

An integrative academic-industry collaboration for biotechnology driven discovery of new functions in marine environmental metagenomes

Renzo Kottmann

**Microbial Genomics and Bioinformatics Research Group
Max Planck Institute for Marine Microbiology**

**Marine Biotechnology in the European Research Area: Challenges and
Opportunities for Europe**

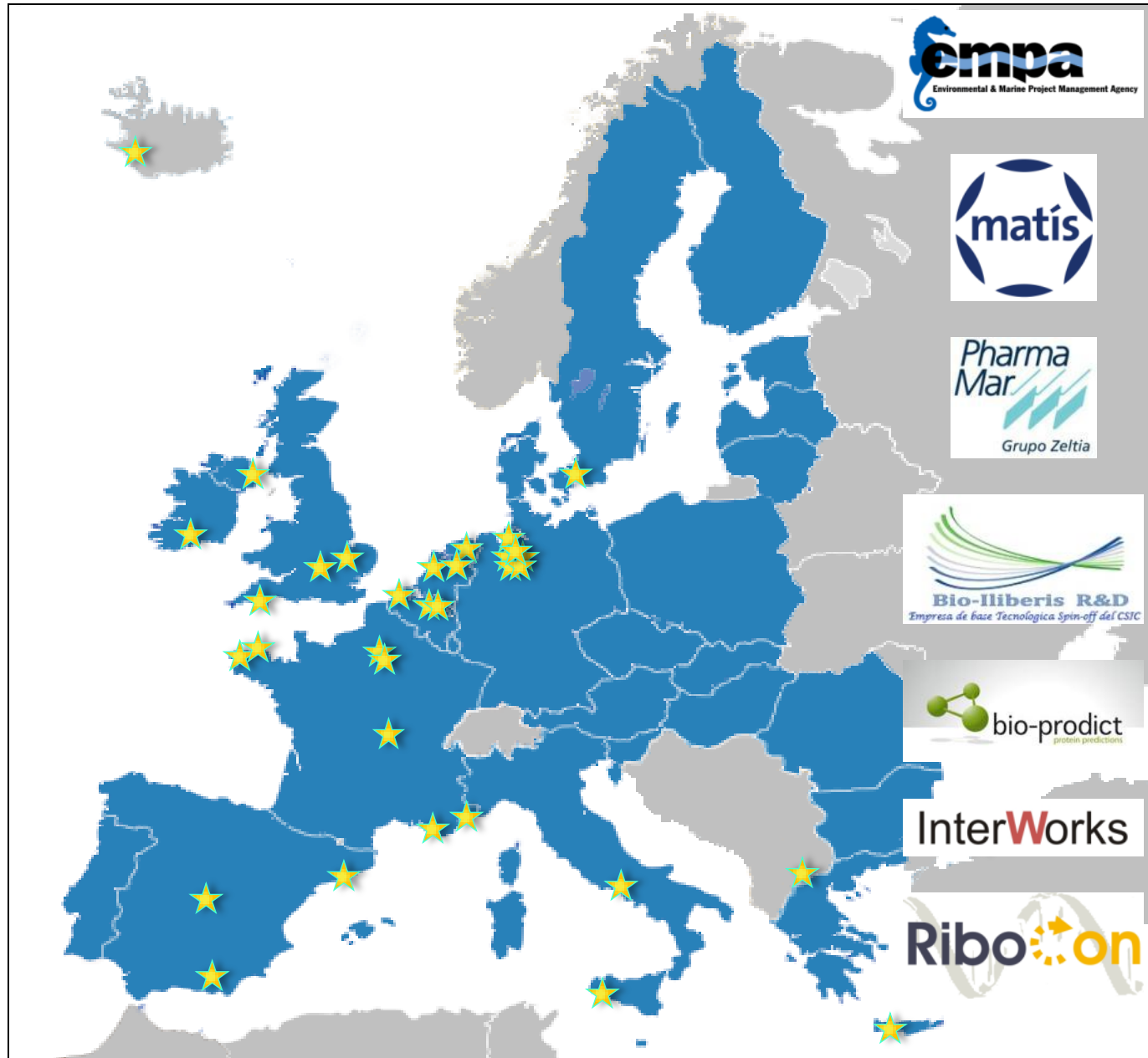
March 2013



Biodiversity. Bioinformatics. Biotechnology.

**Partners:
25
academic
&
7 SMEs**

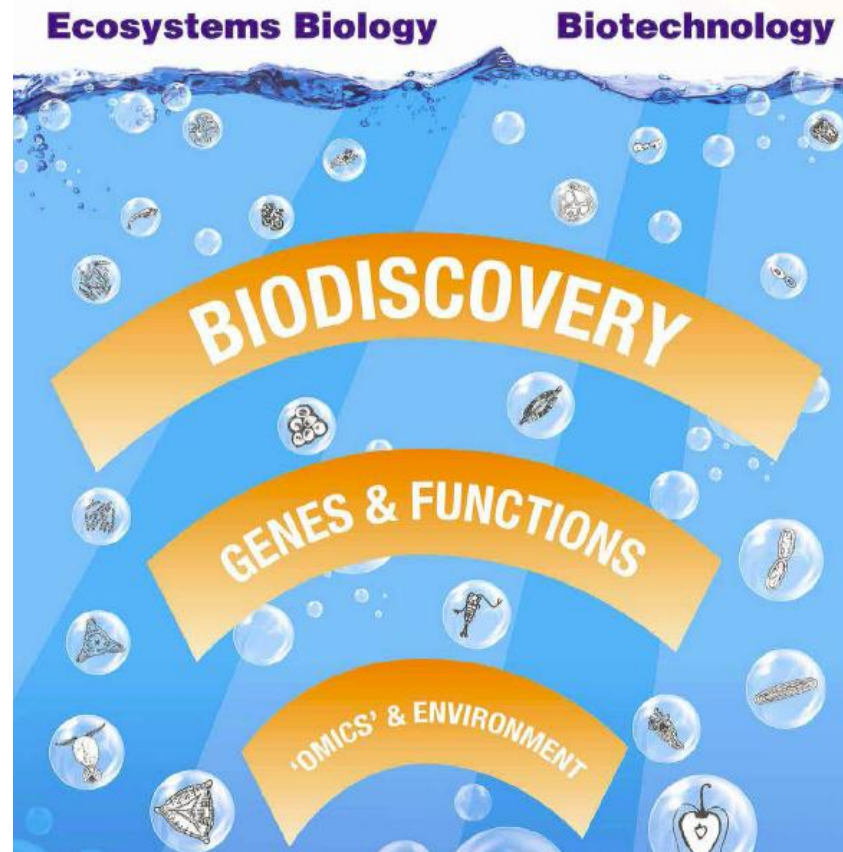
**January
1st 2012
4 years**



Transferring Data into Ecosystems Knowledge and Biotechnological Applications



Data is key



**Software
Service
Infrastructure**

Samples

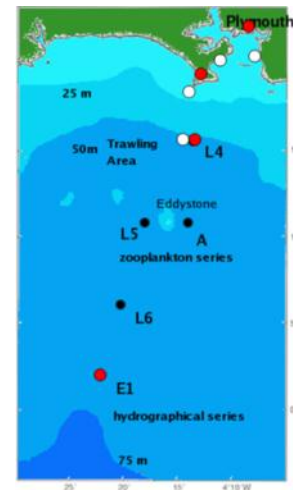
▶ Long Term Ecological Research Sites

- L4 Site Western Channel Observatory
- BBMQ Blanes Bay Microbial Observatory
- LTER-MC Bay of Naples
- M3A HCMR Marine Monitoring Station Crete

