Golden Bear Research Center (GBRC) Update

Pacific Ballast Working Group
Vallejo, CA
April 2, 2019

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Golden Bear Research Center

Outline

1. Golden Bear Research Center Overview
2. Updates
3. Current/Future Projects
4. Issues Impacting Ballast Water Testing Facilities

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Golden Bear Research Center

The Center's objectives:

- Provide an effective platform, for the research, development, testing and evaluation of technologies and practices that reduce marine vessel environmental impacts
- Advance US merchant shipping and environmental technology business interests
- Develop stewards of the environment through Cal Maritime student education, community involvement, and maritime business outreach




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Golden Bear Research Center

Approved USCG sub-laboratory for land based and shipboard BWMS type approval testing

Golden Bear Research Center

Partners/Sublabs:

- MARAD
- Moss Landing Marine Laboratories
- California State Lands Commission
- NOAA Sea Grant
- University of Washington
- Glosten Associates
- Pacific EcoRisk
- BioVir Laboratories

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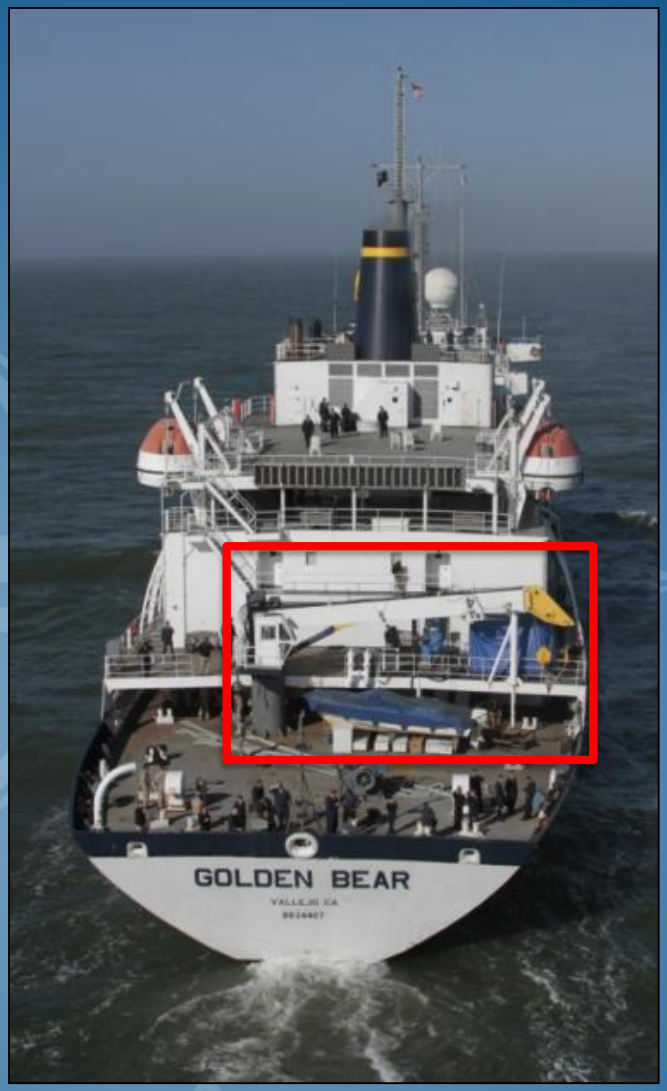
GBRC Testing Facility



- Integration with ship's ballast system allows for both shipboard and land-based ballast treatment testing at one place
- GBRC provides operations team and oversight of MLML science team and other contracted labs

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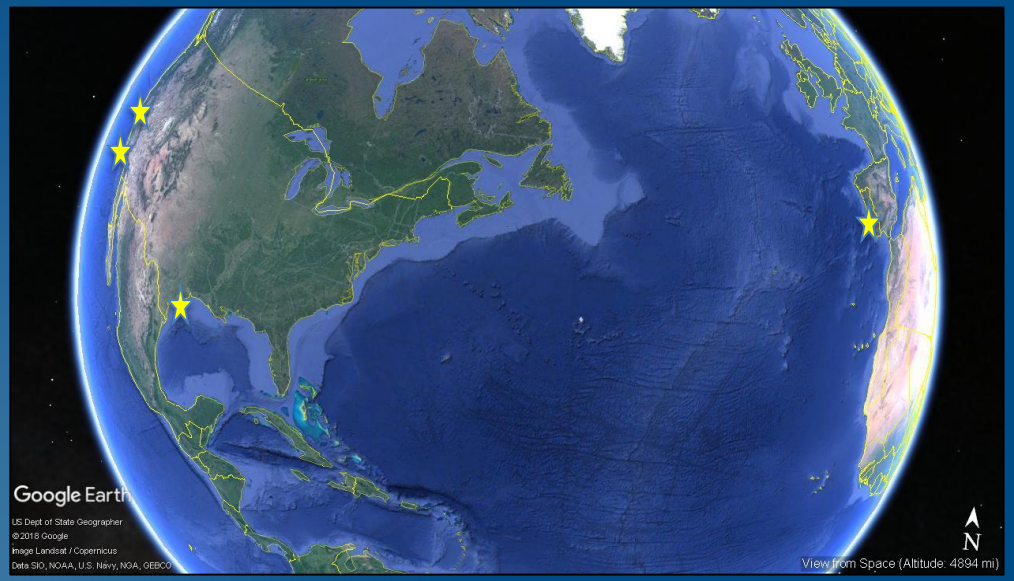
GBRC Testing Facility

