Evaluation of Hydrocyclone/UV Ballast Treatment aboard the cruise ship SEA PRINCESS

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Hyde Marine

HONEST SOLUTIONS. HONEST EQUIPMENT.

WHAT'S NEW

- HOME
- WHY CHOOSE HYDE
- MARINE
- OIL SPILL
- BALLAST WATER TREATMENT
- WHAT'S NEW
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- LINKS

BALLAST WATER TREATMENT SYSTEM INSTALLATIONS

Hyde Marine, Inc. of Cleveland, Ohio, is delivering four new full-scale OptiMar Ballast Water Treatment Systems during the second half of 2001. This state of the art technology, manufactured by OptiMarin A/S of Stavanger, Norway, is designed to control the spread of Aquatic Nuisance Species in ship's ballast water.

Hyde Marine delivered the first ever full-scale ballast water treatment system using ultraviolet light with cyclonic separation pretreatment for installation aboard the cruise ship "Regal Princess". This system

Installation aboard "Sea Princess"

Done Internet

Hyde OptiMarin

OPTIMAR BALLAST SYSTEMS

OptiMar Ballast Systems - Practical Solutions for Ballast Water Treatment

OptiMar Ballast Treatment System installed aboard the cruise ship M/S "Regal Princess" in May 2000

Problem

Around the world more than 10 billion tons of ballast water are carried in ships each year containing thousands of species of aquatic animals and plants. This creates problems for the marine environment and human health and threatens economies that depend on healthy aquatic ecosystems. The transportation of ballast water can not be stopped, but the transfer of harmful aquatic organisms and pathogens can be minimized by deep sea exchange or suitable treatment. Ballast water exchange is costly, time consuming and is at best only 90% effective. Pumps may have to run for 3-4 days, which increases fuel consumption, and wear and tear on equipment and stack emissions. Ballast water exchange can result in increased hull stresses and stability problems.

OptiMar Ballast System

The OptiMar Ballast System offers an effective and reliable solution based on solids separation and UV irradiation. The OptiMar system utilizes existing ballast pumps and piping. Standard systems are available for flow rates from 100 m3/h up to 3000 m3/h.

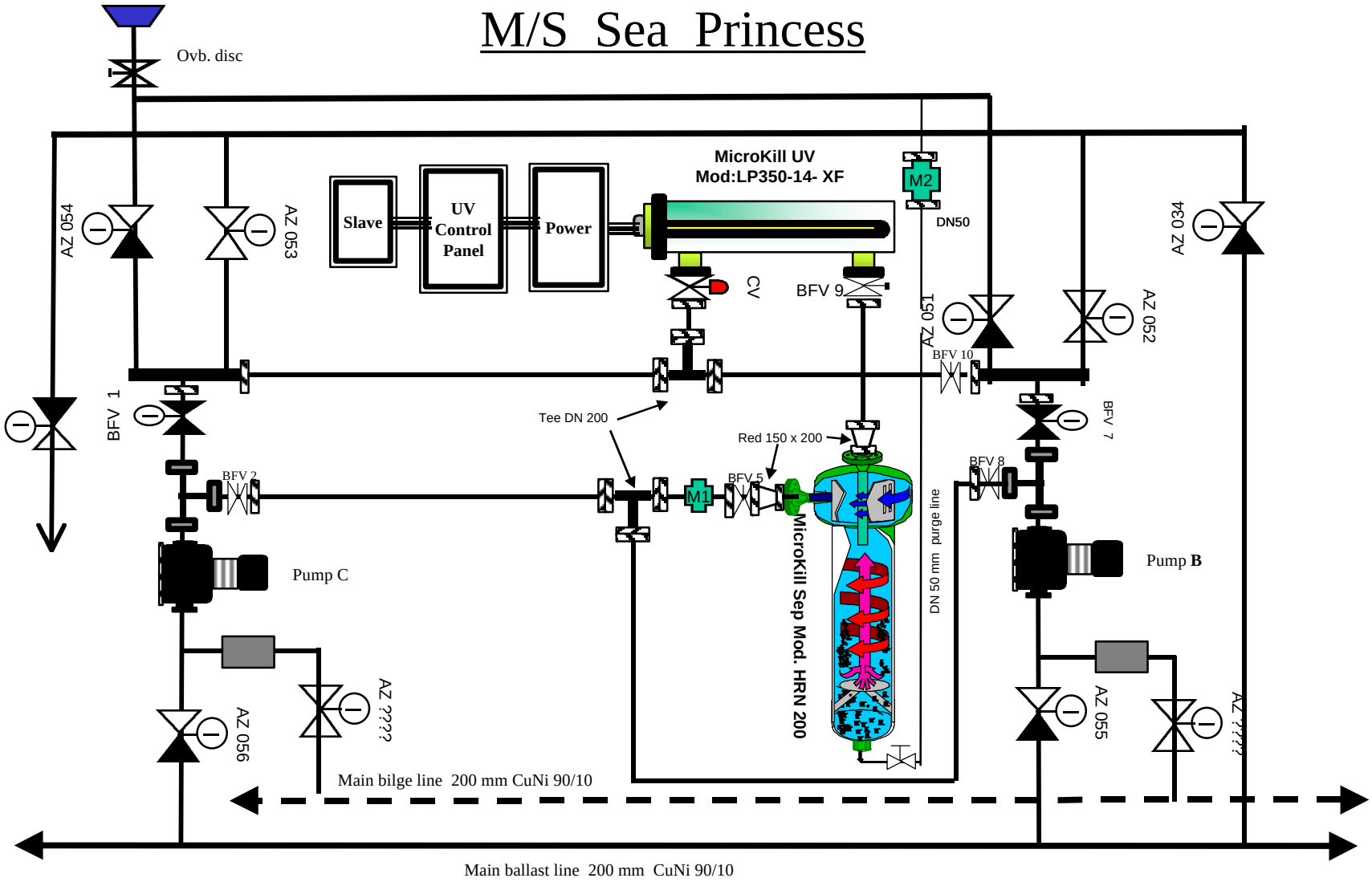
So…

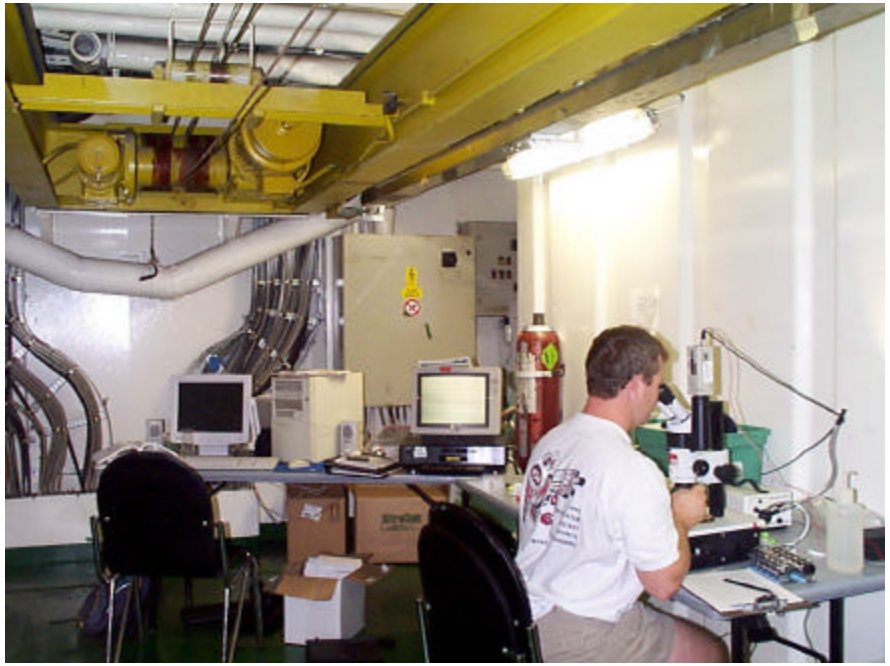
Let’s test the system

Conclusions (at the moment):

- We find no significant effect from the hydrocyclone/UV treatment
- The largest measurable ‘effect’ derives from the ballast tank itself