▶ Extreme habitats

- Iceland
- Mediterranean deep-sea anoxic hypersaline lakes (DHALs)

▶ Ocean Sampling Day



Ocean Sampling Day

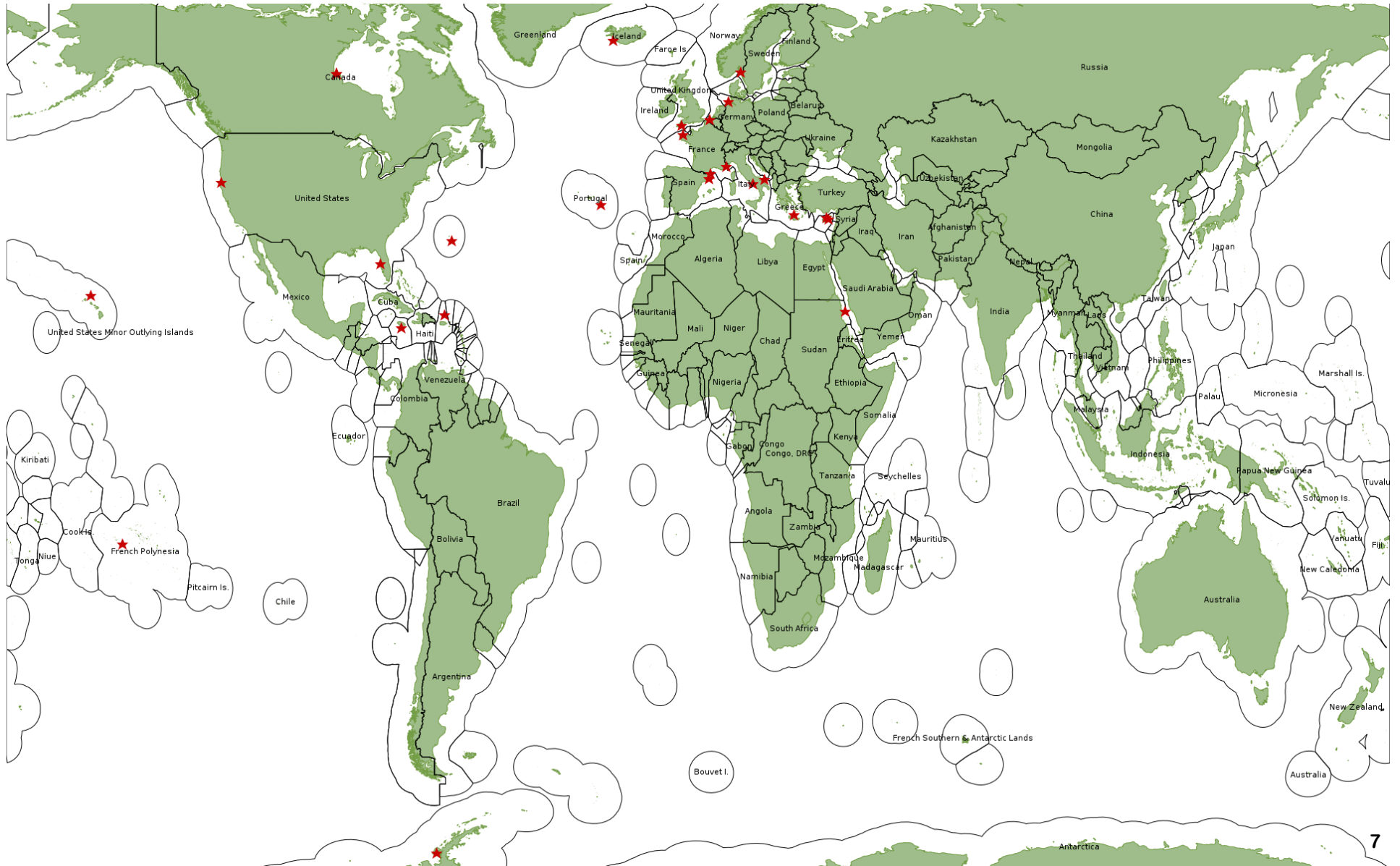
- ▶ Global
- ▶ Standardized
- ▶ Orchestrated
- ▶ Sampling event fixed in time
 - June 21st 2014



www.oceansamplingday.org

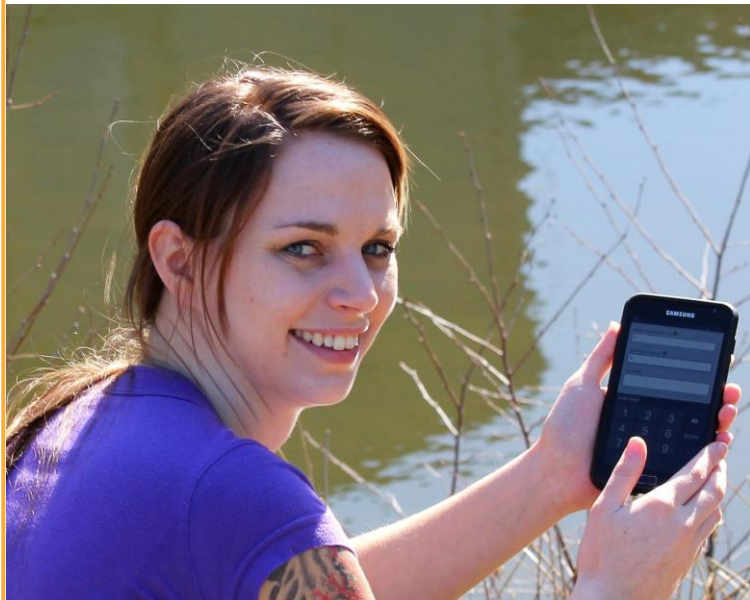


Current OSD participants



Ocean Sampling Day App

- ▶ Smartphone Application (Android, iPhone)
 - Early consistent digital metadata acquisition