- Yearly *TS Golden Bear* training cruise removes shipboard testing 'ship of opportunity' problem
- Allows for shipboard testing in different geographic locations



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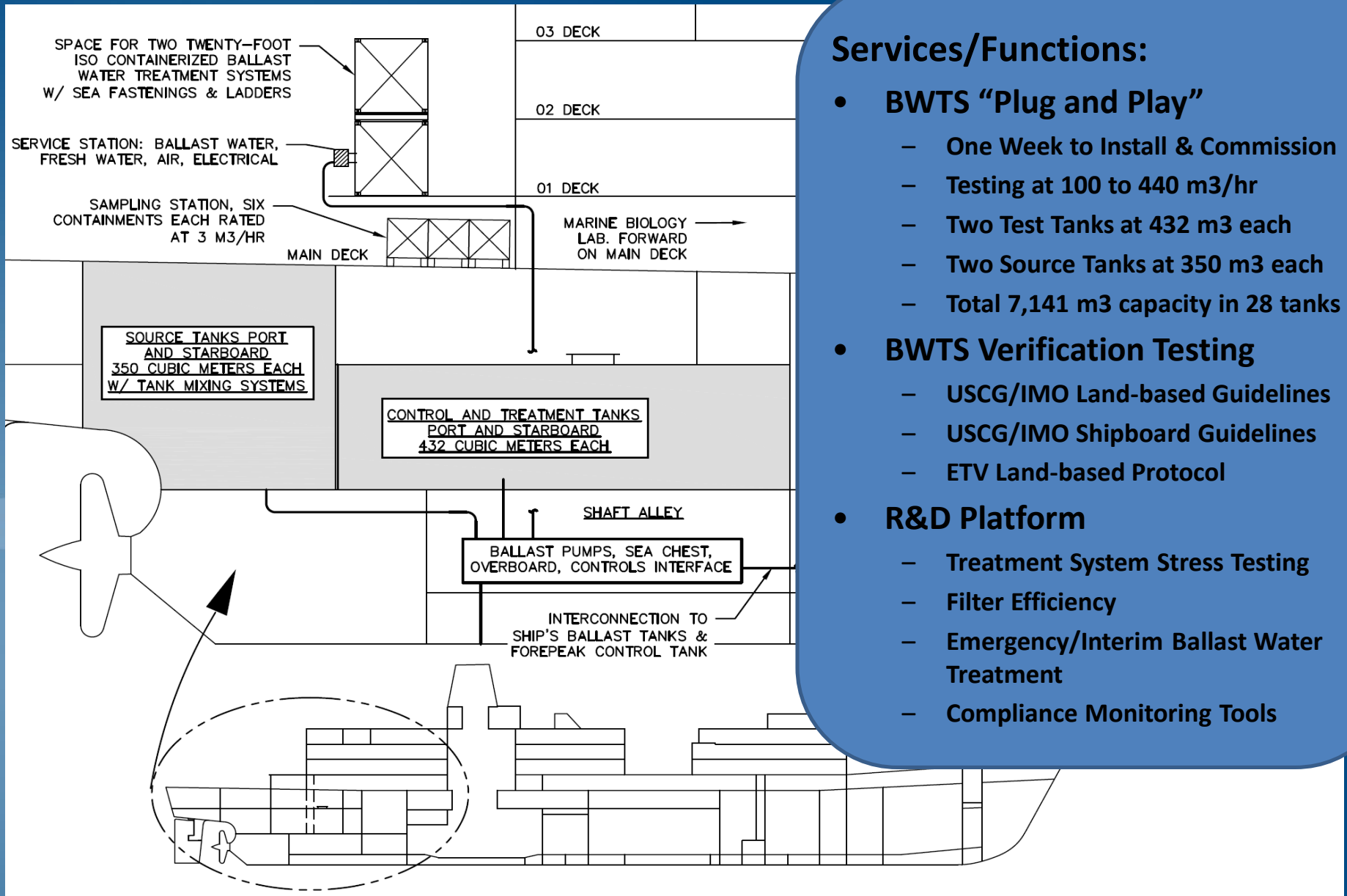
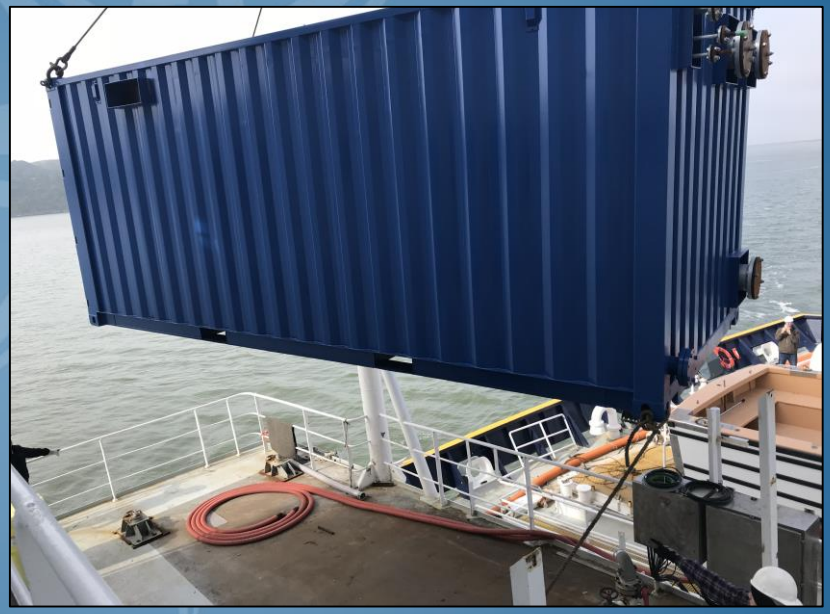
Facility Arrangement & Services



