# Rapid and on-site phytoplankton assessment in water

Sixsenso Technologies S.L

"SIXSENSO information for evaluation promotional purposes"

# Algae bloom in bathing waters

**22 cell/100ml**

**10 Million cells/100ml**

**SIXSENSO FOR MONITORING AND PREDICT ALGAE BLOOM OF URTICANT SPECIES LIKE INCREASING OSTREOPSIS IN MEDITERRAENEAN COASTS.**

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# PHYTOPLANKTON SAMPLING SYSTEM: THE WHISH LIST

**EASY OF USE**

**PORTABLE**

**RAPID**

**REPRESENTATIVE SAMPLING**

**EFFICIENT SAMPLING & CONCENTRATION**

**EASY OF USE**
On ship use in remote locations, automated operation.

**PORTABILITY**
Small size, Low foot-print and weight, battery operated.

**RAPID**
1 liter filtration in 10 minutes. Powered by 25Watts pump.

**REPRESENTATIVENESS**
Large Volume (Liters) for low levels of phytoplankton assessment

**EFFICIENCY**
Efficient cell filtration and recovery elution > 95%

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# SX-CON: SMART SAMPLER CONCENTRATOR

FIRST SIXSENSO'S PRODUCT IN THE MARKET

## PRODUCT LAUNCHED IN APRIL 2022

SX-CON is a microorganism concentrator module **which can rapidly filtrate large volume of water samples (in the order of litres) and elute them in a few millilitres reservoir,** providing an increasing concentration factor of some orders of magnitude, depending on the application. **It is designed to be portable (with large battery autonomy) and robust to use in the most challenging outdoors' environmental conditions or simply operating in the laboratory.**

**Combine SX-CON with several microbiological assessment techniques and methods in order to decrease time to result, increase their representativeness and enhance their sensitivity**, including:

- Lateral Flow Device (LFD) assays,
- Defined Substrate Technology (DST) based assays, Nanoparticles-based assays,
- Antigen-based assays,
- rRNA-based assays,
- culture and
- PCR assays.

SUPPORTED BY Agència Catalana de l'Aigua

**Portable**, **efficient**, **robust** and **easy to use.**

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# SXS-CON *Portable Smart Sampler Concentrator System*

*Enhance rapidly the time to result, sensitivity and representativeness of your microbiological assessment by an on-site pre-concentration step.*

## *Specifications*

| | |
|---|---|
| **Filtrated sample Volume** | *From 100 mls to 3.000 mls* |
| **Eluted sample Volume** | *From 0,1 ml to 3 mls* |
| **Concentration Factor (CF)** | *From x10 to x1.000* |
| **Flow rate** | *200 ml/min @100 rpm. (Powered by 24W peristaltic pump)* |
| **Internal Diameter (ID) tubing** | *From ID 2.4 to 8.0 mm (ID 8mm by default)* |
| **Power** | *Internal rechargeable battery – 8 hours continuous operation* |
| **Dimensions** | *26,5 x 24,5 x 17 cm* |
| **Mass** | *3 Kg* |
| **IP rating lid closed/open** | *IP68 / IP65* |

## *Concentration Kit – Sterilized disposables **

| | |
|---|---|
| | *2x Luer lock 3-port valves* |
| | *1x tubbing kit* |
| | *2x Luer lock 5 ml syringes (with elution buffer)* |
| | *1x Celltrap filter* |

** Sterilized disposables are for only one use to avoid cross-contamination. Multi-use of disposables could be suitable for evaluation purposes.*