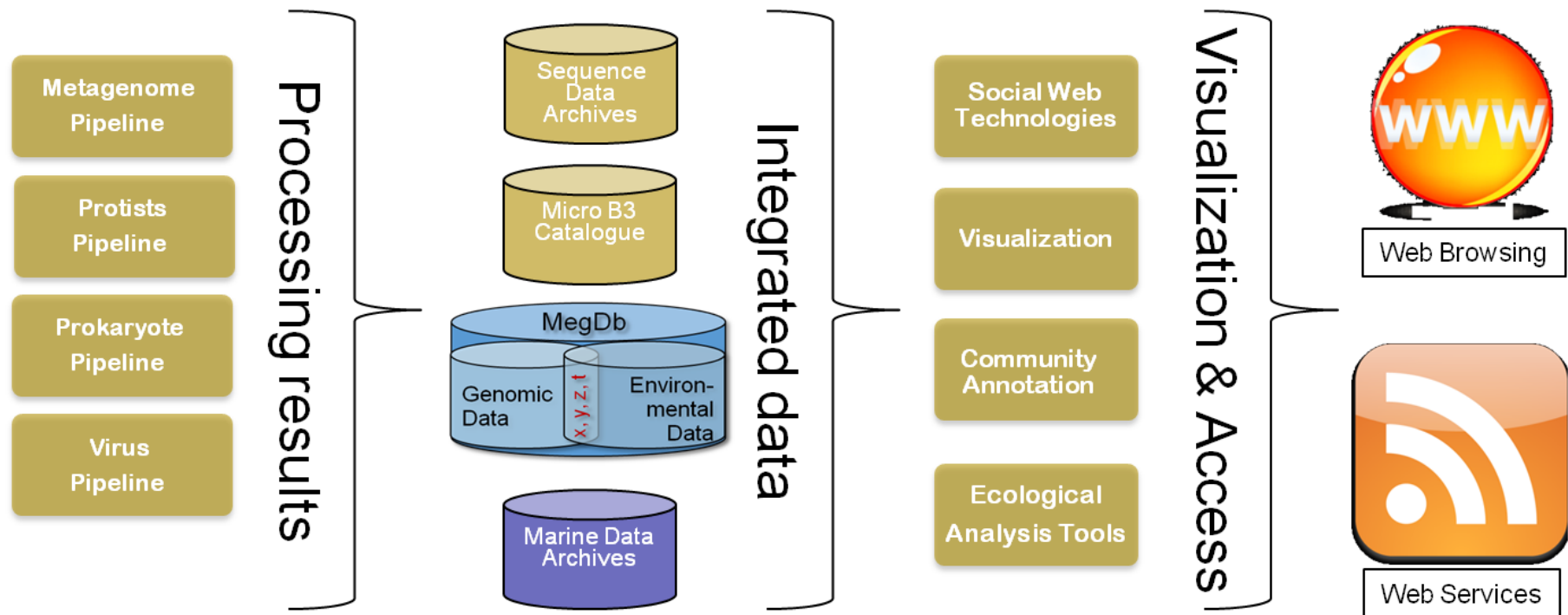


Bioinformatics and Data Integration

Data Processing

Data Integration

Community Services



Data Access: Software Services

log in

megx
marine ecological genomics

home tools browse edutainment portal contact

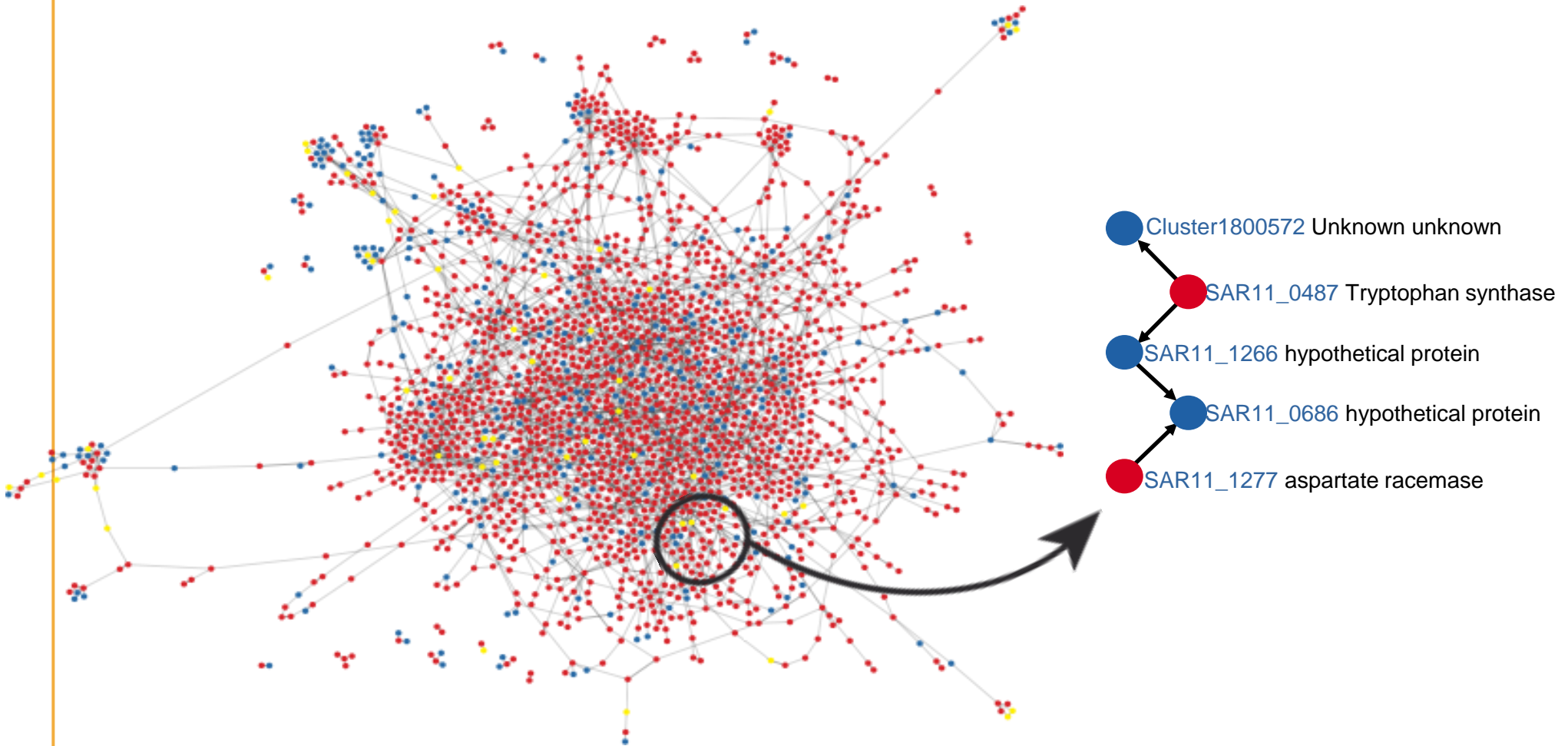
informatics + microbiology
=
quality & efficiency