Flow Diagram
M/S Sea Princess



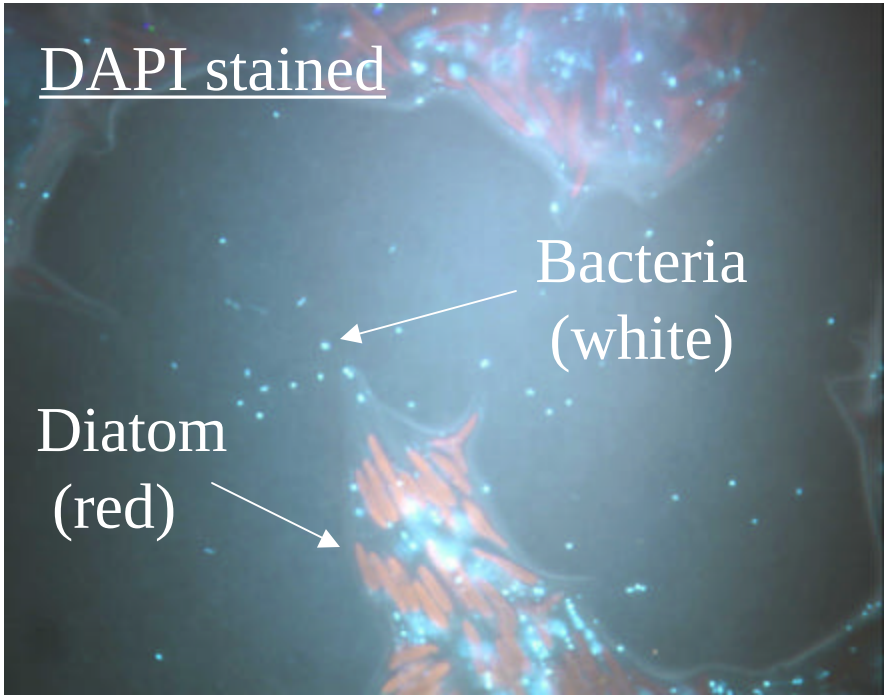


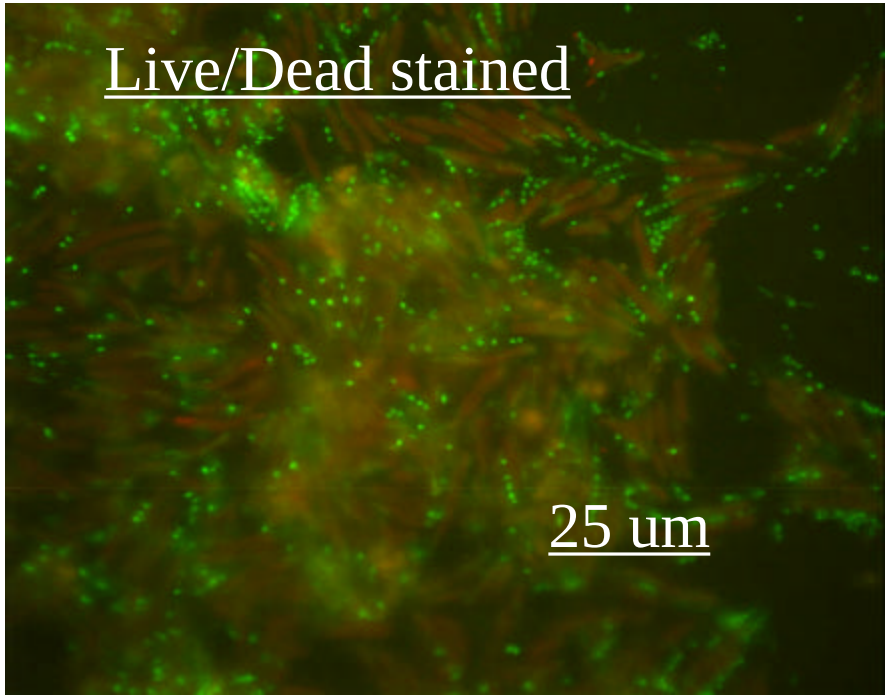
Measurement parameters:

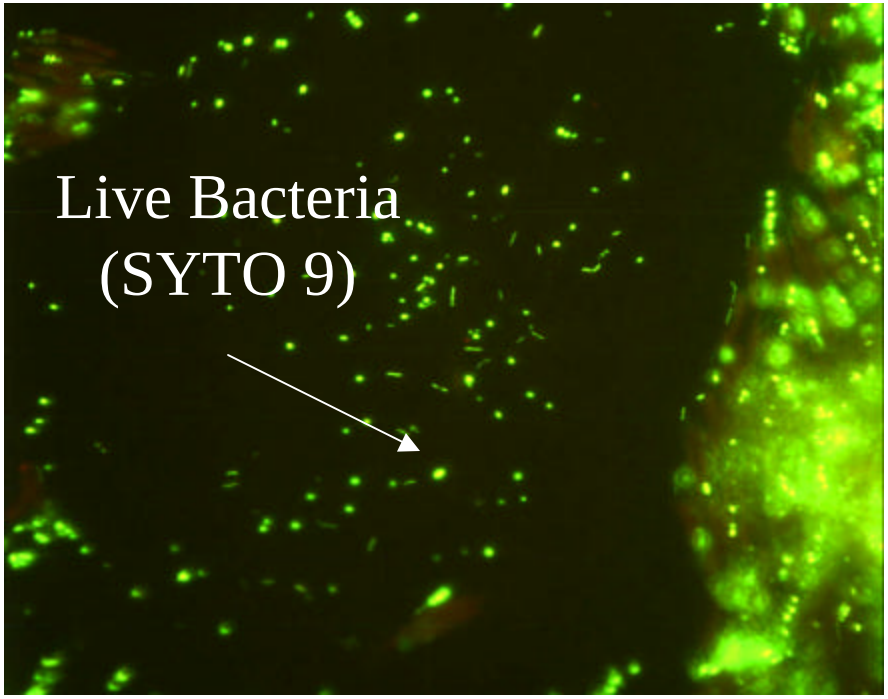
- Virus-like particles (VLP) – 0.02 um aluminum Anodisc filter, Syber-Gold Stain, Epifluorescence enumeration
- Bacteria – same as VLP,
- Phytoplankton – epifluorescence enumeration, bulk chl a (acetone extraction), HPLC determined chlorophylls and carotenoids
- Zooplankton – taxonomic abundance, survivorship
- Pulse Amplitude Modulated Fluorescence (PAM) – Walz PAM 2000 (diode detection); Walz Water PAM (photomultipier detection)
- ATP – luciferin/luciferase, Turner 20/20 luminometer

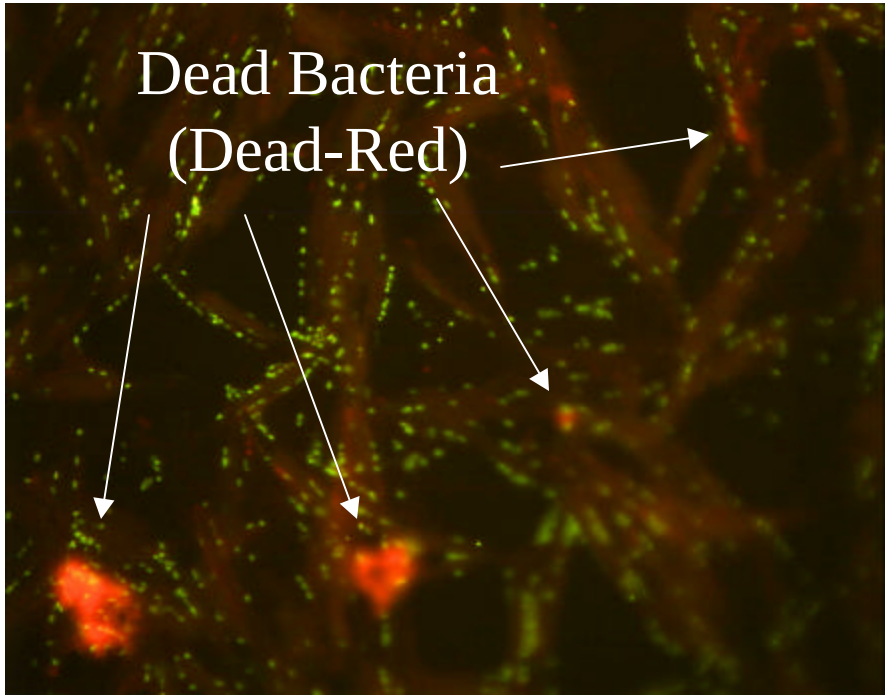
- Others:

  Carbon/Nitrogen (POC, PON)
  Electron Transport System (ETS) respiratory activity
  Bacteria - culture plates, nucleic acid ‘Live/Dead’ stains
  Grow out experiments – phytoplankton, zooplankton