Services/Functions:

- **BWTS "Plug and Play"**
  - One Week to Install & Commission
  - Testing at 100 to 440 m3/hr
  - Two Test Tanks at 432 m3 each
  - Two Source Tanks at 350 m3 each
  - Total 7,141 m3 capacity in 28 tanks
- **BWTS Verification Testing**
  - USCG/IMO Land-based Guidelines
  - USCG/IMO Shipboard Guidelines
  - ETV Land-based Protocol
- **R&D Platform**
  - Treatment System Stress Testing
  - Filter Efficiency
  - Emergency/Interim Ballast Water Treatment
  - Compliance Monitoring Tools


Link-Belt



GBRC Updates

- Became sub-lab to a new USCG Independent Lab (IL)
  - Prüfinstitut für Abwassertechnik GmbH (PIA)
- Panasia Glo-en Patrol
  - Received USCG TA late 2018
- Envirocleanse inTank
  - Received USCG TA early 2019
- Panasonic ATP-BlueSys
  - USCG/IMO G8 land-based and shipboard testing conducted March-October 2018
  - Final reports recently submitted to IL
- Currently testing 2 systems for USCG TA and IMO Revised G8/G9, projected completion Fall 2019

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Marine Safety Center
BWMS Type Approval Status

Approved						
Application Received	**Manufacturer (Country)**	**Model**	**Independent Laboratory**	**System Type**	**Capacity**	**Certificate Issued* (Amended)**
20 Sep 2016	Optimarin (Norway)	OBS/OBS Ex	DNV GL	Filtration + Ultraviolet	100 – 3,000 m^3/h	02 Dec 2016 (25 Feb 2019)
21 Sep 2016	Alfa Laval (Sweden)	PureBallast 3	DNV GL	Filtration + Ultraviolet	150 – 3,000 m^3/h	23 Dec 2016 (21 Dec 2017)
23 Sep 2016	TeamTec OceanSaver AS (Norway)	OceanSaver MK II	DNV GL	Filtration + Electrodialysis	200 – 7,200 m^3/h	23 Dec 2016 (18 Oct 2017)
24 Jan 2017	Sunrui (China)	BalClor	DNV GL	Filtration + Electrolysis	50 – 8,500 m^3/h	06 Jun 2017 (05 Jan 2018)
31 Mar 2017	Ecochlor, Inc. (USA)	Ecochlor BWTS	DNV GL	Filtration + Chemical Injection	500 – 16,200 m^3/h	10 Aug 2017 (26 Apr 2018)
02 May 2017	ERMA FIRST (Greece)	Erma First FIT	Lloyd's Register	Filtration + Electrolysis	100 – 3,740 m^3/h	18 Oct 2017 (13 Feb 2019)
31 Oct 2017	Techcross, Inc. (Republic of Korea)	Electro-Cleen	Korean Register	Electrolysis	150 – 12,000 m^3/h	05 Jun 2018
28 Sep 2017	Samsung Heavy Industries Co., Ltd (Republic of Korea)	Purimar	Korean Register	Filtration + Electrolysis	250 – 10,000 m^3/h	15 Jun 2018 (20 Jul 2018)
12 Mar 2018	BIO-UV Group (France)	BIO-SEA B	DNV GL	Filtration + Ultraviolet	55 – 1,400 m^3/h	20 Jun 2018
09 Apr 2018	Wärtsilä Water Systems, Ltd. (UK)	Aquarius EC	DNV GL	Filtration + Electrolysis	250 – 4,000 m^3/h	30 Aug 2018
31 May 2018	Hyundai Heavy Industries Co., Ltd. (Republic of Korea)	HiBallast	DNV GL	Filtration + Electrolysis	75 – 10,000 m^3/h	26 Oct 2018
09 May 2018	Headway Technology Co., Ltd. (People's Republic of China)	OceanGuard	DNV GL	Filtration + Electrolysis	65 – 5,200 m^3/h	06 Nov 2018
29 Mar 2018	JFE Engineering Corporation (Japan)	BallastAce	Control Union	Filtration + Chemical Injection	500 – 3,500 m^3/h	13 Nov 2018 (08 Feb 2019)
30 Mar 2018	Panasia Co., Ltd. (Republic of Korea)	GloEn-Patrol	DNV GL	Filtration + Ultraviolet	50 – 6,000 m^3/h	14 Dec 2018
03 Mar 2018	De Nora (USA)	BALPURE	Lloyd's Register	Filtration + Electrolysis	400 – 8,570 m^3/h	19 Dec 2018
20 Jul 2018	Envirocleanse, LLC (USA)	inTank BWTS	DNV GL	Electrolysis + Chemical Injection	Up to 200,000 m^3	01 Feb 2019