Megx.net allows access to integrated environmental & (meta)genomic data intended for use in marine microbial ecology

- Map Server
View georeferenced sampling sites in their environmental context... [view](#)
- GeoBlast
BLAST your sequences against georeferenced (meta)genomes ... [view](#)
- Envo-lite
Browse genome projects classified according to sampling environment... [view](#)

InterWorks

Discovery: knowns, known *unknowns* and *unknown unknowns*



Pelagibacter ubiquus proteome centered subnetwork
Antonio Fernandez, submitted

Potential new targets



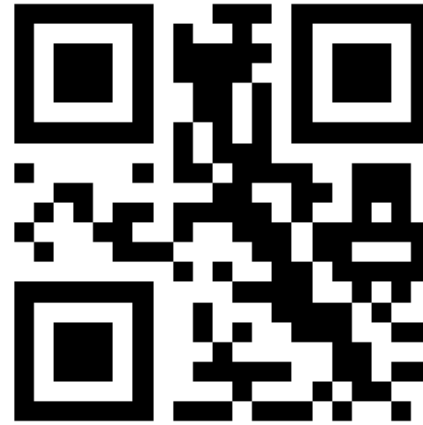
▶ Laboratory experiments

- Confirmation of functions
- Pre-enrichments
- Functional screening of large-insert libraries
- Micro-colonies and micro-cultures
- Heterologous expression
- Bioassays



Summary & Conclusion

- ▶ **Micro B3 is on a good way to establish data flow from sampling to the discovery of potential new targets**
- ▶ **Key for collaboration**
 - open access to data
 - open source software products
 - ◊ Permissive industry friendly license
 - clear communication of intellectual property rights
 - training



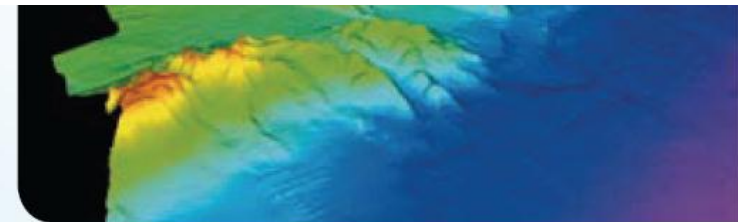
www.microb3.eu

Thanks for your attention

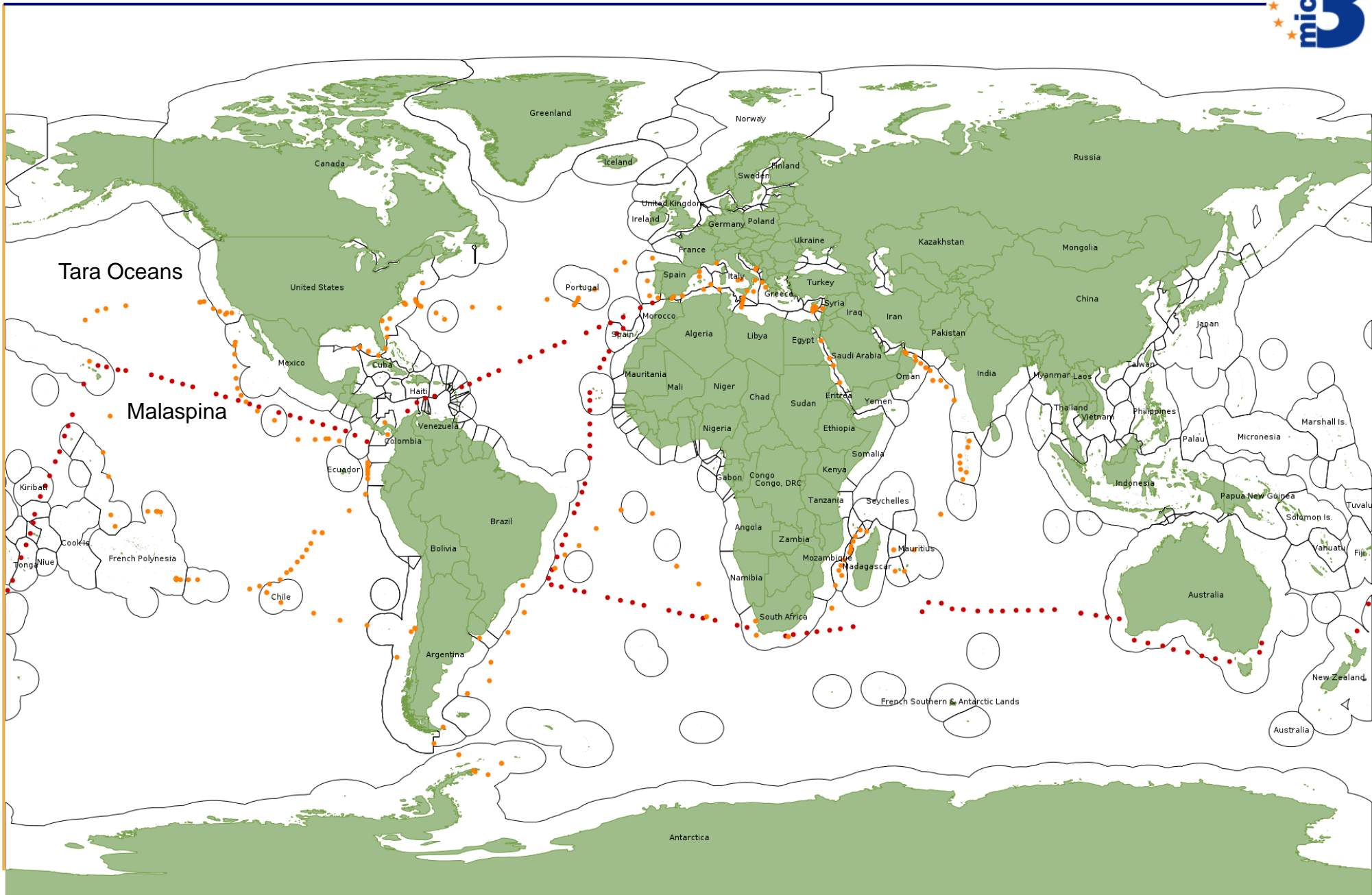
PROCEEDINGS

Hypotheses come and go but data remain

Santiago Ramón y Cajal,
Nobel Prize 1906



1st Marine Board Forum: Marine data Challenges: from Observation to Information





JBL Test-Set Mg+Ca / Magnesium Calcium

statt ~~22,95€~~
jetzt ab **5,99 €***



18 Bewertungen

» alle Varianten

[zur Produktseite](#)



