

Organisms in Ballast Water

- In-tank organism distribution
 - influenced by e.g.
 - holding time
 - weather conditions
- Homogenous distribution
 - one sample sufficient?
- Heterogeneous distribution
 - location of organism-rich water zone unknown in advance
 - sampling over the entire discharge time?

The Questions

- What is more representative, taking samples over the entire ballasting operations or samplings in the beginning, middle and end?
- What are suitable sample volumes (per organism group of D-2)?

Vessel Details

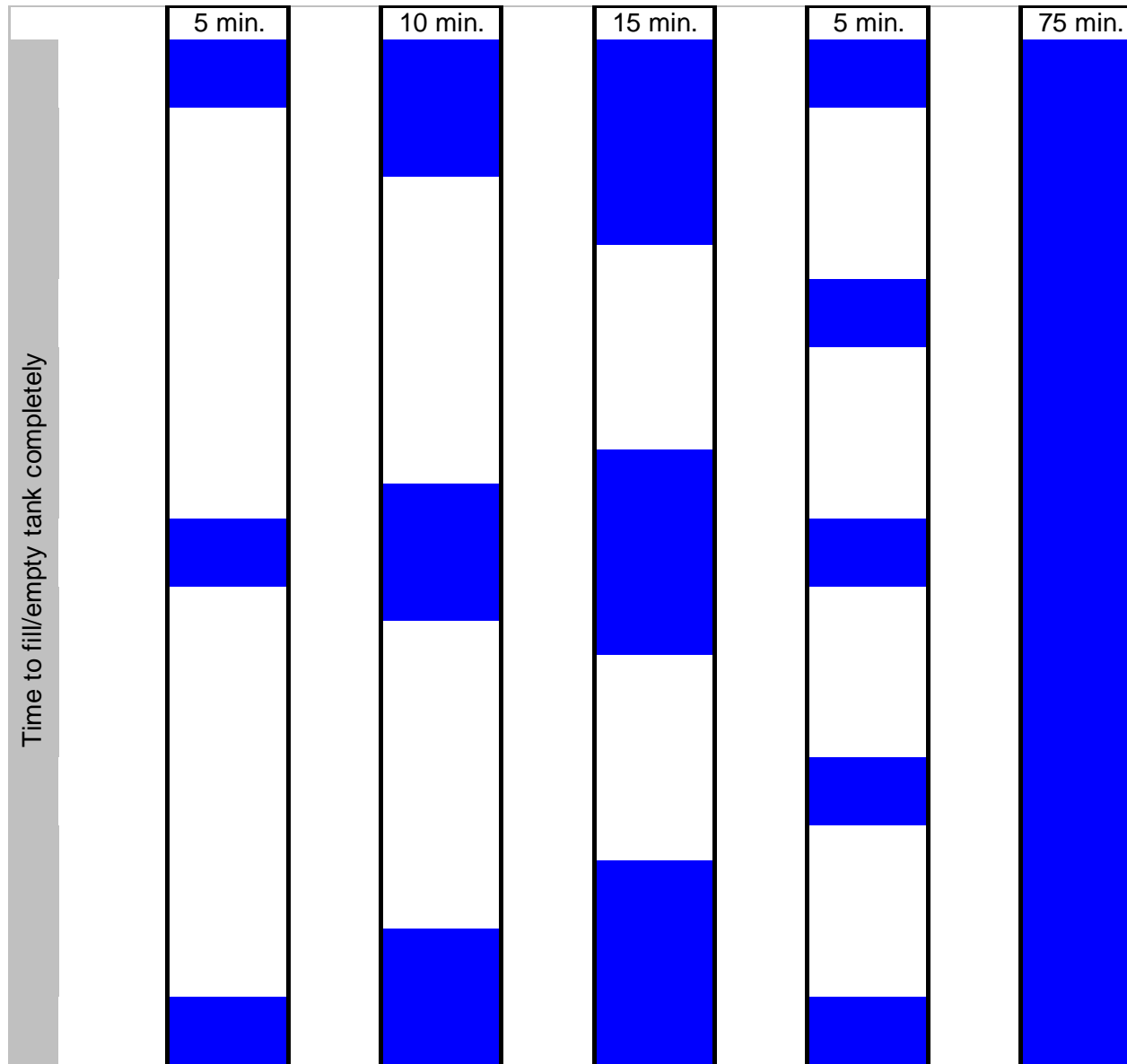
- Wilhelmsen Lines Pure Car and Truck Carrier *Toronto* with Unitor BWTS
- DWT 19628 t
- Cargo capacity 6350 car units on 12 car decks
- Maximum ballast water capacity 9669 t in 19 tanks