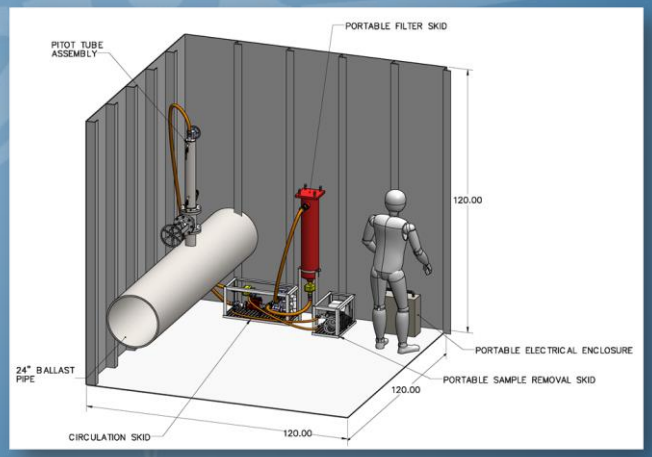
*Some manufacturers have requested multiple amendments to their Type Approval Certificates. The first date is the date when the original certificate was issued, and the date in parentheses is the date of the current amendment. Copies of Type Approval Certificates can be found at http://www.dco.uscg.mil/msc/Ballast-Water/TACs/, or by visiting the USCG Approved Equipment List at: http://cgmix.uscg.mil/Equipment/Default.aspx.

Revised 26 February 2019

Current/Future Projects

California STATE LANDS Commission

Glosten



- Portable sampling rig for collecting representative samples for compliance testing (Kevin Reynolds)
- Ballast water exchange plus treatment (Jonathan Thompson)
- Waste heat recovery technology
  - Joint project with DOE, DOD, MARAD
- Sky Sails
- Type approval verification testing of indicative tools
- Shipboard commissioning/compliance testing
- BSc in Oceanography beginning Fall 2020

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USTS *Golden Bear* in Samoa

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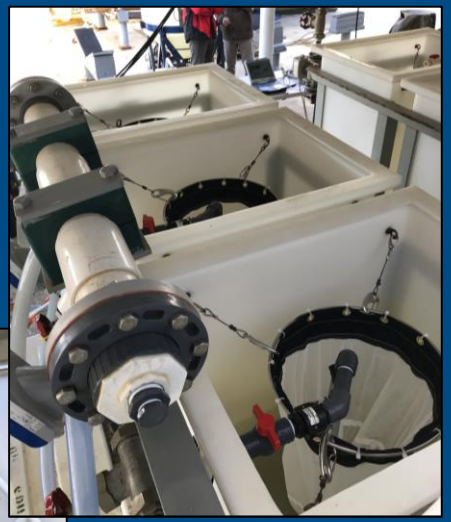
Updates Impacting BWMS Testing Facilities



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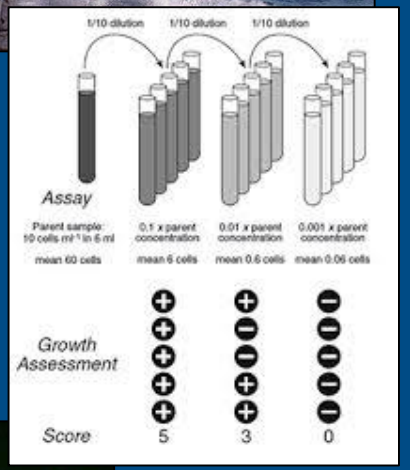
Vessel Incidental Discharge Act

- Expands the definition of "living" to ensure that “nonviable” organisms are not considered to be living
- Gave USCG 180 days to update policy on analysis methods
- Must consider testing methodologies that utilize organism grow-out MPN analysis to determine the number of viable organisms in ballast water capable of reproduction
- IMO officially accepted the use of MPN in July 2017



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2019 Global TestNet Meeting

"To promote comparable and accurate test results on the performance evaluation of technologies and methodologies to control the risk of bio-invasion and harmful species introductions by shipping, through an open exchange of information, transparency in methodologies and advancing the science of testing."