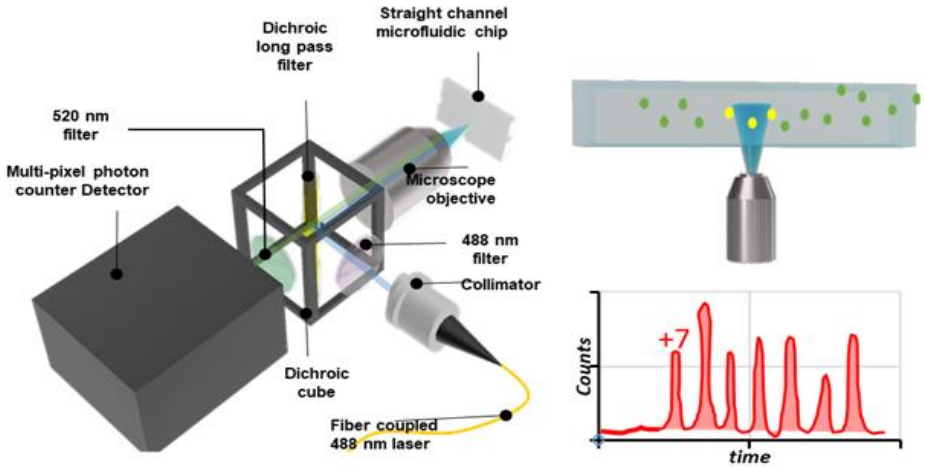
# SX-CYT

PATENTED

## *Specifications*

| | |
|---|---|
| **Laser pump** | *Diode laser @ 488nm* |
| **Detection channels** | *Green channel @537nm*<br>*Red channel @ >610nm* |
| **Microorganism detection** | *Bacteria, virus, phytoplankton.* |
| **Microorganism sizes** | *From 0.2 µm to 50 µm.* |
| **Operational concentration range** | *From 1 to 10^4 cell/ml*<br>*From 1 to 10^4 cell/100ml (with SXS-CON)* |
| **Power** | *Internal rechargeable USB battery – 8 hours continuous operation* |
| **Dimensions** | *36 x 29 x 16 cm* |
| **Mass** | *4 Kg* |
| **IP rating lid closed/open** | *IP68 / IP65* |

**Portable**, **accurate**, **robust** and **easy to use.**




- **On-site** microorganism quantification.
- Suitable for **bacteria**, **virus** and **phytoplankton.**
- **Large sample volume** analysis.
- **Rapid analysis.**
- **Accurate** as gold standard methods.

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# Phytoplankton: Sampling and Concentration results

PERFORMANCE OF THE CONCENTRATION CONCENTRATING PHYTOPLANKTON FROM REAL BATHING WATERS

**1 Liter water sample**

## Concentration

=

Filtration + Elution

**<6 mls concentrated sample providing a Concentration factor in the order of x250.**

Optimized concentration protocol has been developed that filters 1L of sample to be further eluted to a volume of ~5.75mL providing a concentration factor in average of **C-Factor: x255 for phytoplankton** with samples up to 10NTU turbidity, with whole process taking **less than 10 minutes.**

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# Validation: Phytoplankton concentration & detection

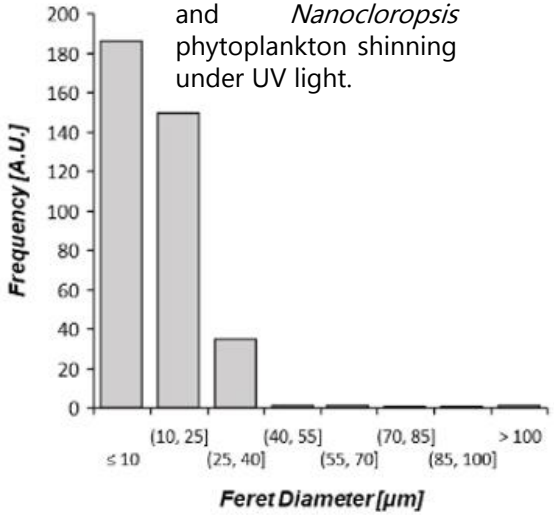
PERFORMANCE OF THE CONCENTRATION AND READER MEASURING PHYTOPLANKTON <50um IN REAL SEA WATER

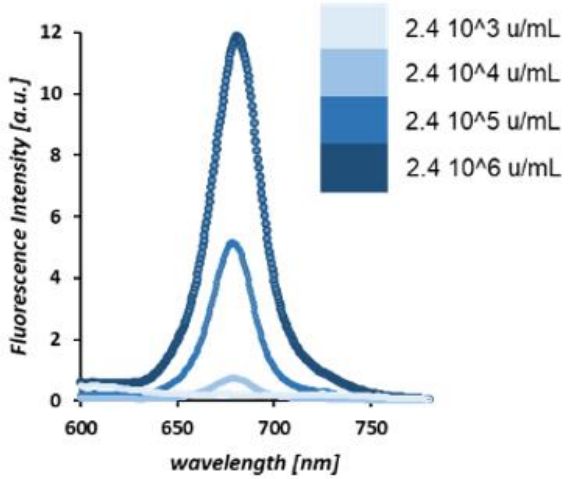
Concentration Operation **Range from $10^1$ to $10^5$ cells/mL** .