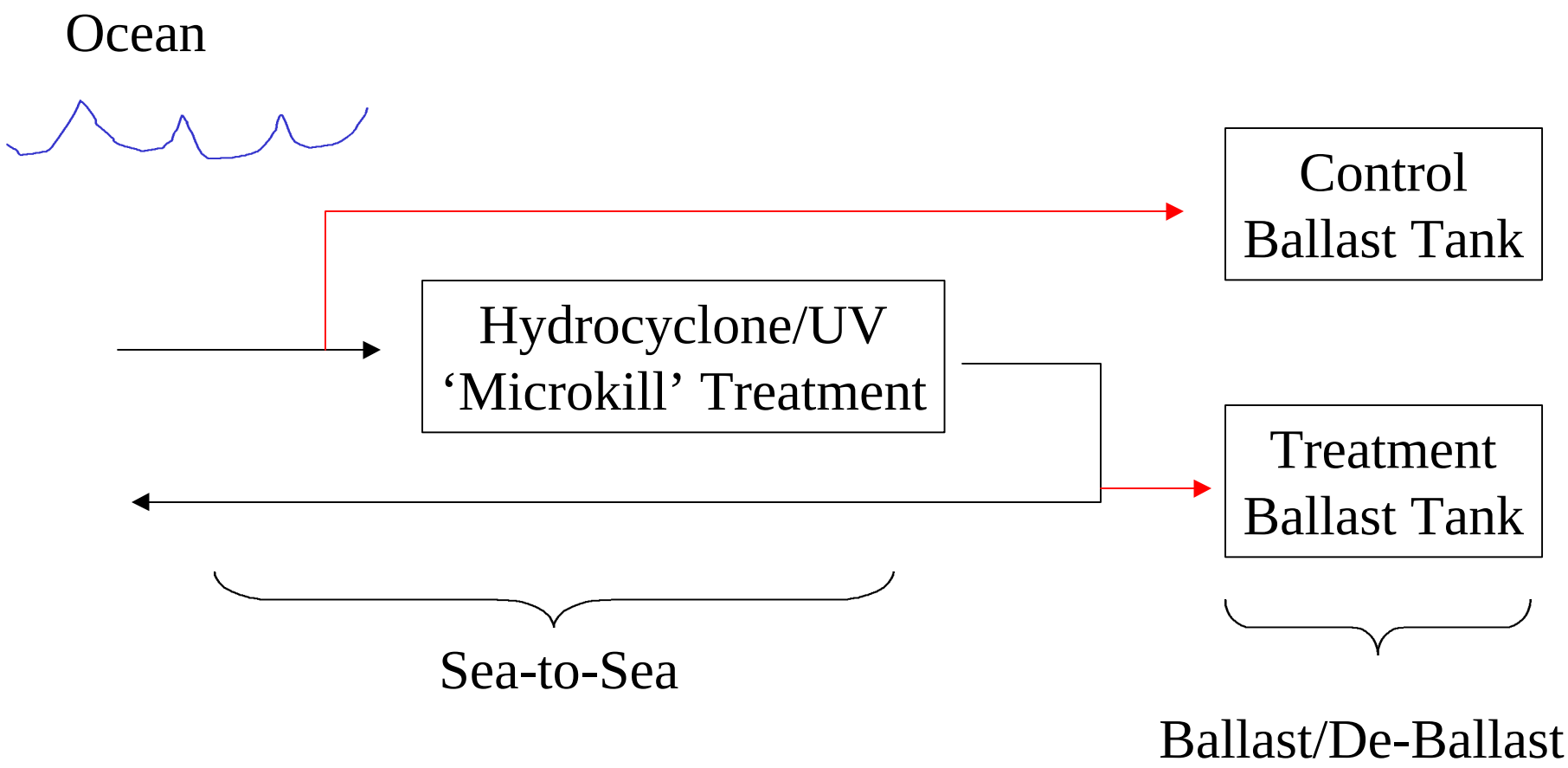

DAPI stained
Bacteria
(white)
Diatom
(red)

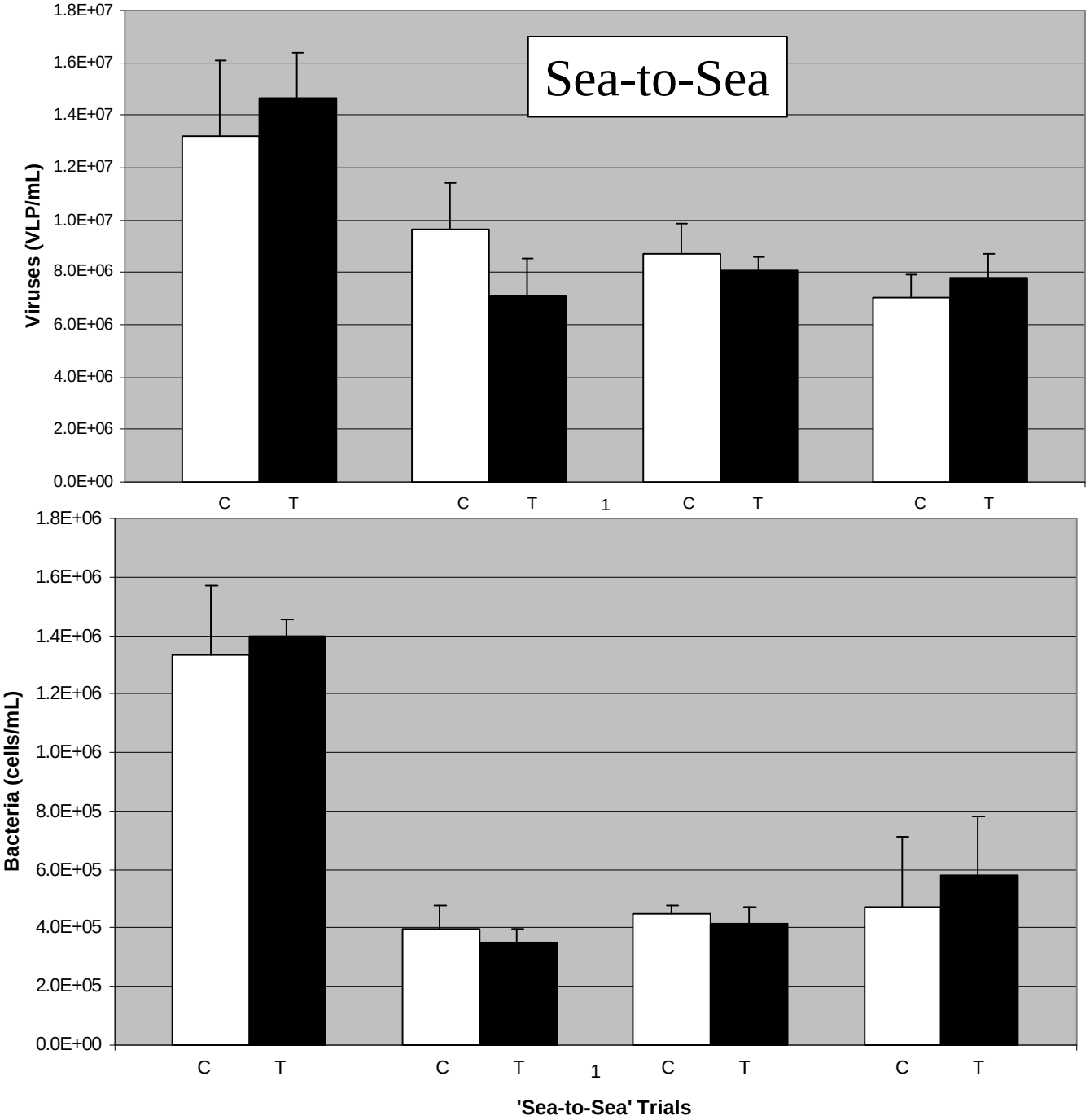

Live/Dead stained
25 um

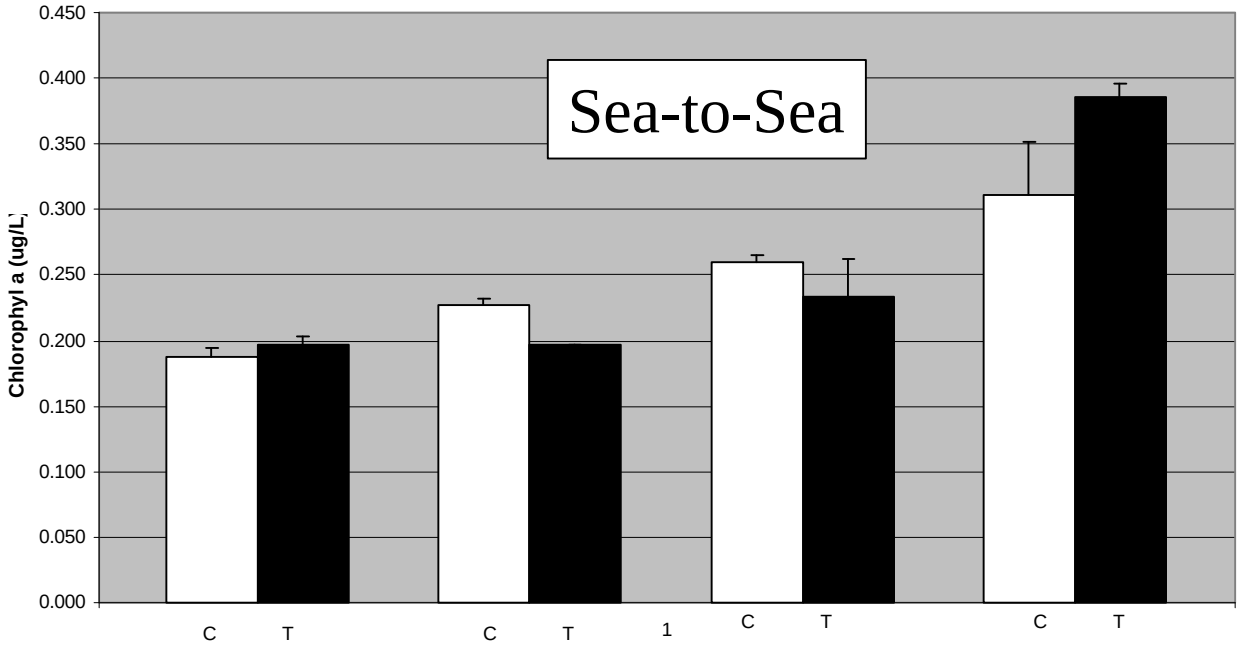

Live Bacteria
(SYTO 9)