JBL Test-Set NO3 / Nitrat

statt ~~16,95€~~
jetzt ab **8,39 €***



24 Bewertungen

» alle Varianten

[zur Produktseite](#)



JBL Test-Set SiO2 / Silikat

statt ~~15,95€~~
jetzt ab **7,98 €***



14 Bewertungen

» alle Varianten

[zur Produktseite](#)



JBL Test-Set Fe / Eisen

statt ~~15,45€~~
jetzt ab **8,19 €***



27 Bewertungen

» alle Varianten

[zur Produktseite](#)



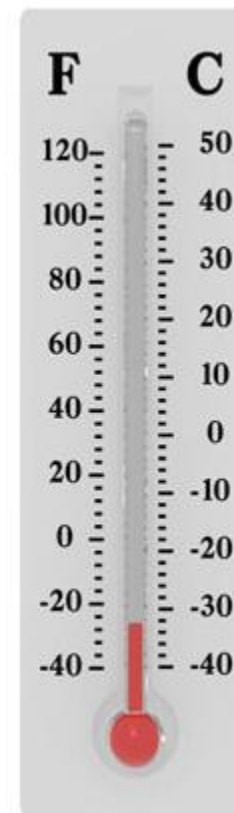
JBL EasyTest 6 in 1

statt ~~15,49€~~
jetzt nur **13,19 €***

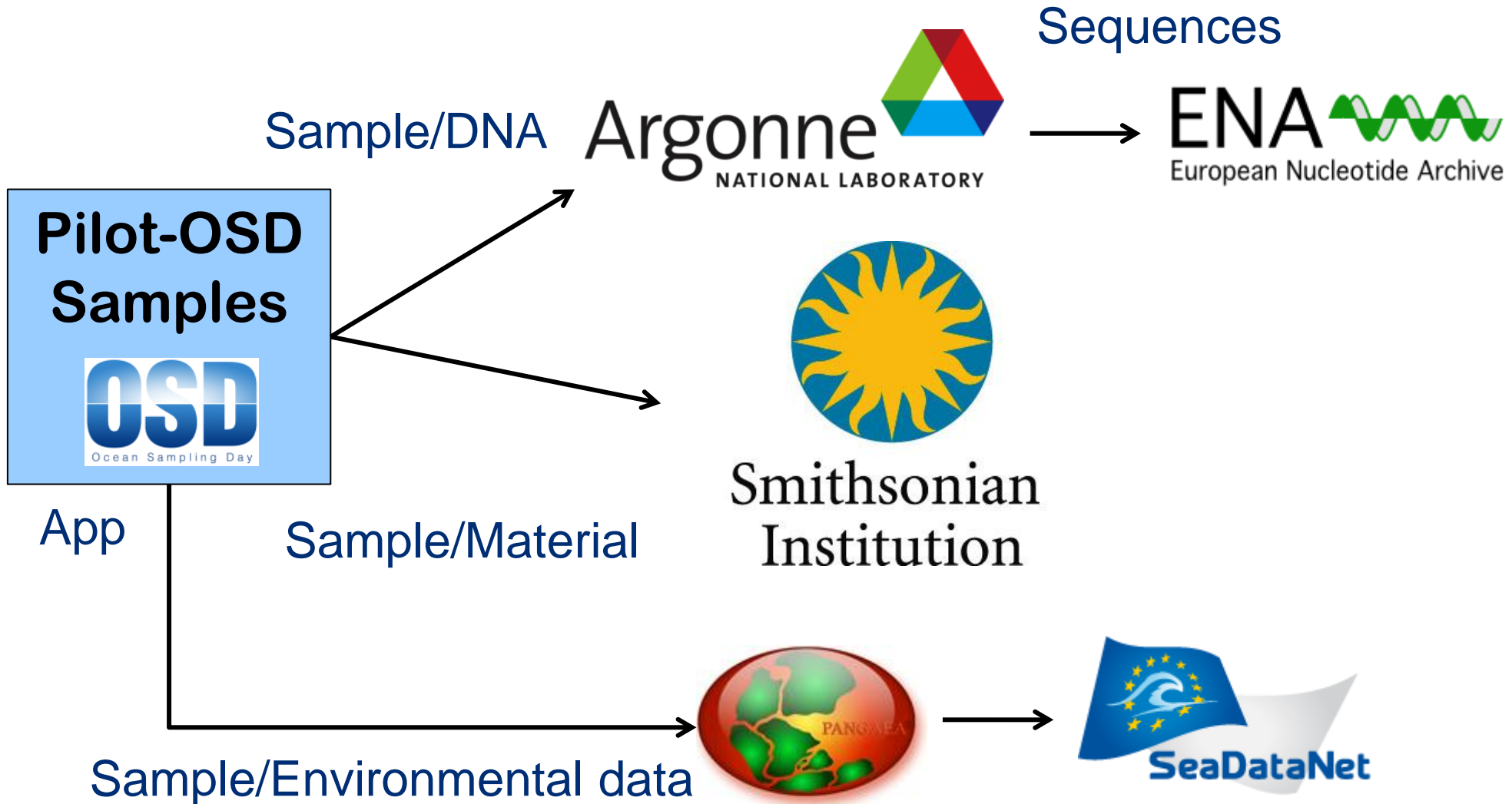


15 Bewertungen

[zur Produktseite](#)