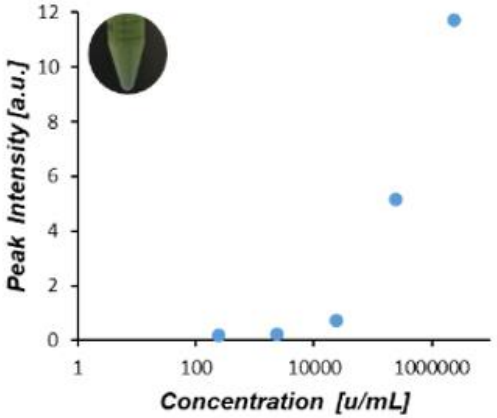
LOD Phytoplankton sub 50 micron:

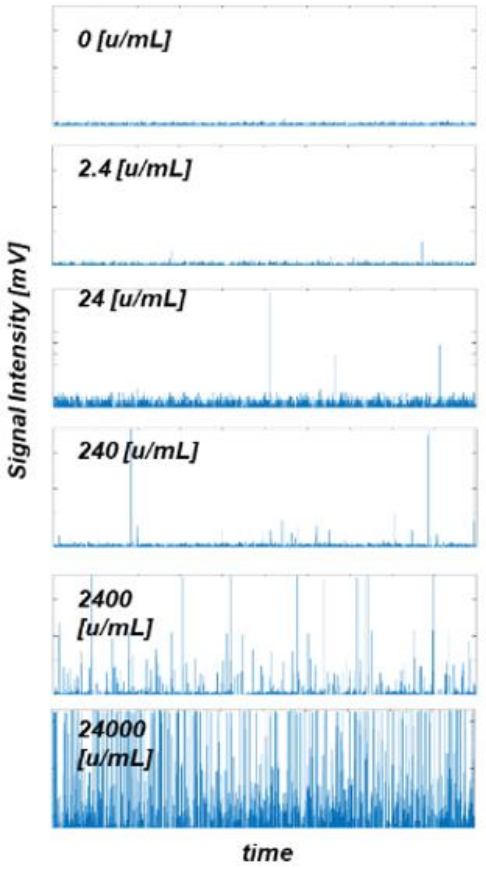
- **LOD: 53 cells/mL** (95% CI) direct measurement
- **LOD: 22 cells /100 ml** (95% CI) in combination with the concentrator

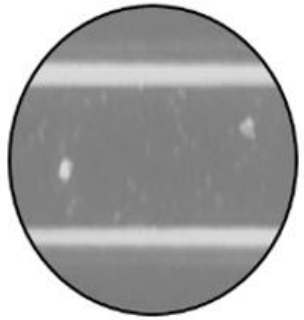
Sample of *Tetraselmis* and *Nanocloropsis* phytoplankton shinning under UV light.

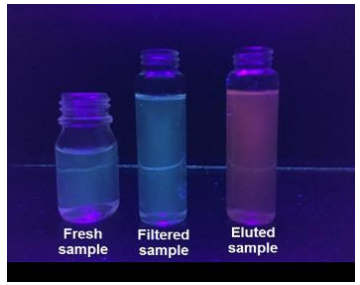


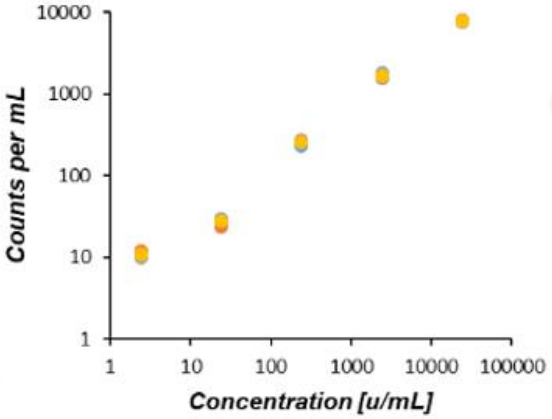






Cells of *Tetraselmis* and *Nanocloropsis* phytoplankton passing through the interrogation Field Of View (FOV) of the microfluidic channel of the SX-CYT reader. Samples on the right under UV light showing the eluted concentrated sample shining in red color.