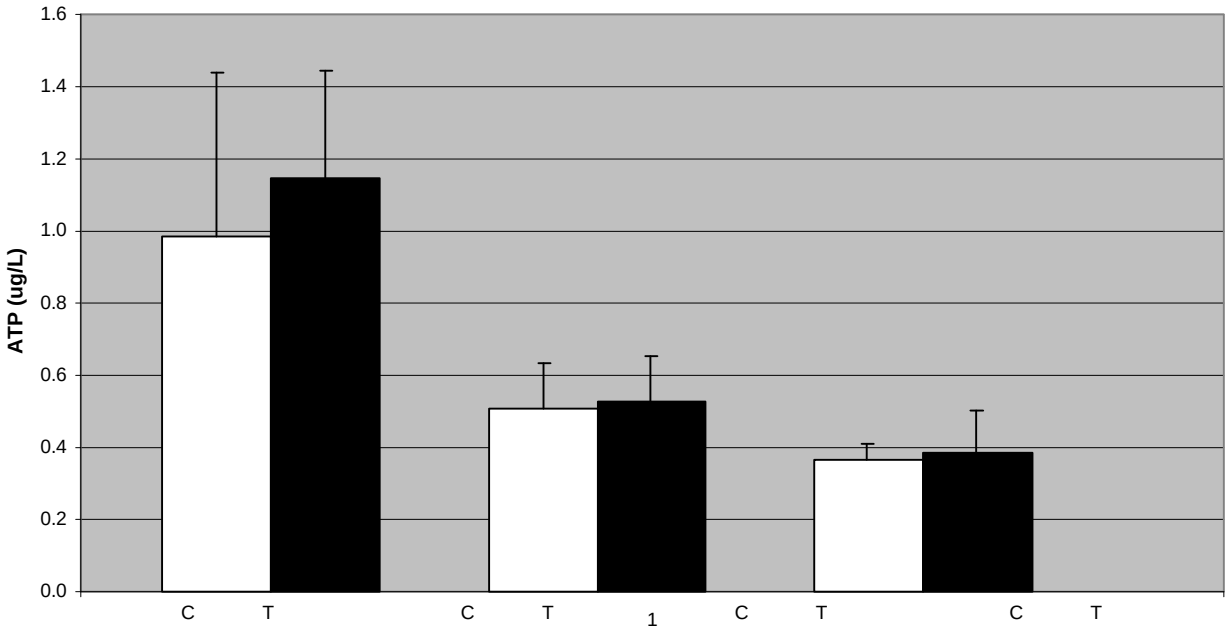

Dead Bacteria
(Dead-Red)

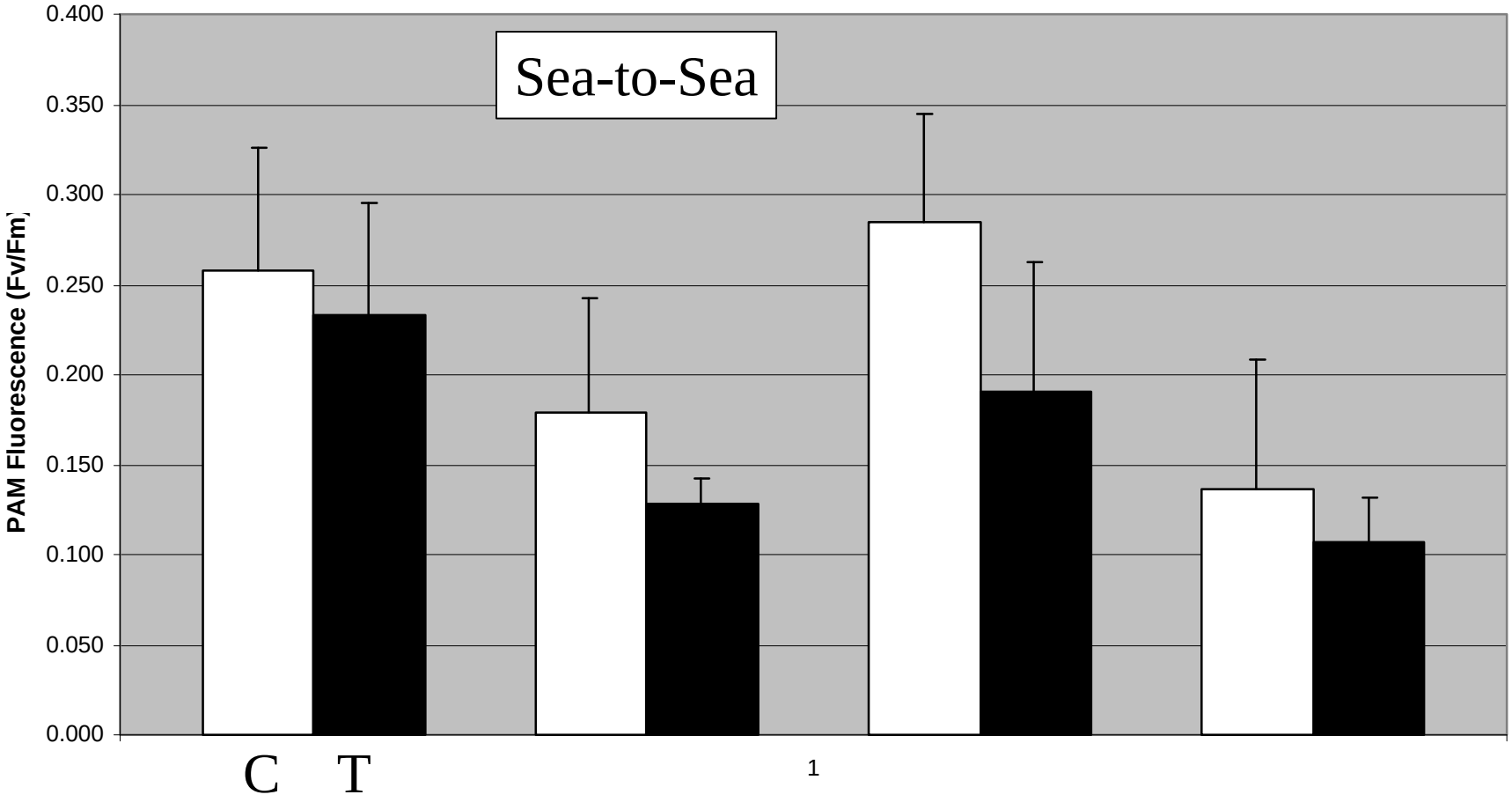
USA
Los Angeles
Mexico
Pacific
Ocean
Cabo San
Lucas
Mazatlan
Puerto Vallarta
N
©2000 MaxVR.com


Ocean
Control
Ballast Tank
Hydrocyclone/UV
'Microkill' Treatment
Treatment
Ballast Tank
Sea-to-Sea
Ballast/De-Ballast