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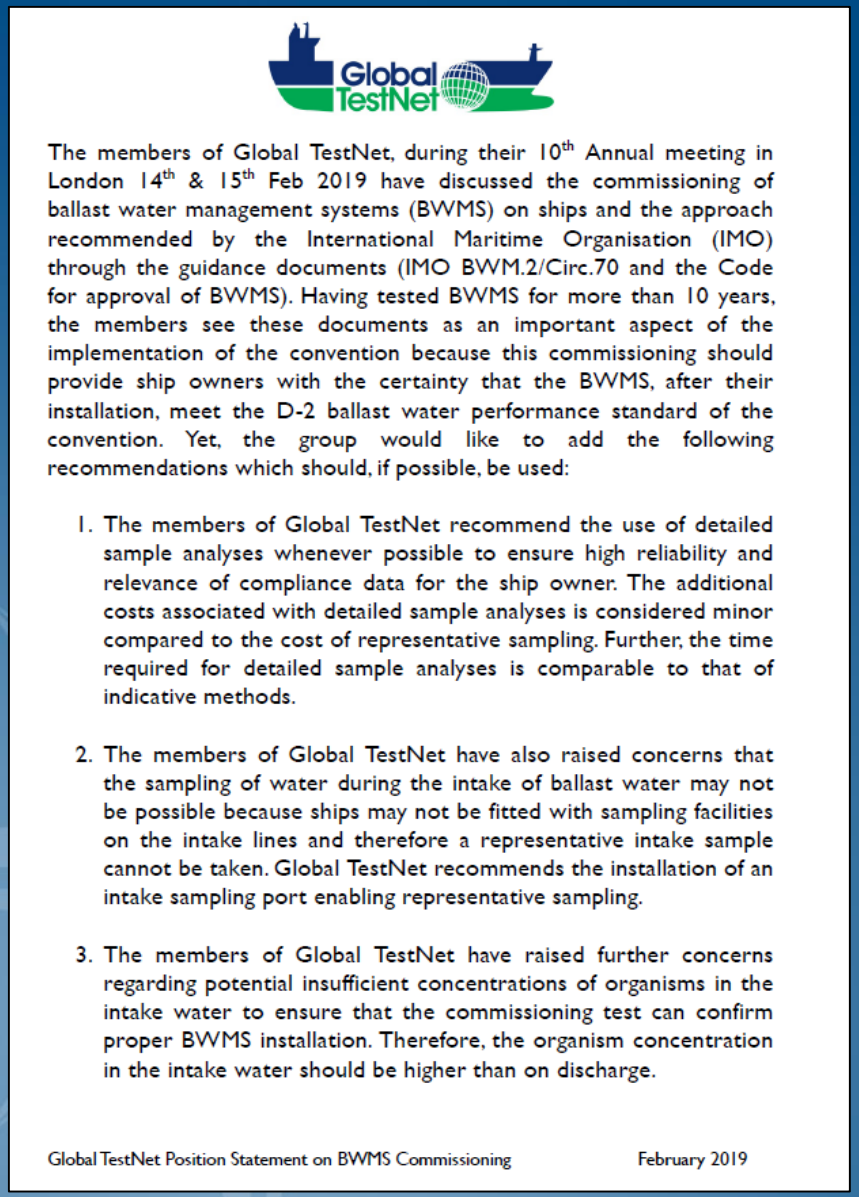
2019 Global TestNet Meeting

- Agenda focused on wide ranging topics, from:
  - Update on IMO NGO status
  - BWT and formation of DBPs
  - Indicative analysis tool availability and TA testing
  - Commissioning Tests
  - Compliance Testing
  - GloFouling Project Update
  - In-water Cleaning Technologies
- GTN members agreed to expand membership to facilities working on technologies to reduce biofouling



The members of Global TestNet, during their 10th Annual meeting in London 14th & 15th Feb 2019 have discussed the commissioning of ballast water management systems (BWMS) on ships and the approach recommended by the International Maritime Organisation (IMO) through the guidance documents (IMO BWM.2/Circ.70 and the Code for approval of BWMS). Having tested BWMS for more than 10 years, the members see these documents as an important aspect of the implementation of the convention because this commissioning should provide ship owners with the certainty that the BWMS, after their installation, meet the D-2 ballast water performance standard of the convention. Yet, the group would like to add the following recommendations which should, if possible, be used:

1. The members of Global TestNet recommend the use of detailed sample analyses whenever possible to ensure high reliability and relevance of compliance data for the ship owner. The additional costs associated with detailed sample analyses is considered minor compared to the cost of representative sampling. Further, the time required for detailed sample analyses is comparable to that of indicative methods.

