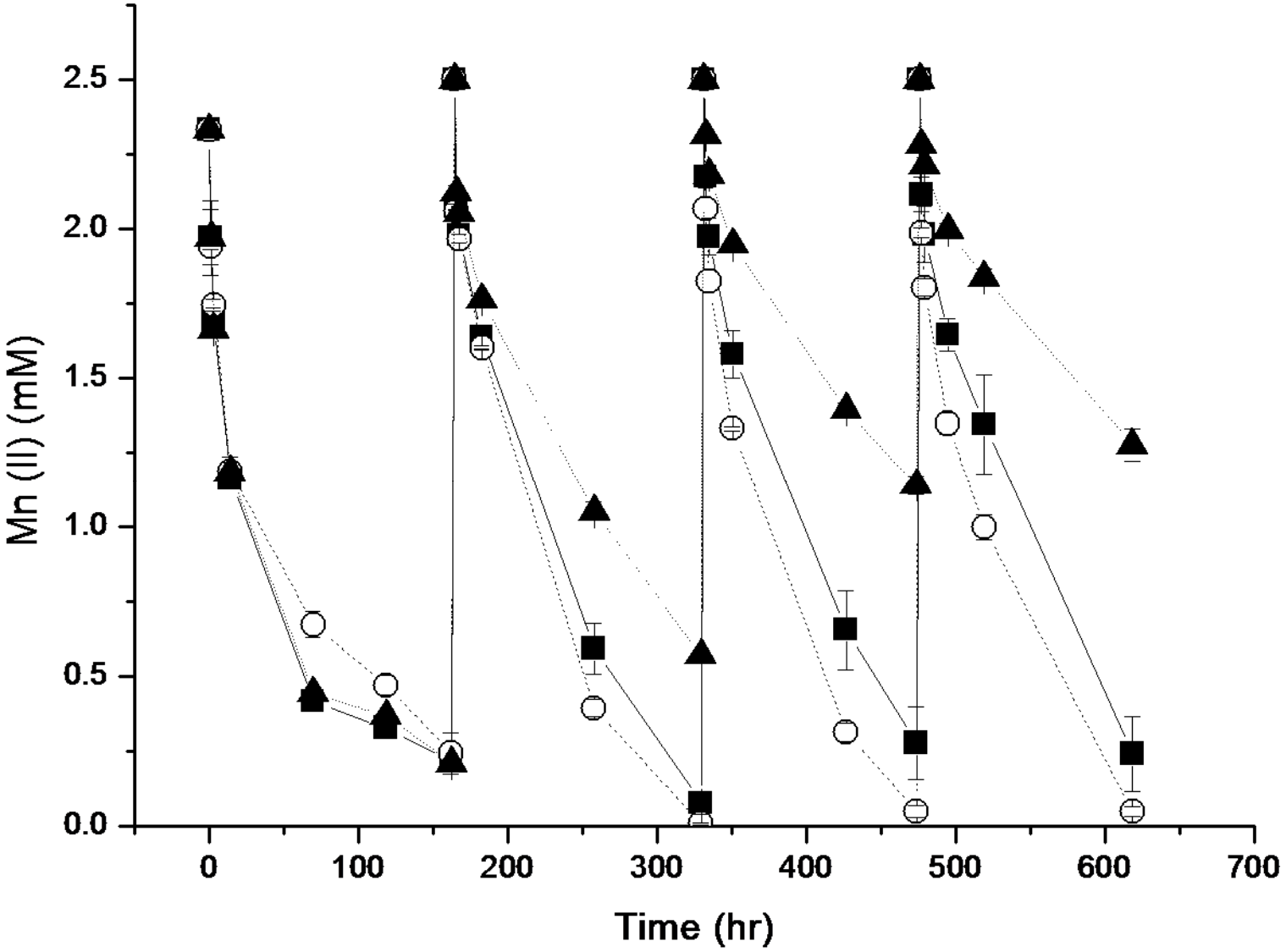
MS3 - Figure 1

White circles – live under 21% pO2
Black squares – live under 10% pO2
Black triangles – live under 1% pO2