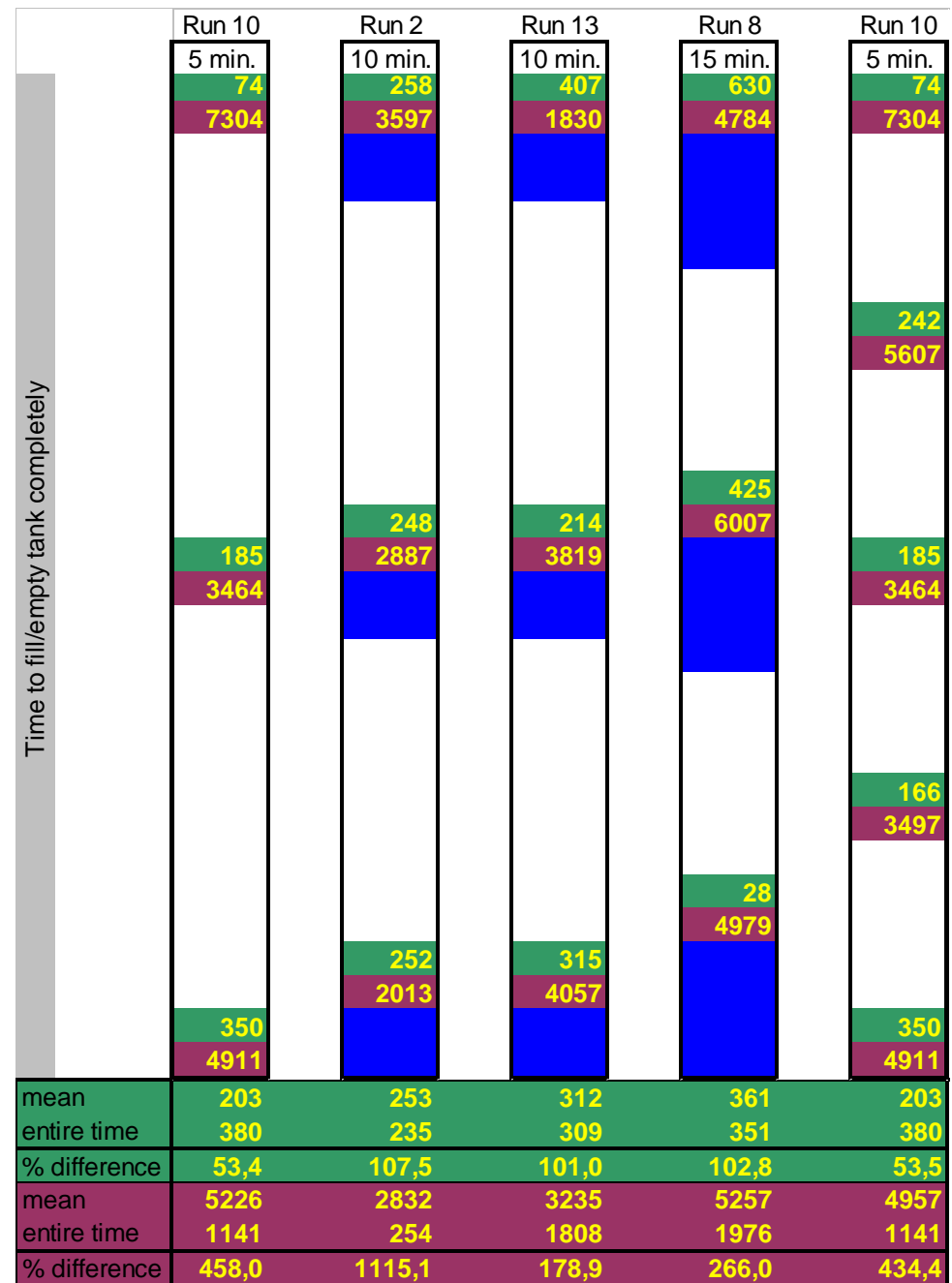
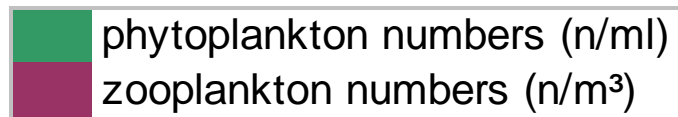
Sampling Seawater vs Treated Water

- Seawater contains more organism than treated water
- To check for the most representative sampling method organisms are needed
- Consequently untreated seawater was sampled

The Tests



Sequential test run results



Concentrating a sample



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EMSA Ballast Water Sampling Workshop, Lisbon, February 2010