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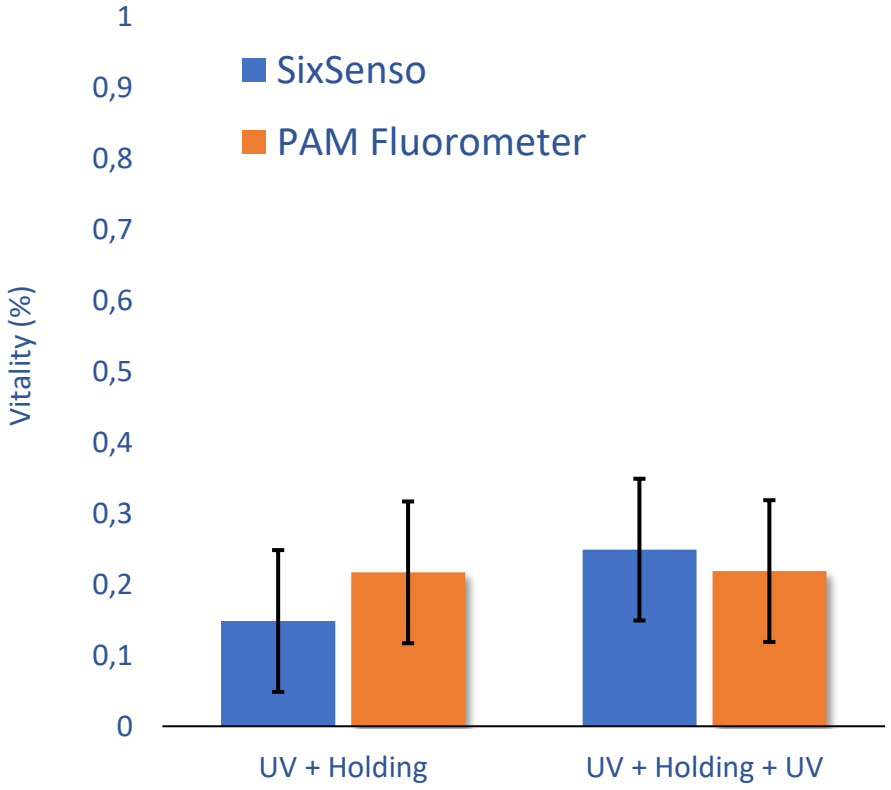
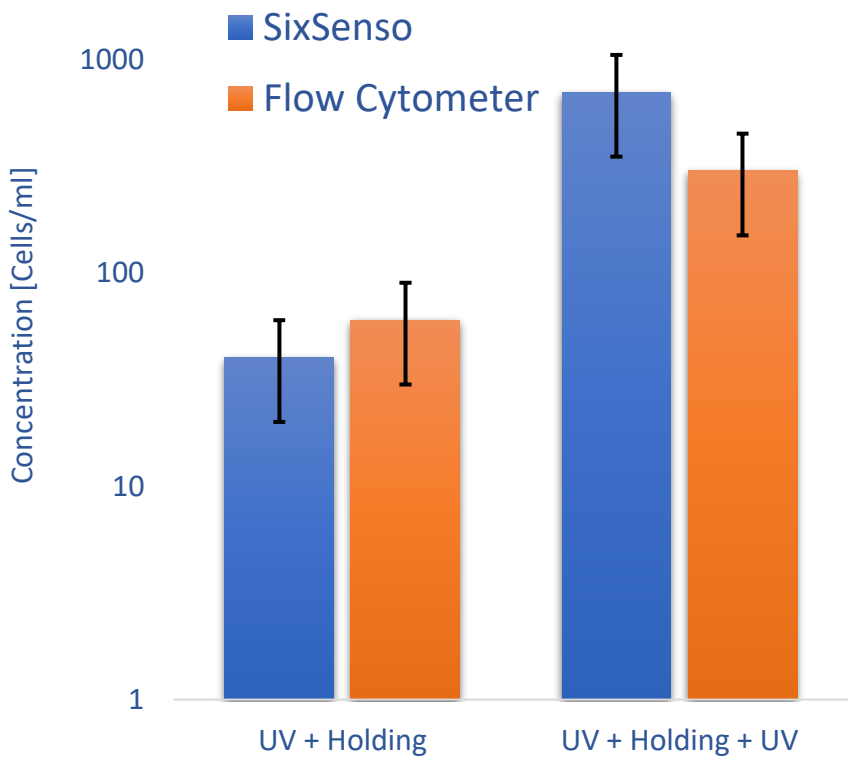
# Validation: Environmental Phytoplankton monitoring