2. The members of Global TestNet have also raised concerns that the sampling of water during the intake of ballast water may not be possible because ships may not be fitted with sampling facilities on the intake lines and therefore a representative intake sample cannot be taken. Global TestNet recommends the installation of an intake sampling port enabling representative sampling.

3. The members of Global TestNet have raised further concerns regarding potential insufficient concentrations of organisms in the intake water to ensure that the commissioning test can confirm proper BWMS installation. Therefore, the organism concentration in the intake water should be higher than on discharge.

Global TestNet Position Statement on BWMS Commissioning February 2019

GTN Statement on Commissioning Tests

- Recommendations include:

1. Echoed other calls for installation of intake sample ports
2. Uptake organism concentrations be higher than potential discharge concentrations
3. Use detailed sample analyses whenever possible to ensure high reliability of data

http://globaltestnet.org/getattachment/Home/GloBal_TestNet_Position_Statement_BWMS_Commissioning_Feb_2019.pdf

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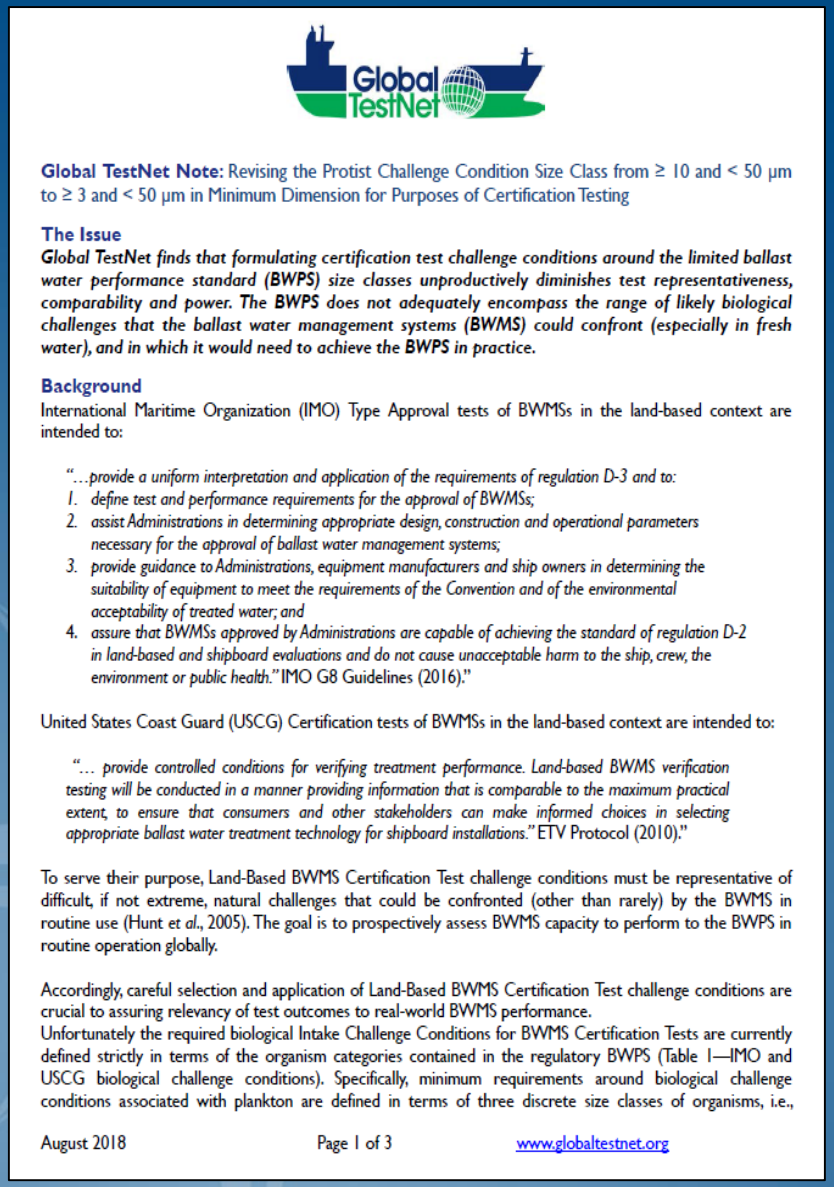

Global TestNet Note: Revising the Protist Challenge Condition Size Class from ≥ 10 and < 50 µm to ≥ 3 and < 50 µm in Minimum Dimension for Purposes of Certification Testing

The Issue

Global TestNet finds that formulating certification test challenge conditions around the limited ballast water performance standard (BWPS) size classes unproductively diminishes test representativeness, comparability and power. The BWPS does not adequately encompass the range of likely biological challenges that the ballast water management systems (BWMS) could confront (especially in fresh water), and in which it would need to achieve the BWPS in practice.