Statistical vs Biological Perspective

- Sample frequencies and volumes
- Statistical view
- Biological view
 - Sample volume critical when concentrating the sample
 - Organisms $>50\text{ }\mu\text{m}$ in minimum dimension sample total volume between 1000 and 2000 L

Number of Samples

Number of Samples for several volumes of ballast water discharged during deballasting (sampling error 1%)

	5,000	10,000	50,000	100,000	150,000
Volume of BW to be discharged (m³)					
Confidence Level	95%	95%	95%	95%	95%
Probability of success, P	0.5	0.5	0.5	0.5	0.5
Probability of failure, $(1-P)$	0.5	0.5	0.5	0.5	0.5
% of volume of BW to be discharged (m³) required for sampling	65.7%	48.9%	16%	8.7%	6%
Number of 1 m³ samples (m³), n	3,288	4,899	8,056	8,762	9,026

Ehsan Mesbahi 2010, UK MCA Study

Sample Handling

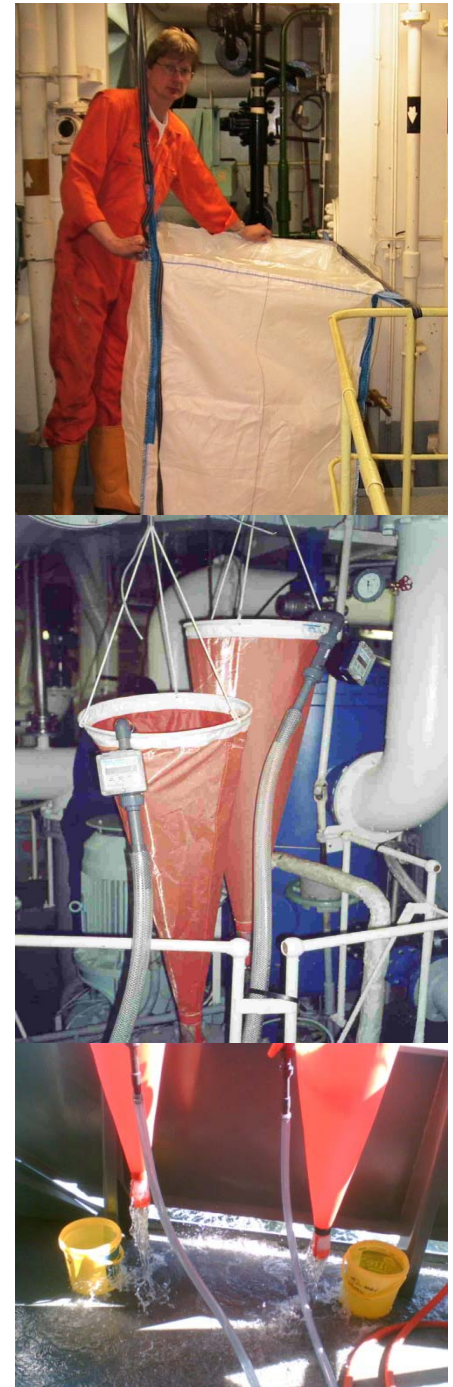
- Ensure organisms will not die during sample transport
 - Place all samples in a cooling bag
 - Bring samples to laboratory as soon as possible after sampling
 - Sample processing should start immediately
 - Consider using a mobile laboratory for sample analysis in the port/terminal

Indicative vs In-depth

- Compliance with D-2 (organisms > 50 micron)
- Tank volume 100 to (max. 999 orgs in tank)
- Take sample of any water volume, count visible living organisms
- **1st step** - 1 L unconcentrated sample contains 1 living organism = 1000 in 1 to
- **2nd step** - 10 L concentrated sample contains 10 living organisms = 1000 in 1 to
- **3rd step** - Sample larger volumes from tank or in-line to proof indicative sampling result

Recommendations I

- Sample representativeness is crucial (legal implications, how can we proof non-compliance?)
- Take samples over the entire discharge time??? If so, less than 2000 L per sample
- In sequential samplings a 10 minute time window for each sample
- Phyto- and zooplankton show contrary densities in beginning, middle & end sequences (need all)



Recommendations II

- Sample volumes
 - Bacteriae, collect over entire pumping event with ca. 10 ml subsampe every few minutes or in sequences, total volume ca. 1 L
 - Organisms <50 and $>10\mu\text{m}$ in mininimum dimension collect over entire pumping event with ca. 100 ml subsampe every few minutes or in sequences, total volume > 3 L
 - Organisms $>50 \mu\text{m}$ in mininimum dimension collect over entire pumping event or in sequences, total volume between 1000 and 2000 L