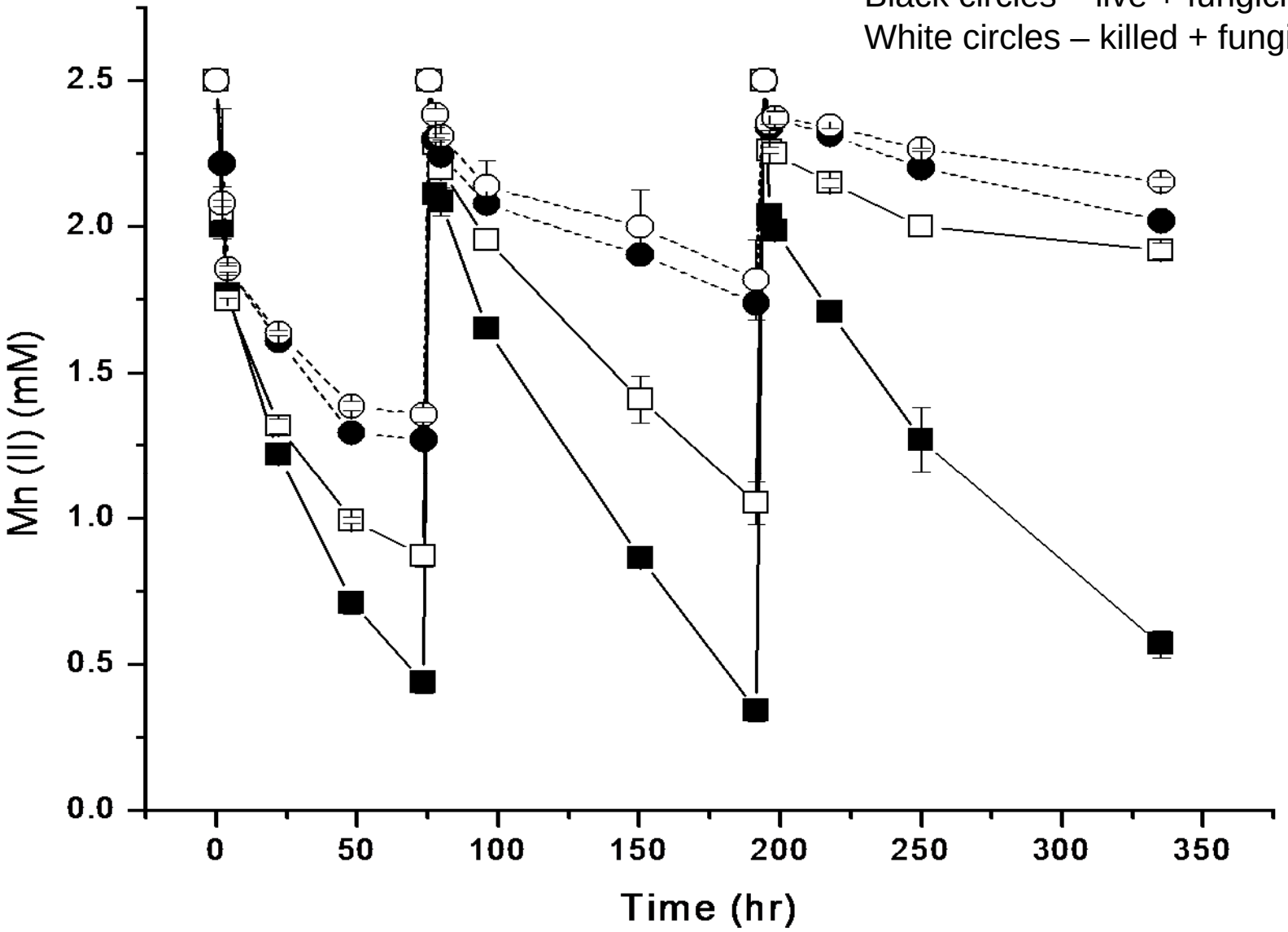
MS3 - Figure 2

Black squares – no org-C addition
White circles – + glucose
Black triangles – + carboxymethylcellulose