Background

International Maritime Organization (IMO) Type Approval tests of BWMSs in the land-based context are intended to:

> *"…provide a uniform interpretation and application of the requirements of regulation D-3 and to:*
> 1. *define test and performance requirements for the approval of BWMSs;*
> 2. *assist Administrations in determining appropriate design, construction and operational parameters necessary for the approval of ballast water management systems;*
> 3. *provide guidance to Administrations, equipment manufacturers and ship owners in determining the suitability of equipment to meet the requirements of the Convention and of the environmental acceptability of treated water; and*
> 4. *assure that BWMSs approved by Administrations are capable of achieving the standard of regulation D-2 in land-based and shipboard evaluations and do not cause unacceptable harm to the ship, crew, the environment or public health."* IMO G8 Guidelines (2016)."

United States Coast Guard (USCG) Certification tests of BWMSs in the land-based context are intended to:

> *"… provide controlled conditions for verifying treatment performance. Land-based BWMS verification testing will be conducted in a manner providing information that is comparable to the maximum practical extent, to ensure that consumers and other stakeholders can make informed choices in selecting appropriate ballast water treatment technology for shipboard installations."* ETV Protocol (2010)."

To serve their purpose, Land-Based BWMS Certification Test challenge conditions must be representative of difficult, if not extreme, natural challenges that could be confronted (other than rarely) by the BWMS in routine use (Hunt *et al.*, 2005). The goal is to prospectively assess BWMS capacity to perform to the BWPS in routine operation globally.

Accordingly, careful selection and application of Land-Based BWMS Certification Test challenge conditions are crucial to assuring relevancy of test outcomes to real-world BWMS performance.
Unfortunately the required biological Intake Challenge Conditions for BWMS Certification Tests are currently defined strictly in terms of the organism categories contained in the regulatory BWPS (Table 1—IMO and USCG biological challenge conditions). Specifically, minimum requirements around biological challenge conditions associated with plankton are defined in terms of three discrete size classes of organisms, i.e.,

GTN Position Paper on Protist Size Revision for Challenge Conditions

- Challenge conditions that only include the 10-50 µm protists diminishes test representativeness

http://globaltestnet.org/getattachment/Discussions/GBTN_Subsized_Protists_Position_Paper_Final_V030818.pdf

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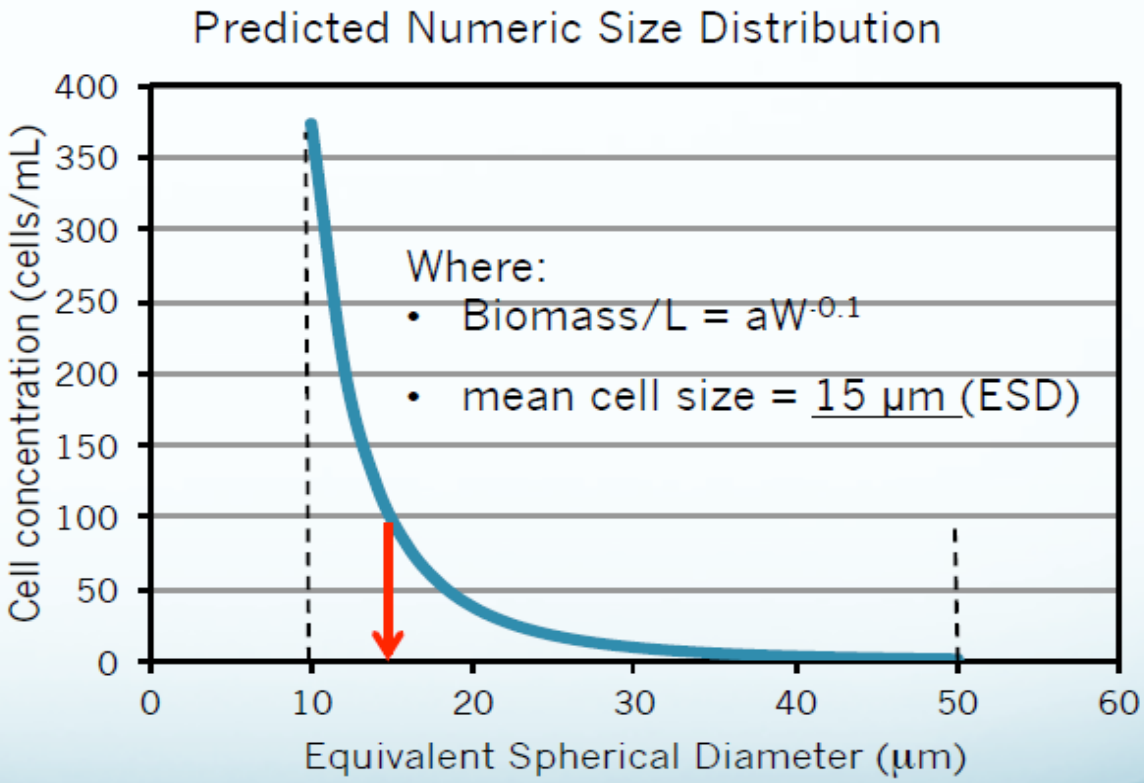
Organism Size Distribution in Oceans and Lakes