Benchmarking against gold standard Flow Cytometry measuring phytoplankton in a Ballast Water Testing ship in the North Sea. Third party validation by MEA-NL




*Paper presented at 6th IMarEST Ballast Water Technology Conference at IMO in London (2017).*



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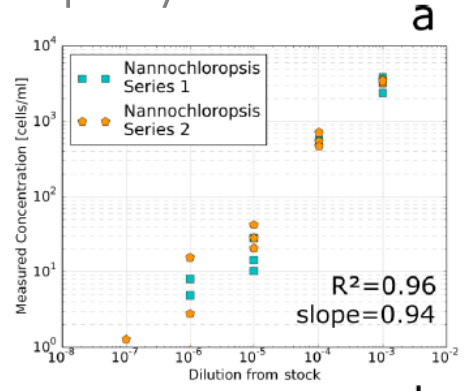
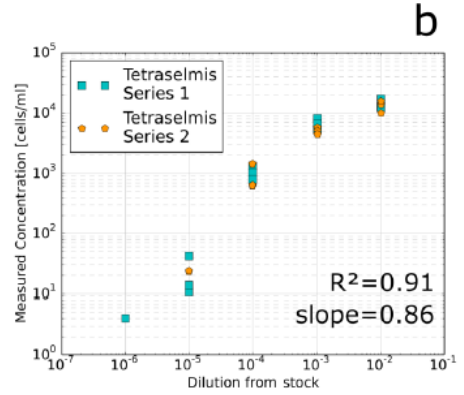
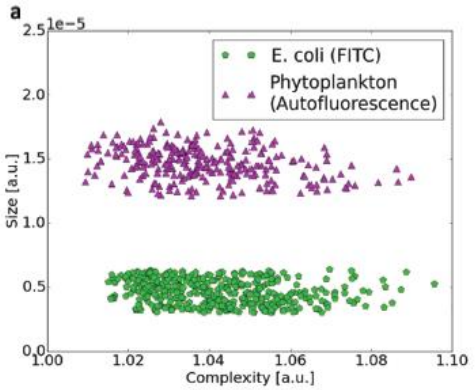
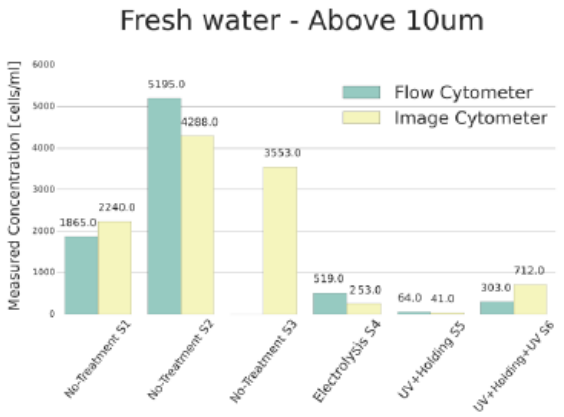
# Validation: Environmental Phytoplankton monitoring