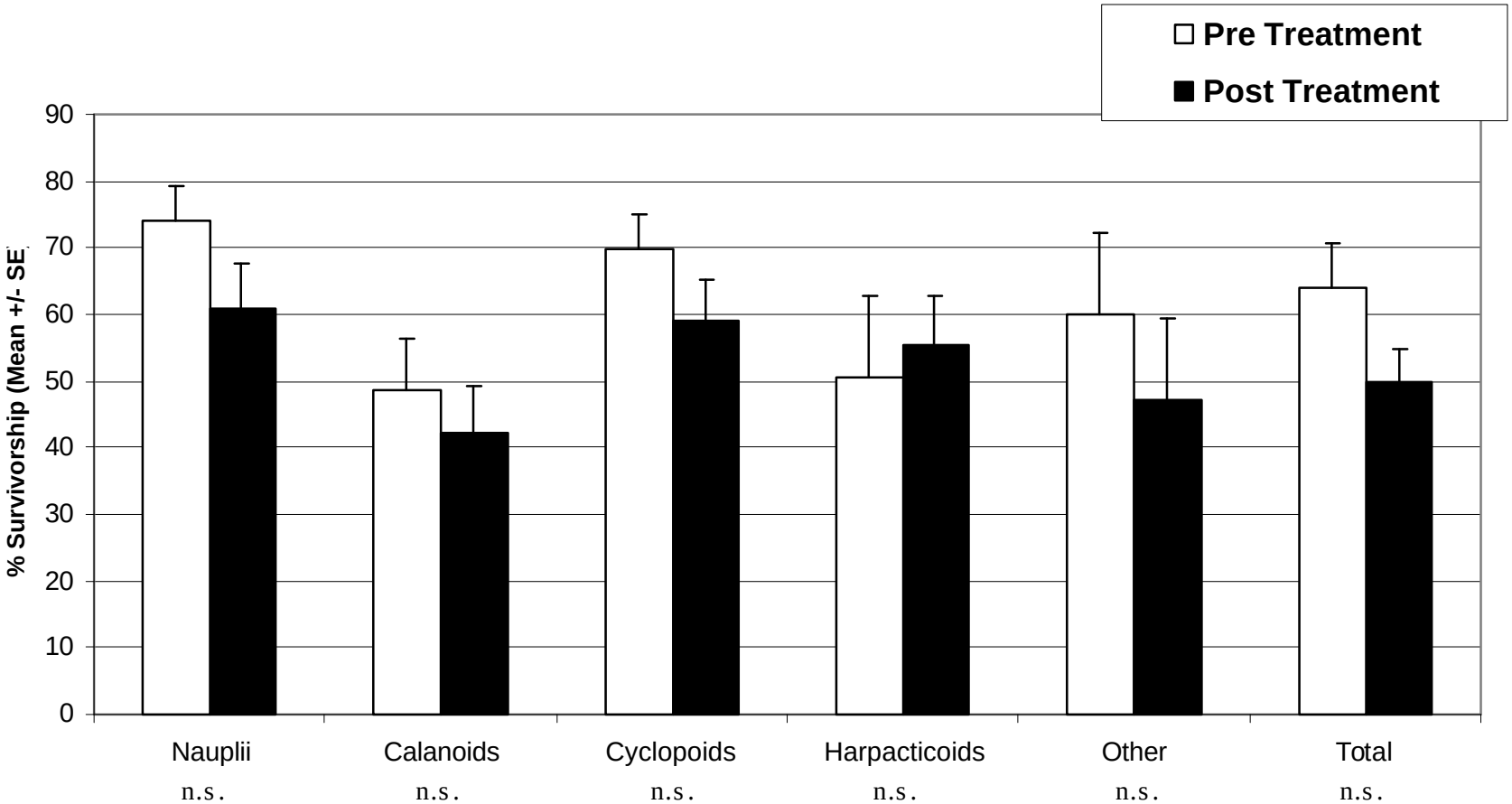

Sea-to-Sea
Viruses (VLP/mL)
1.8E+07
1.6E+07
1.4E+07
1.2E+07
1.0E+07
8.0E+06
6.0E+06
4.0E+06
2.0E+06
0.0E+00
C T C T 1 C T C T
Bacteria (cells/mL)
1.8E+06
1.6E+06
1.4E+06
1.2E+06
1.0E+06
8.0E+05
6.0E+05
4.0E+05
2.0E+05
0.0E+00
C T C T 1 C T C T
'Sea-to-Sea' Trials


Sea-to-Sea
Chlorophyl a (ug/L)
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
C
T
C
T
1
C
T
C
T

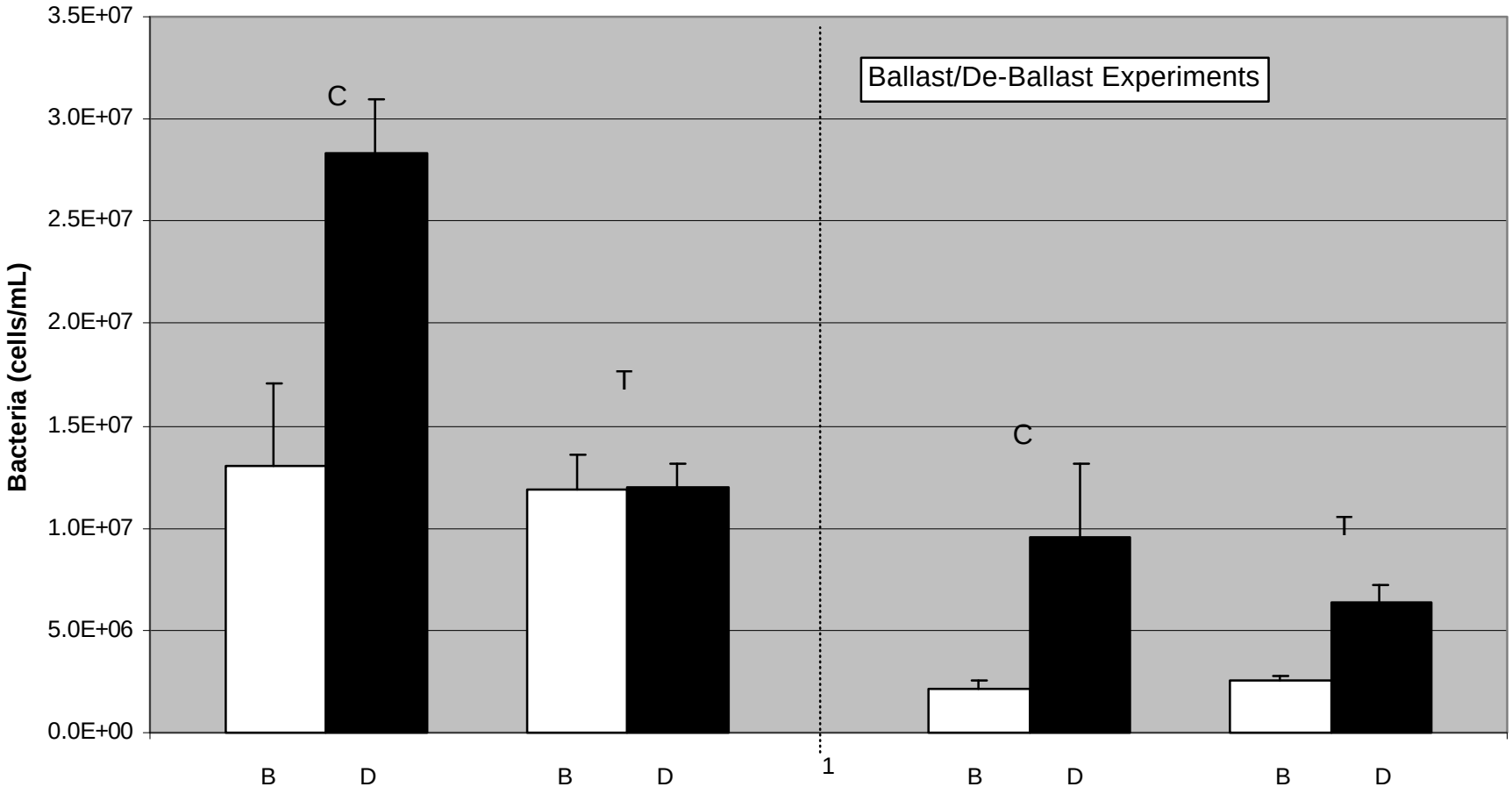

ATP (ug/L)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
C
T
C
T
1
C
T
C
T