Current "Sample Workflow" for Pilot-OSD

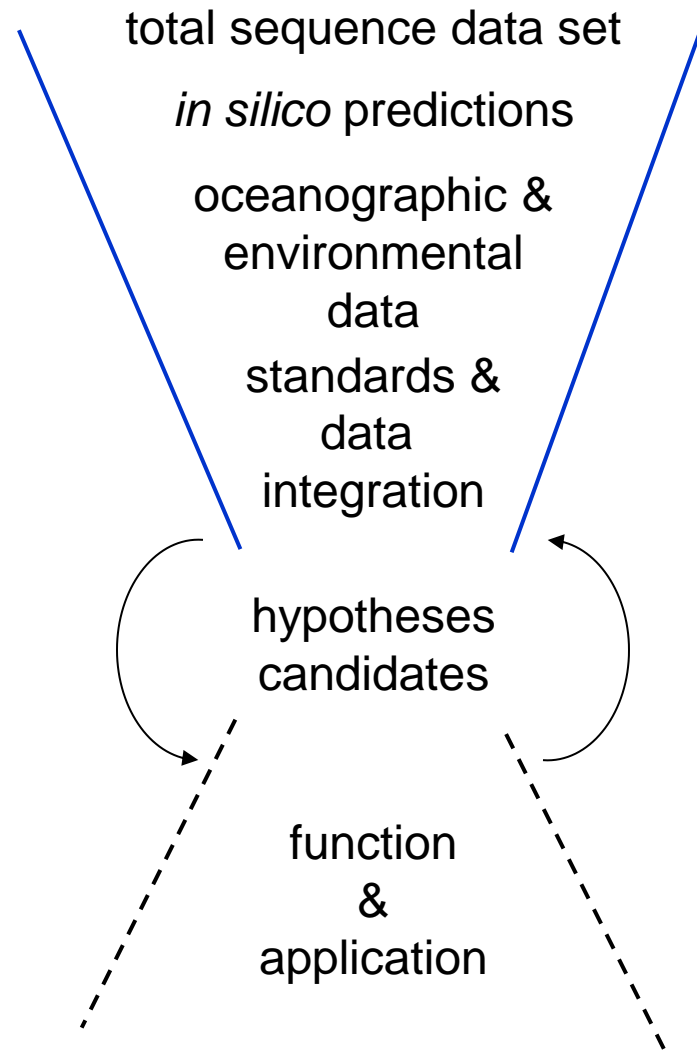


Micro B3

- ▶ Micro B3 will develop innovative **bioinformatic approaches** and a **legal framework** to make large-scale data on marine viral, bacteria, archaeal and protists genomes and metagenomes accessible for **marine ecosystems biology** and to define new targets for **biotechnological applications**.
- ▶ Micro B3 will build upon a highly **interdisciplinary consortium** of **32 academic and industrial partners** comprising world-leading experts in bioinformatics, computer science, biology, ecology, oceanography, bioprospecting and biotechnology, as well as legal aspects.
- ▶ Budget: 9 Mio Euro for 4 years