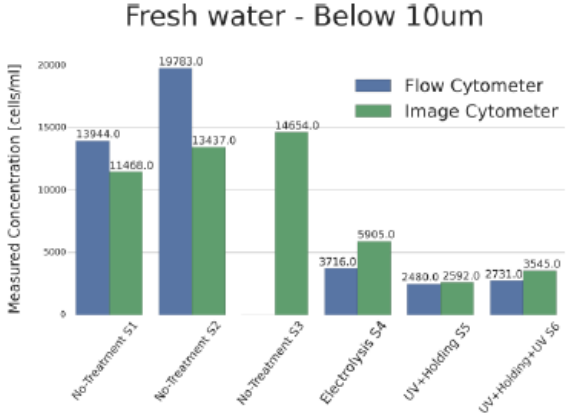
Performance measuring phytoplankton in Ballast Water Vessel discharge Testing in the North Sea.
Third party validation by MEA-NL

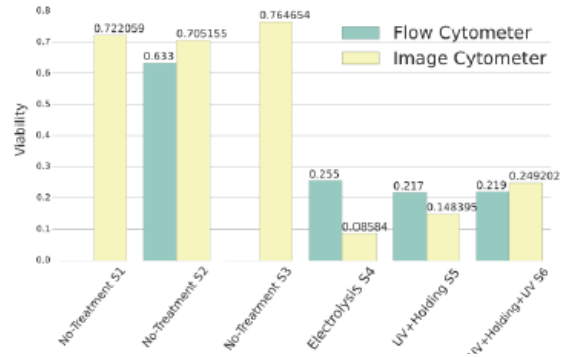


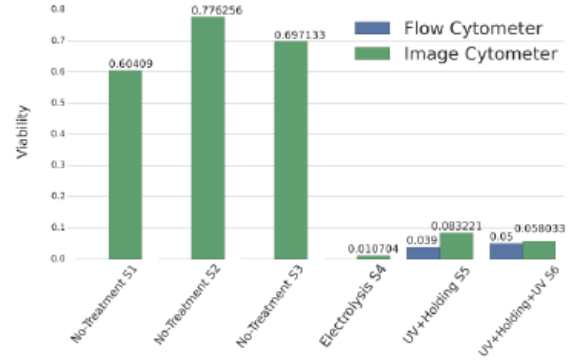



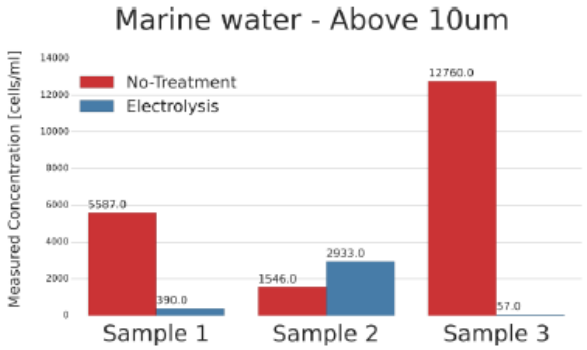



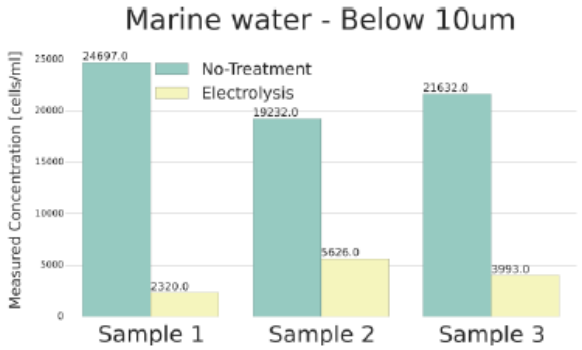




**Phytoplankton assessment results** presented at the **6th IMarEST Ballast Water Technology Conference at IMO in London (2017).** Final concentration factor for phytoplankton was x 130, and the **SX-CYT Reader system LoD moved down to 77 cell/L (7,7 cell/100ml)** after the concentration procedure. Achieving a LoD <10 cell/100ml in deep ocean water and meeting with lower alarm level of toxic phytoplankton (DSP< 50 cell/100ml).