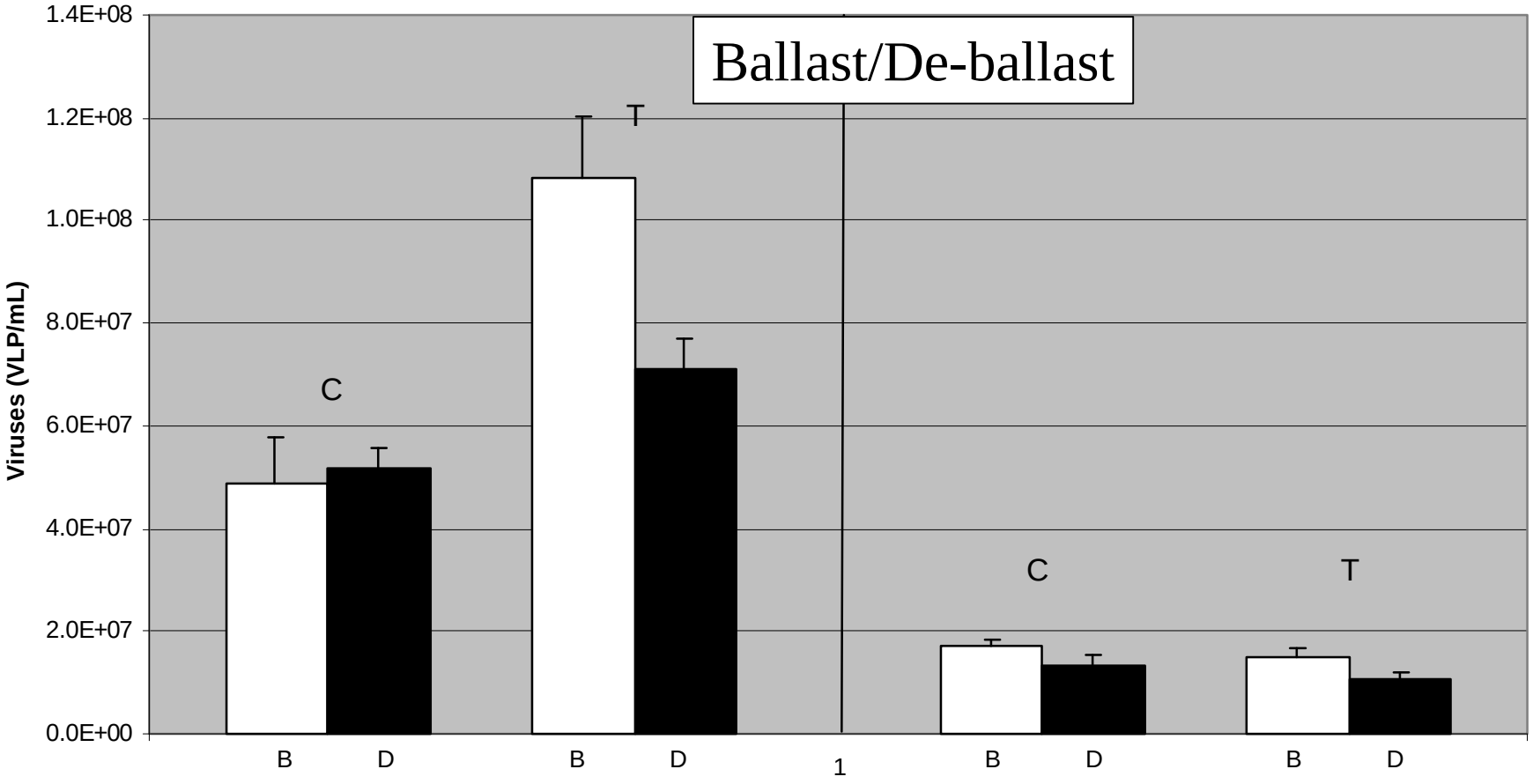

Sea-to-Sea
PAM Fluorescence (Fv/Fm)
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
C
T
1

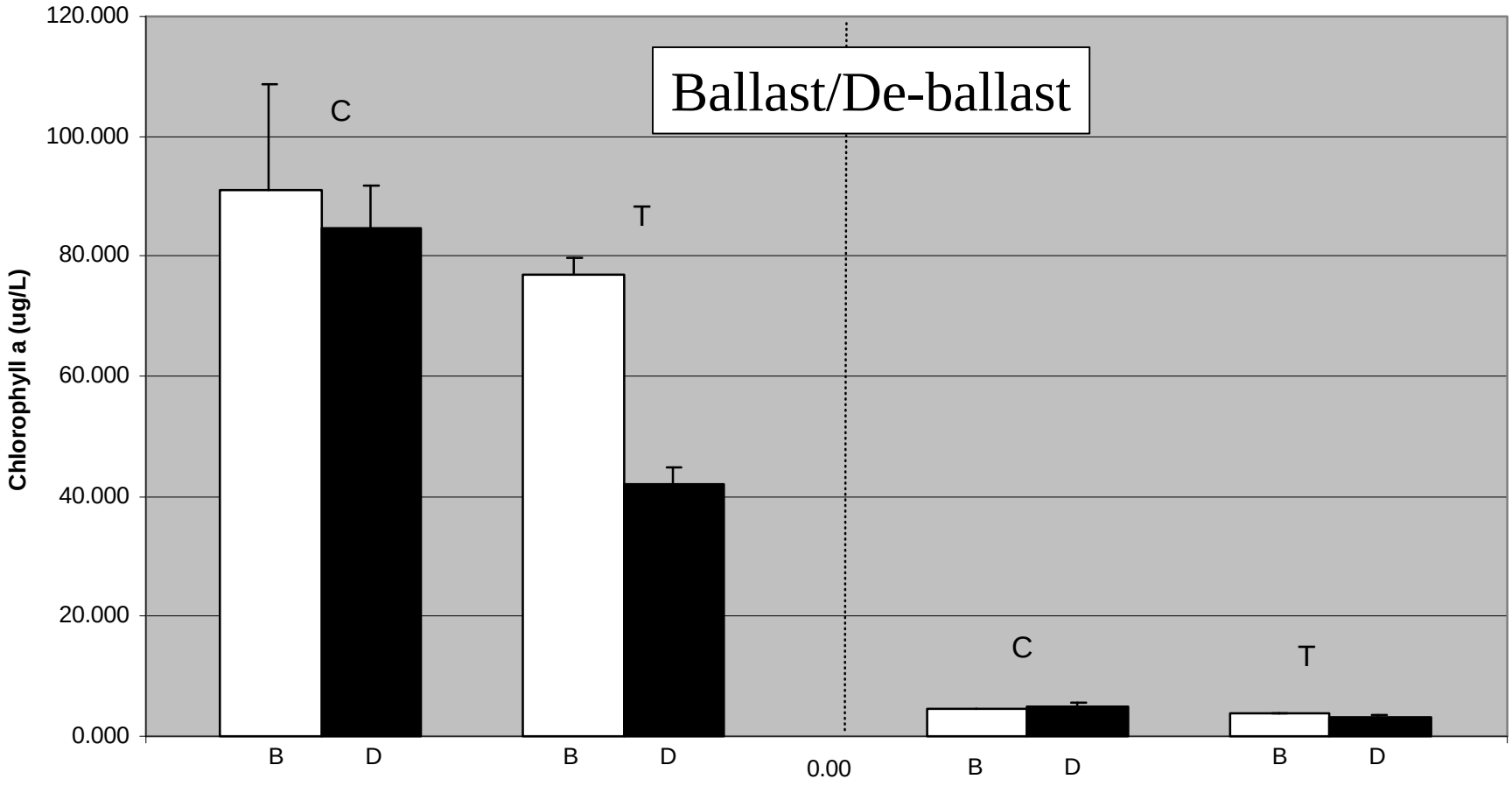
OptiMar Ballast System Efficacy (M/V Sea Princess Cruises 1 and 2): "Pre-Treatment" vs. "Post-Treatment"