small and large scale study sites

intellectual property rights



process & filter

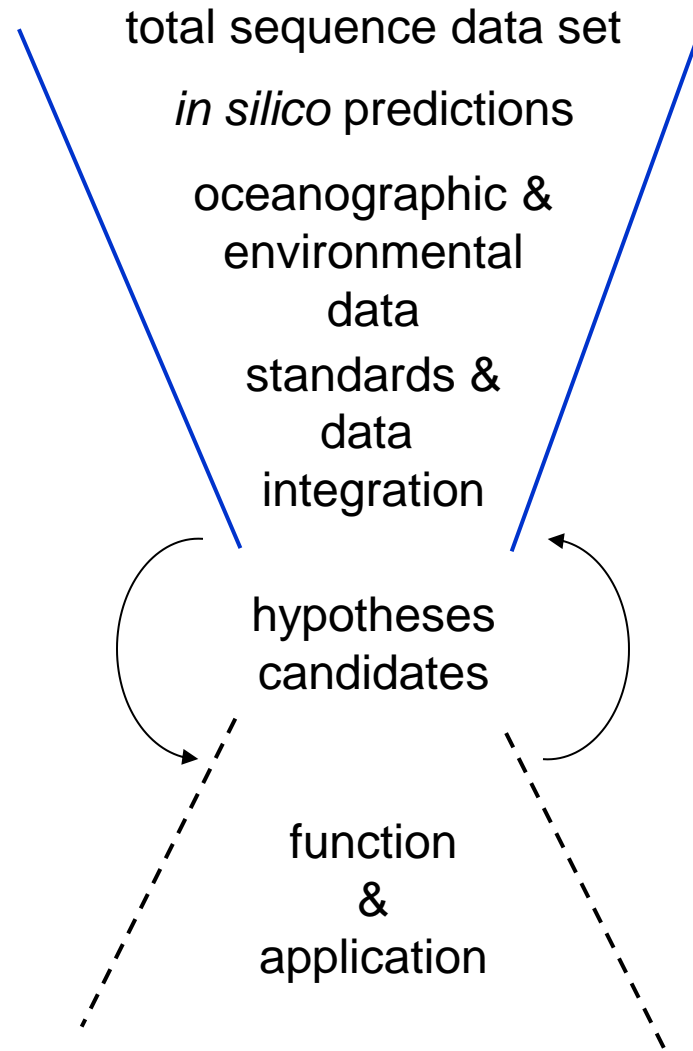
Bioinformatics

test & learn

Laboratory

ecosystems biology & biotechnology

intellectual property rights



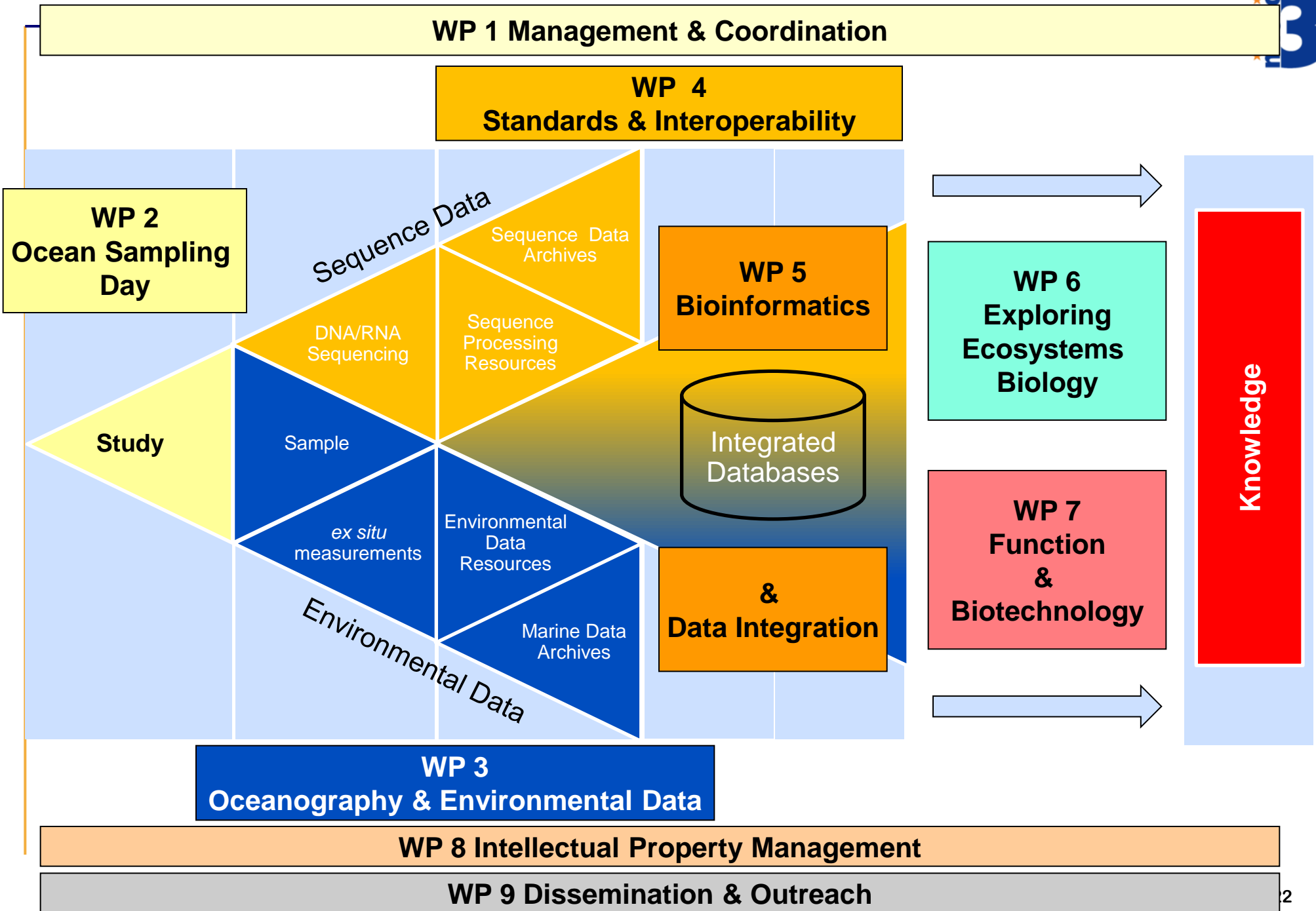
process & filter