References:


*J. Pérez, M. Jofre, P.Martinez, A.Paerker, A. Yáñez, V.Catalan, M. Veldhuis, V. Pruneri(2016). "CMOS based image cytometry for detection of phytoplankton in ballast water". Biomedical Optics Express. 8. 10.1364/BOE.8.001240.*

*Pérez, J. M., Jofre, M., Martínez, P., Yáñez, M. A., Catalan, V., & Pruneri, V. (2015). "An image cytometer based on angular spatial frequency processing and its validation for rapid detection and quantification of waterborne microorganisms". The Analyst, 140(22), 7734–7741. https://doi.org/10.1039/c5an01388k*

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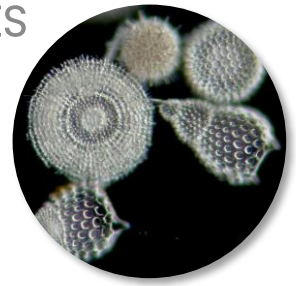
# SIXSENSO PRODUCTS

FOR PREVENTIVE ANALYSIS OF PATHOGENS AND INVASIVE SPECIES IN MARINE AND FRESH WATERS

- **REPRESENTATIVE SAMPLING (LITERS)**
- **HIGH SENSITIVITY - LOW LIMIT OF DETECTION**
- **HIGH SPECIFICITY (DNA/RNA LABELLING)**
- **RAPID ANALYSIS ( 30 MIN- 3 HOURS)**
- **IN-SITU / PORTABILITY**



**PHYTOPLANKTON**

**BACTERIA**

**VIRUS**

## Rapid indicative tests

***LOW END PRODUCTS (PASS/FAIL Test):***

Filters and tubing in **SX-BioKit-LFD**

**SX-CON**

Lateral Flow Device (LFD) in the **SX-BioKit-LFD**

**QUALITATIVE**
**MICROBIOLOGICAL ASSESSMENT**
**< 30 MIN**

## Quantitative Monitoring System

***HIGH END PRODUCTS (Report in cells/100ml)***

**GENETIC LABELLING**

Reagents and filters in the **SX-BioKit-SYS**

Smart Sampler Concentrator Filtration - Elution
**SX-CON**

Fluorescence Reader
**SX-CYT**

**QUANTITATIVE**
**MICROBIOLOGICAL ASSESSMENT**
**< 3 HOURS**

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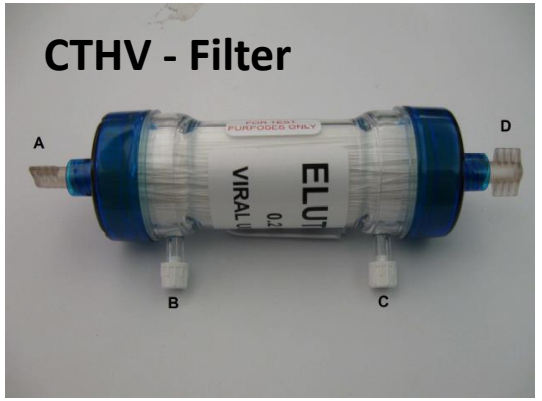
# SIXSENSO PRODUCTS

AVAILABLE FILTERS FOR SPECIFIC APPLICATION NEEDS

**Filtration volumes from 0.1 to 10.000 liters**

**CT - Filter**

**CTHV - Filter**




| Product | CT221 | CT401 | CTHV 100 | CTHV 400 | CTHV 1000 | CT222 | CT402 | CT802 | CTHV 1002 | CTHV 4002 | CTHV 10002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Product identifying cap colours | Light blue | Dark blue | Yellow | White | Dark blue | Colourless | Red | White | Red | Light blue | Colourless |
| Membrane type | PP | PP | PP | PP | PP | PES | PES | PES | PES | PES | PES |
| Volume (L) | 1-5 | 5-10 | 1 -100 | 1 -1,000 | 1-10,000 | 0-1 | 1-5 | 1-10 | 1-100 | 1-1,000 | 1-10,000 |
| Effective filtration area ($cm^2$) | 20 | 39 | 217 | 815 | 1,600 | 11 | 20 | 39 | 108 | 407 | 1,080 |
| Hold up volume (mL) | 0.4 | 0.75 | 3.5 | 13.3 | 27 | 0.1 | 0.19 | 0.38 | 0.89 | 3.4 | 8.9 |
| Flow (mL/min) | 140 | 270 | 1,200 | 4,482 | 9,000 | 242 | 440 | 858 | 2,380 | 8,950 | 18,000 |

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# IMPACT SCHEME

**BALLAST WATER**

**All is linked.** We can **protect food sources, health people, marine biodiversity and climate** by **better monitoring** and controlling invasive alien species (IAS) in Ballast Water operations.