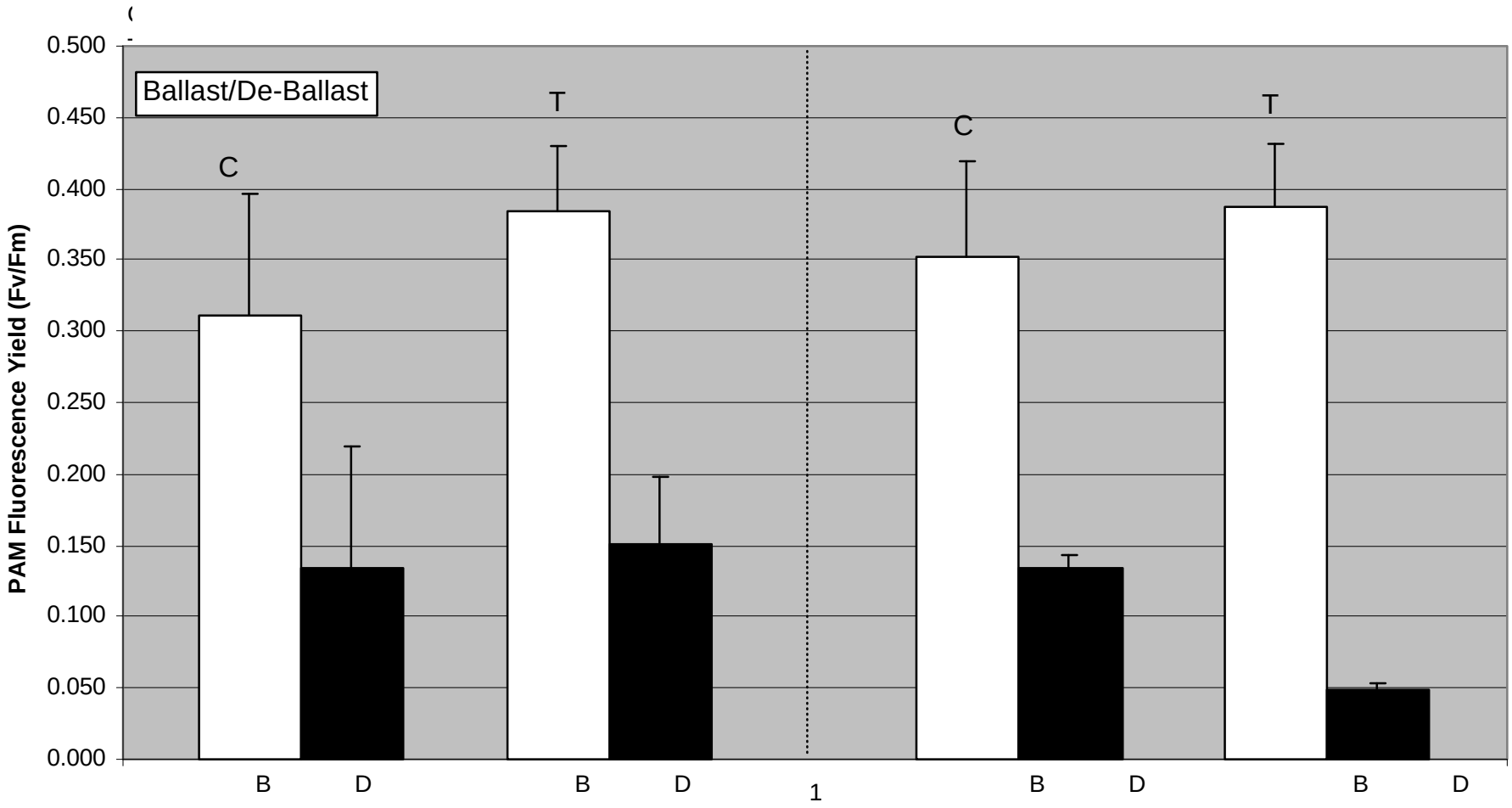


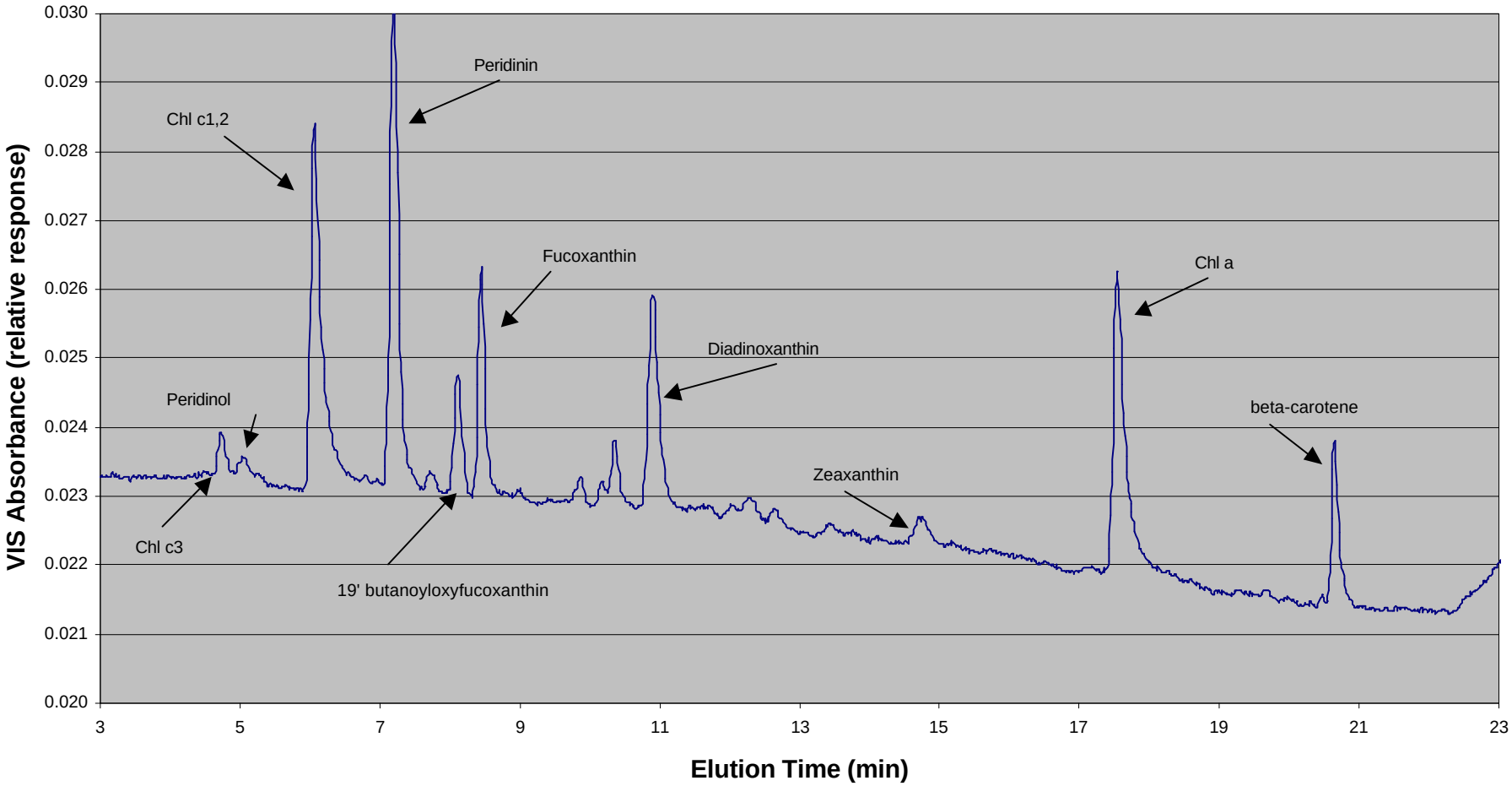
N = 10 experiments
n= # specimens counted
n.s. = not significant

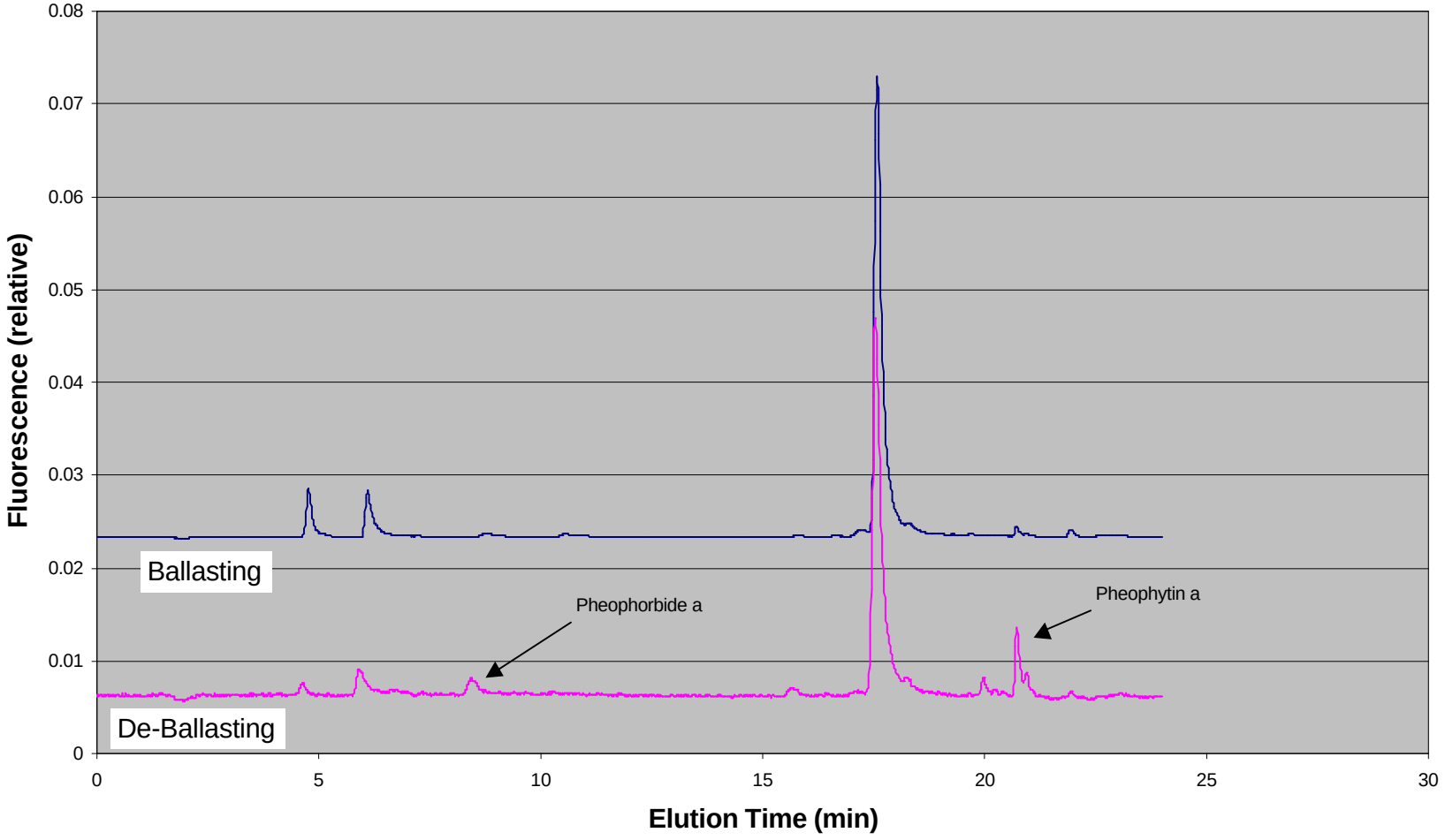

Ballast/De-Ballast Experiments
Bacteria (cells/mL)
3.5E+07
3.0E+07
2.5E+07
2.0E+07
1.5E+07
1.0E+07
5.0E+06
0.0E+00
C
T
C
T
B
D
B
D
1
B
D
B
D


Ballast/De-ballast
Viruses (VLP/mL)
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
C
T
C
T
B
D
B
D
1
B
D
B
D


Ballast/De-ballast
Chlorophyll a (ug/L)
120.000
100.000
80.000
60.000
40.000
20.000
0.000
C
T
C
T
B
D
B
D
0.00
B
D
B
D