Scientific Publications:

Ahrens and Peters, 1991
Basedow et al., 2010
Belgrano et al., 2002
Blanco et al. 1994
Blanco et al., 1998
Borgmann, 1987
Boudreau and Dickie, 1989
Calder 1985
Carpenter and Kitchell, 1984
Cavender-Bares et al., 2001
Chishom 1992
Dickie and Boudreau, 1987
Duarte et al., 1987
Echevarria et al., 1990
Gaedke 1992
Gin et al., 1998
Gin et al., 1999
Kerr, 1974
Marquet et al., 2005
Mullin et al., 1966
Peters 1983
Platt 1985
Platt and Denman, 1978
Prothero, 1986
Quinones et al., 2003
Rodriguez and Mullin, 1986
Rodriguez et al., 1987
Schmidt-Nielsen, 1984
Sheldon et al., 1972, 1977
Sprules and Manuwar, 1986
Sprules et al., 1983
Takahashi and Bienfang, 1983
Verity et al., 1993
Vidondo et al., 1997



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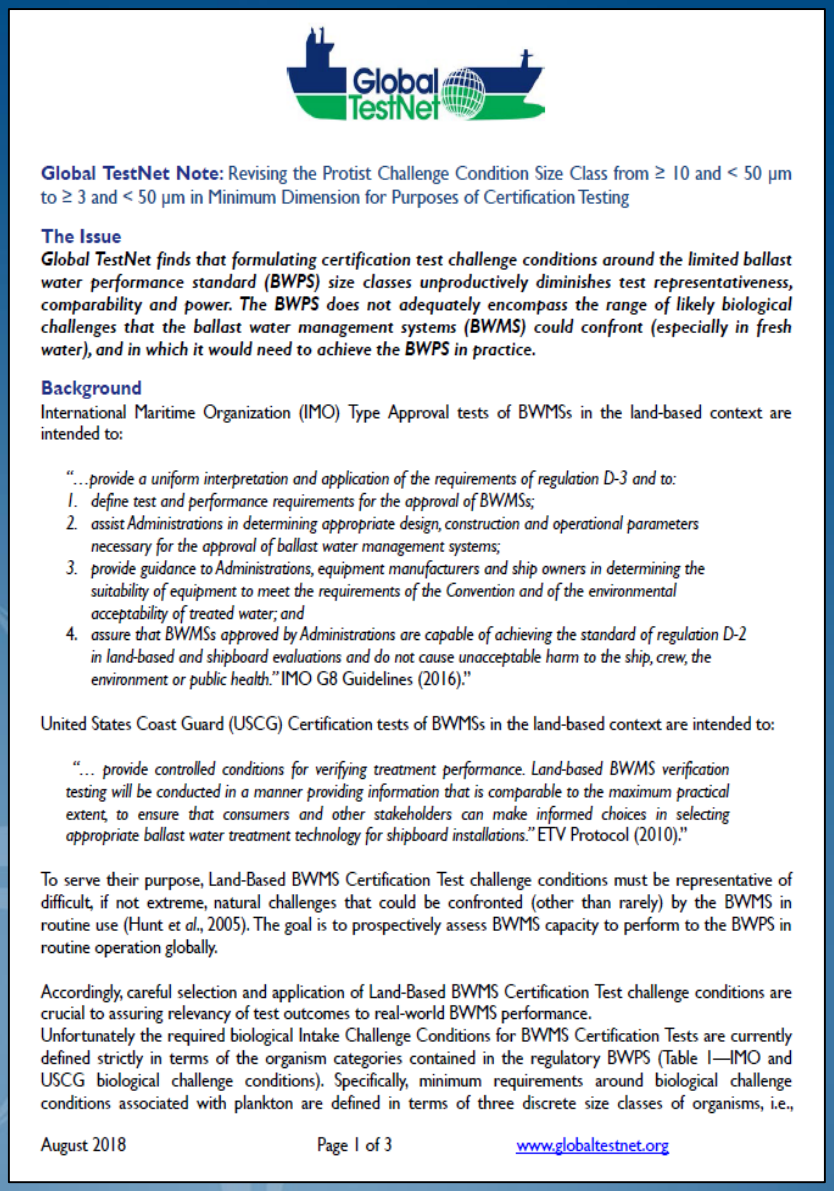

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GTN Position Paper on Protist Size Revision for Challenge Conditions

- Challenge conditions that only include the 10-50 µm protists diminishes test representativeness
- Several harmful algal species in the 3-10 µm range
- Limiting uptake challenge concentrations to 10-50 µm unproductively constrains test facilities to meet challenge using ambient organisms
- Challenge conditions should be reconsidered and revised to 1,000 live cells 3-50 µm, including > 100 live cells ≥ 10 microns in minimum dimension on uptake

http://globaltestnet.org/getattachment/Discussions/GBTN_Subsized_Protists_Position_Paper_Final_V030818.pdf

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Thank you!

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