**Bacteria, virus and phytoplankton monitoring by Sixsenso systems**.

IAS

IAS

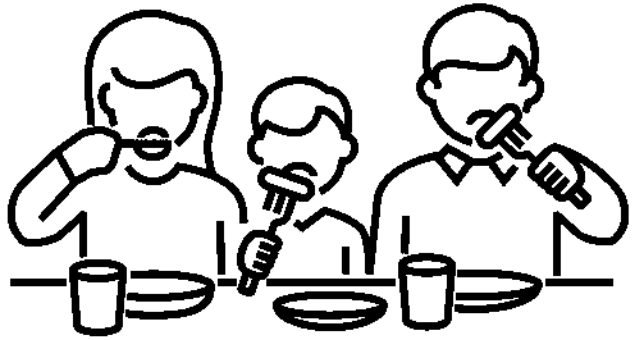
IAS

BIODIVERSITY

SEA FOOD

WRID

WRID



*INVASIVE ALIEN SPECIES (IAS)

**WATER-RELATED INFECTIOUS DISEASES (WRID)

# Ballast Water Regulation

REGULATION
ENTERED INTO FORCE
GLOBALLY ON SEPT 2017:
**IMO-BALLAST WATER D-2 STANDARD**

**TO CONTROL THE INVASIVE SPECIES BALLASTED TO THE PORT WATER FROM SHIPS.**

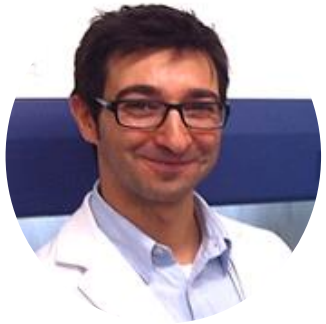
- **PHYTOPLANKTON** < 10 cell / ml
- **E.COLI** < 250 CFU / 100ml
- **ENTEROCOCCI** < 100 CFU/ 100ml
- **VIBRIO CHOLERAE** < 1 CFU/100mL

# THE TEAM

## MANAGEMENT DIRECTORS

**Adrian J. Parker |** *Co-founder and CEO*

Specialist sales and marketing in water treatment markets.



**Pedro Martinez |** *Co-founder and CTO*

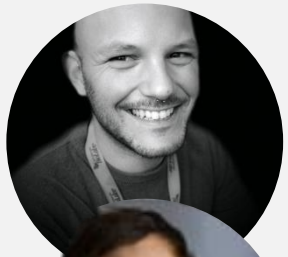
Photonics, electronics and software development.

## TECHNOLOGY ADVISORY BOARD

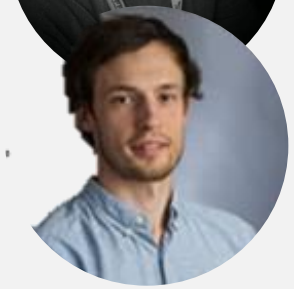
**Prof. Valerio Pruneri |**
*Co-founder & Technology Advisor*
Group Leader @ ICFO

## COLLABORATORS

### TECHNICAL SUPPORT



**Alfredo Ongaro** | *Microfluidics*
Assay development and microfluidics design



**David Kernan** | *RD*
Protocol development for sample filtration and concentration

ICFO

### PUBLIC SUPPORT

Agència Catalana de l'Aigua

IRTA

ACCIÓ

Generalitat de Catalunya

### PRIVATE ALLIANCES

PML | Applications Ltd

BioVisible Microbial Diagnostics

ERMA FIRST THE EXCELLENCE OF SIMPLICITY

naqua

Clean Rivers Hub

genemis

hydrosense

SY-LAB

operon immuno & molecular diagnostics

SILVER LAKE RESEARCH

MEM TEQ Concentrating Technology

SECPhO Southern European Cluster in Photonics and Optics

fi ready an FI Group service

sixsenso
SENSE DIFFERENT
THANKS