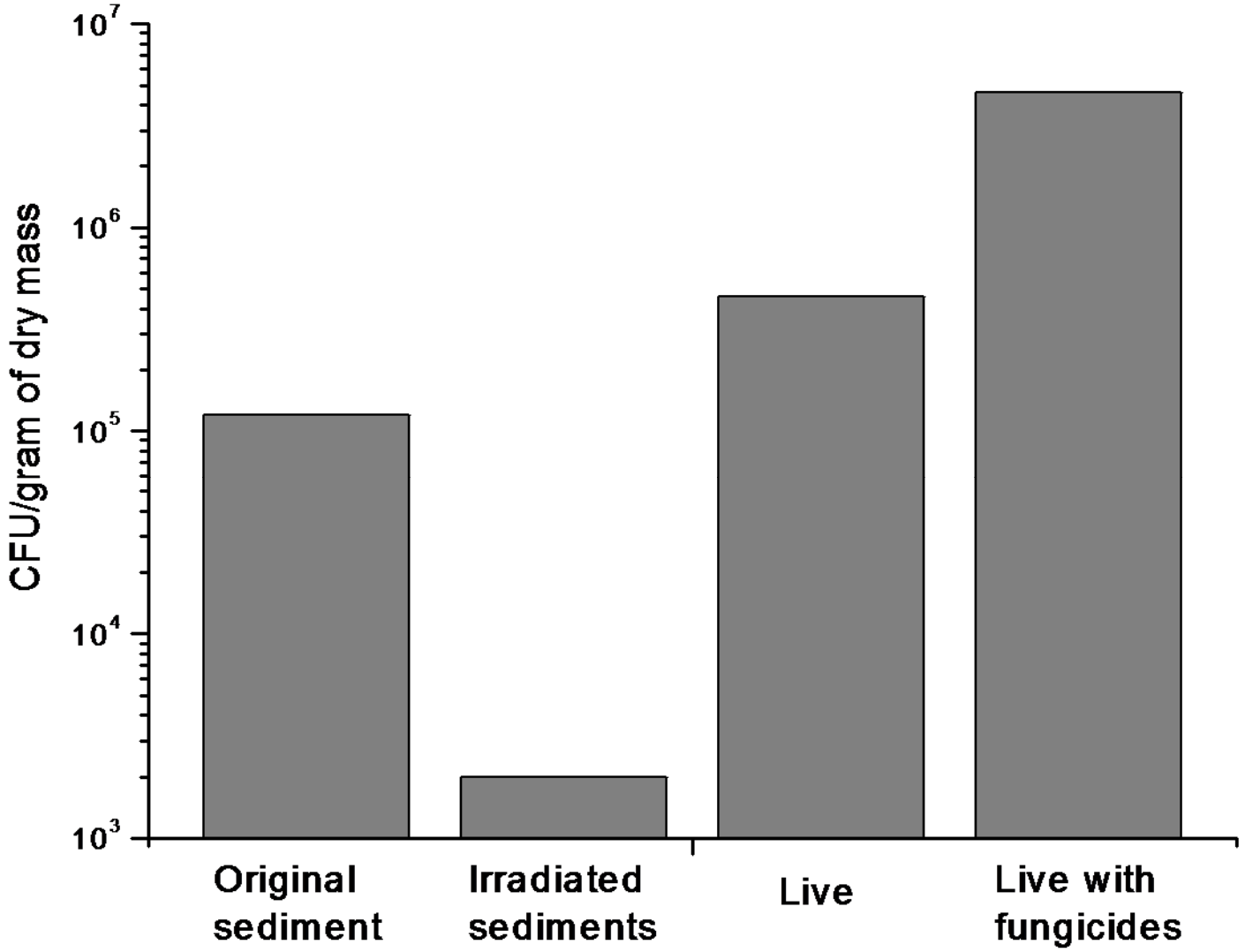


MS3 - Figure 3

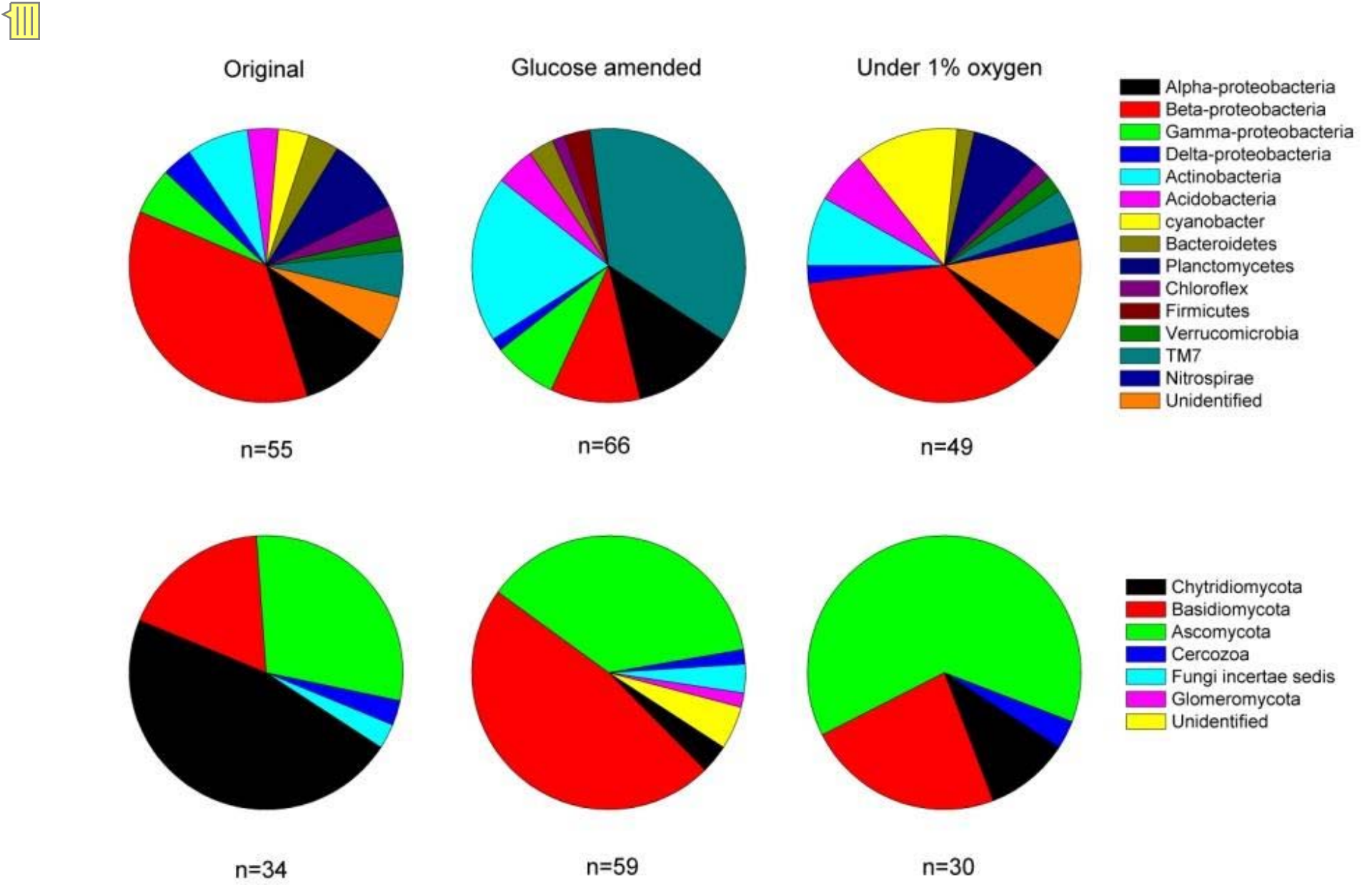
Black squares – live no fungicides
White squares – killed no fungicides
Black circles – live + fungicides
White circles – killed + fungicides



MS3 - Figure 4


CFU/gram of dry mass
10^7
10^6
10^5
10^4
10^3
Original sediment
Irradiated sediments
Live
Live with fungicides

MS3 - Figure 5


Original
Glucose amended
Under 1% oxygen
Alpha-proteobacteria
Beta-proteobacteria
Gamma-proteobacteria
Delta-proteobacteria
Actinobacteria
Acidobacteria
cyanobacter
Bacteroidetes
Planctomycetes
Chloroflex
Firmicutes
Verrucomicrobia
TM7
Nitrospirae
Unidentified
n=55
n=66
n=49
Chytridiomycota
Basidiomycota
Ascomycota
Cercozoa
Fungi incertae sedis
Glomeromycota
Unidentified
n=34
n=59
n=30

MS3 - Figure 6