Ballast/De-Ballast
PAM Fluorescence Yield (Fv/Fm)
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
C
T
C
T
B
D
B
D
1
B
D
B
D


VIS Absorbance (relative response)
0.030
0.029
0.028
0.027
0.026
0.025
0.024
0.023
0.022
0.021
0.020
3
5
7
9
11
13
15
17
19
21
23
Elution Time (min)
Peridinin
Chl c1,2
Fucoxanthin
Chl a
Diadinoxanthin
Peridinol
beta-carotene
Zeaxanthin
Chl c3
19' butanoyloxyfucoxanthin

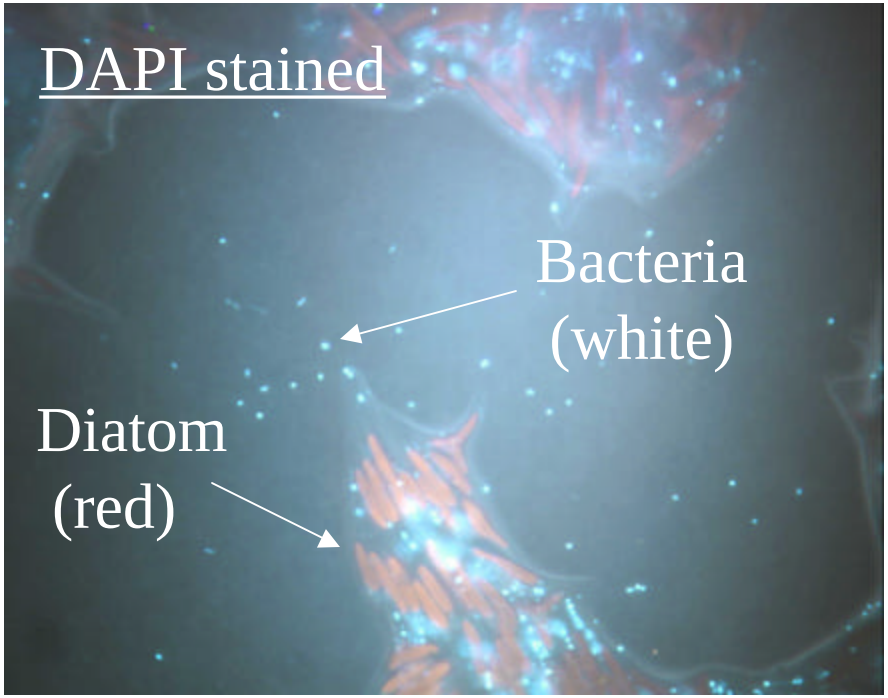

0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Fluorescence (relative)
Ballasting
De-Ballasting
Pheophorbide a
Pheophytin a
0
5
10
15
20
25
30
Elution Time (min)

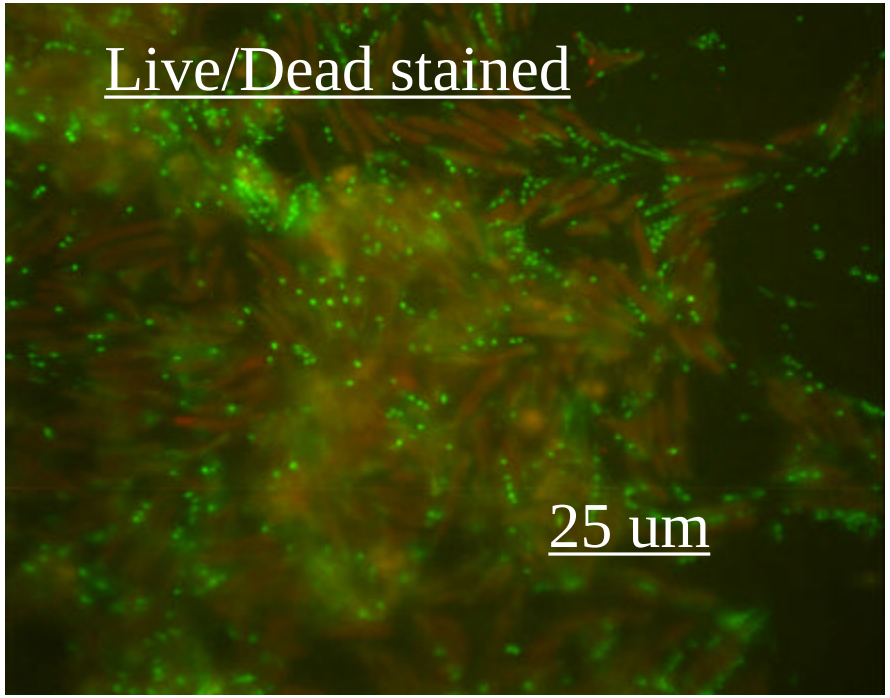
Conclusions (at the moment):

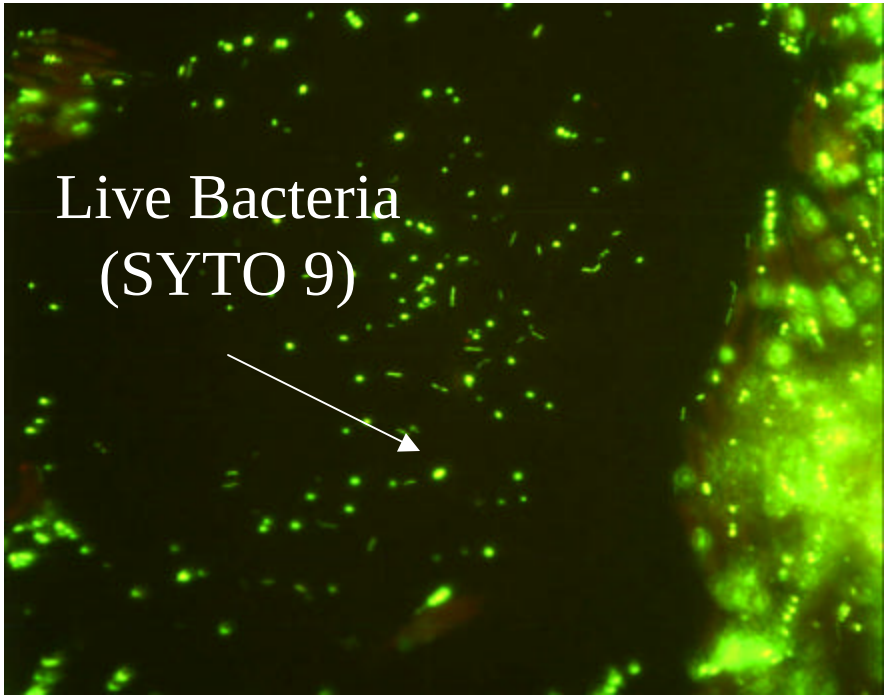
- We find no significant effect from the hydrocyclone/UV treatment
- The largest measurable ‘effect’ derives from the ballast tank itself
- We better do another test!!

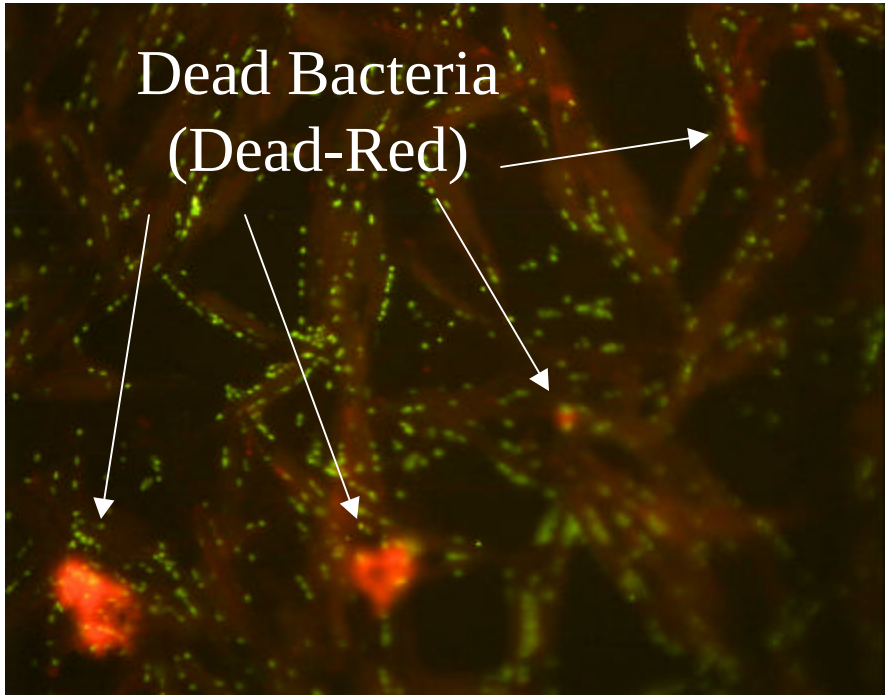
Problems…

More work…


DAPI stained
Bacteria
(white)
Diatom
(red)


Live/Dead stained
25 um


Live Bacteria
(SYTO 9)


Dead Bacteria
(Dead-Red)