Bioinformatics

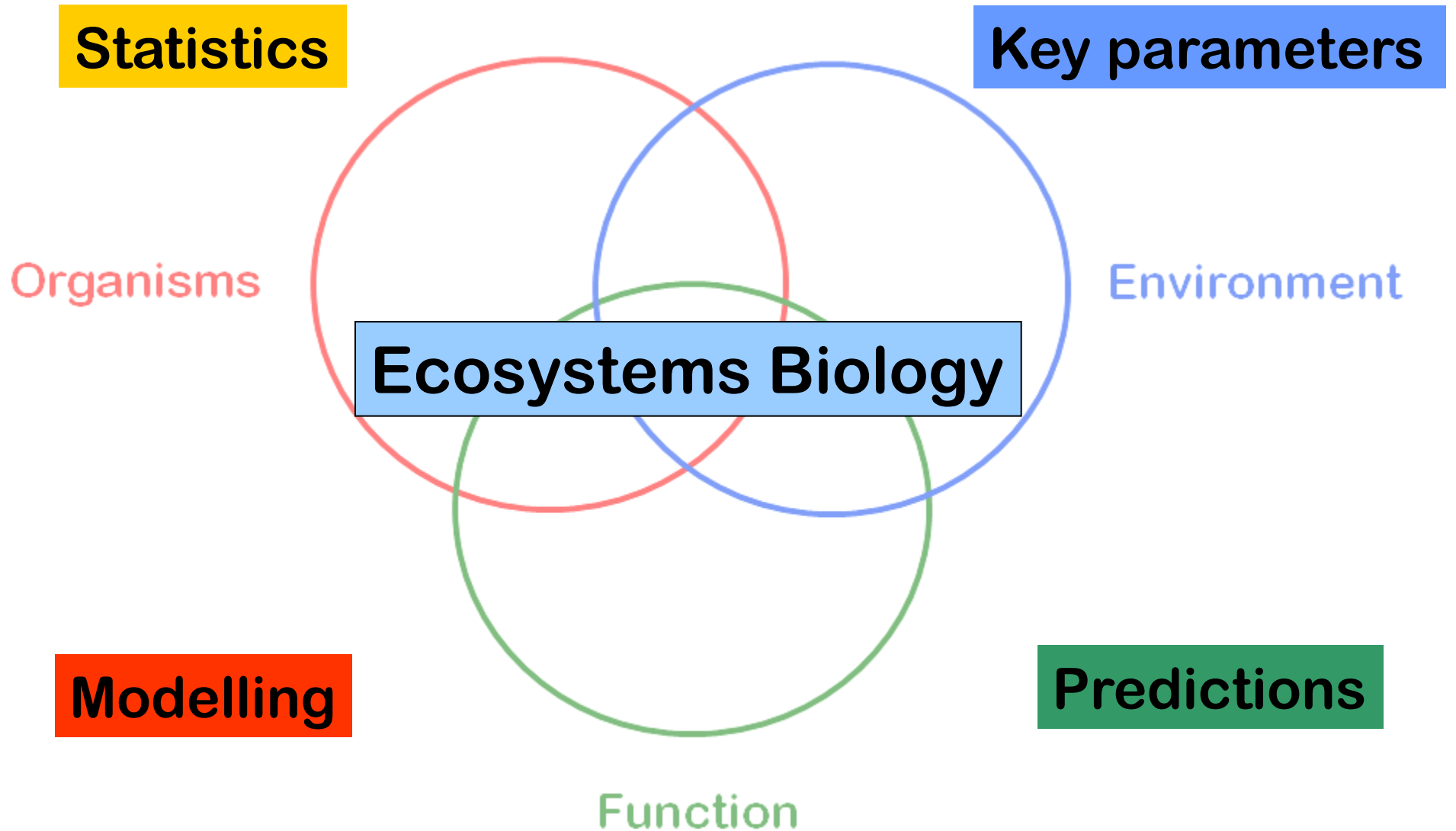
test & learn

Laboratory

ecosystems biology & biotechnology

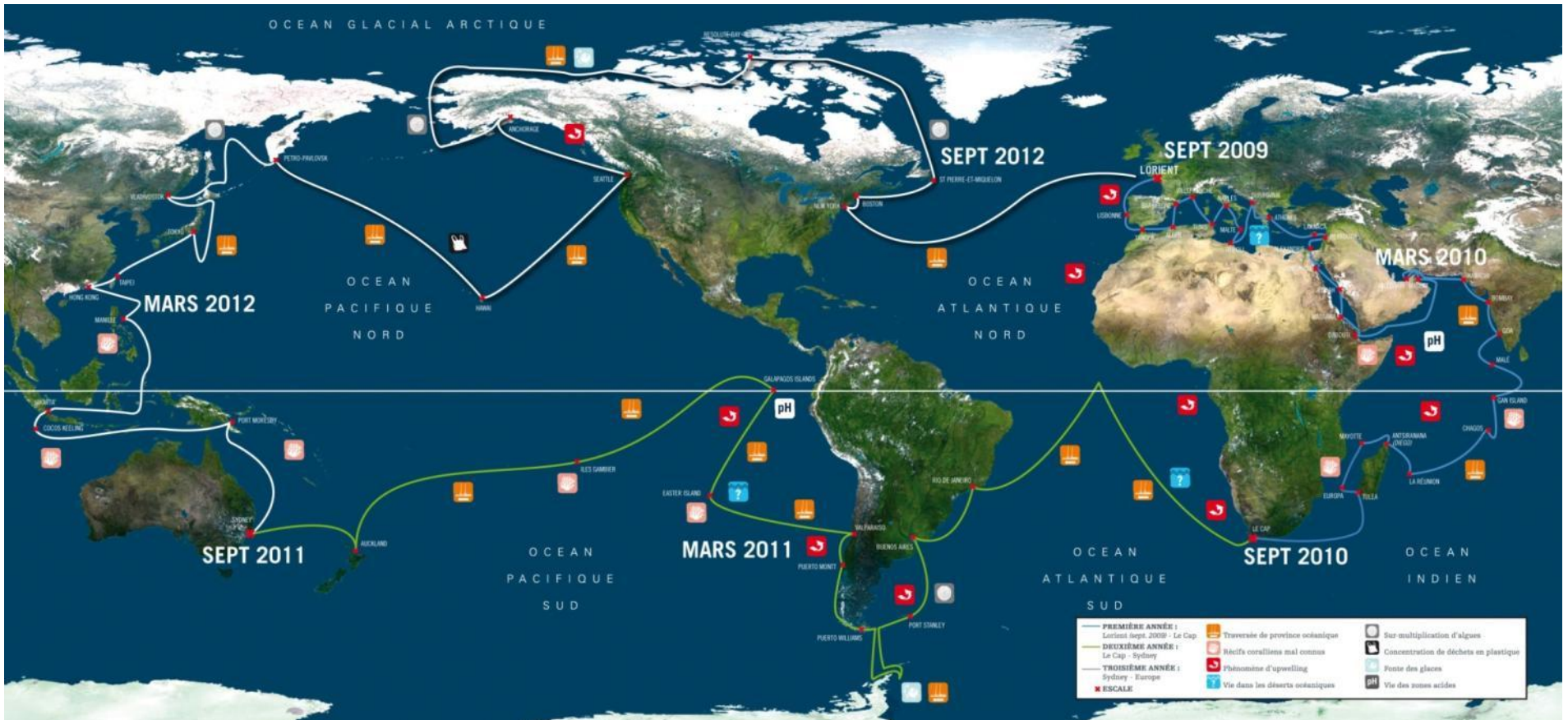


Exploring Ecosystems Biology

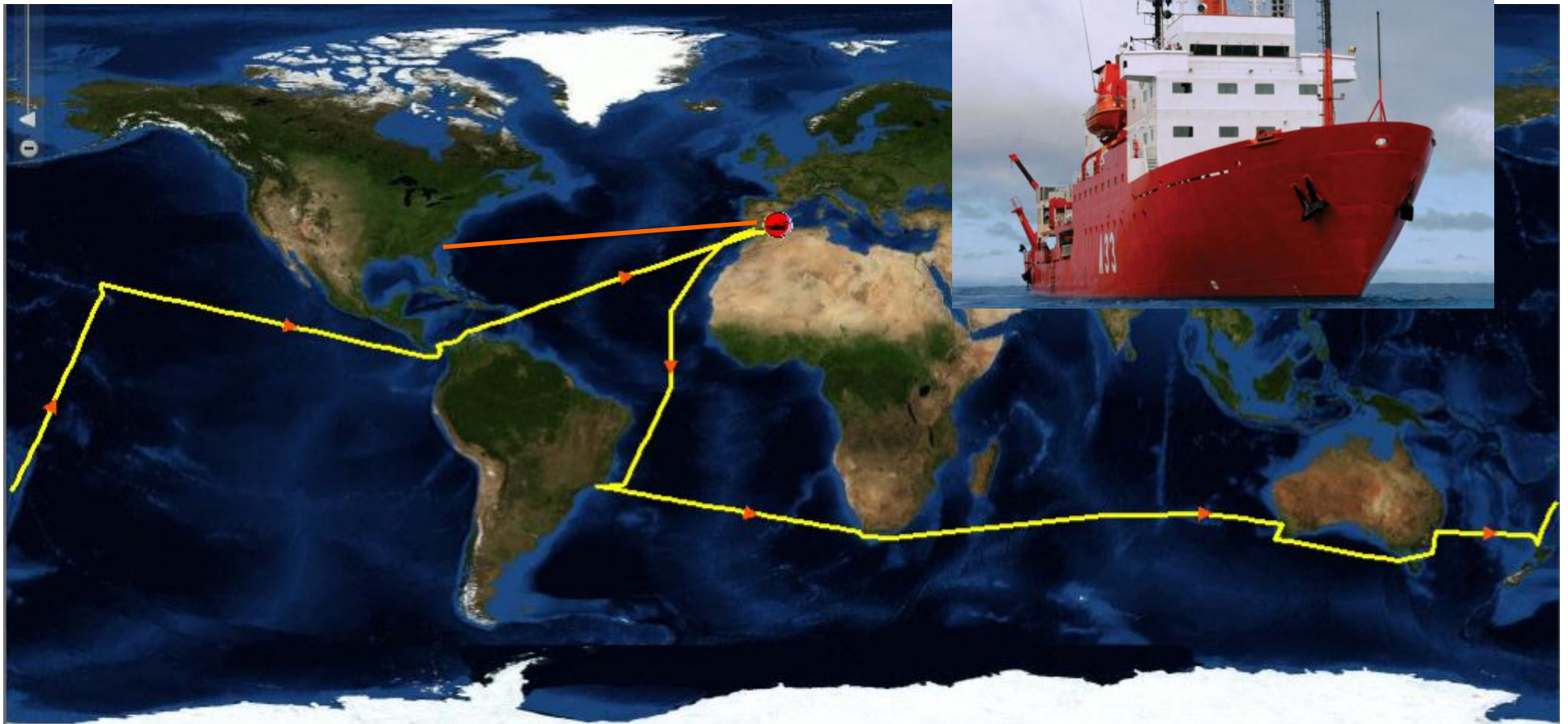




TARA OCEANS



Slide modified from Chris Bowler

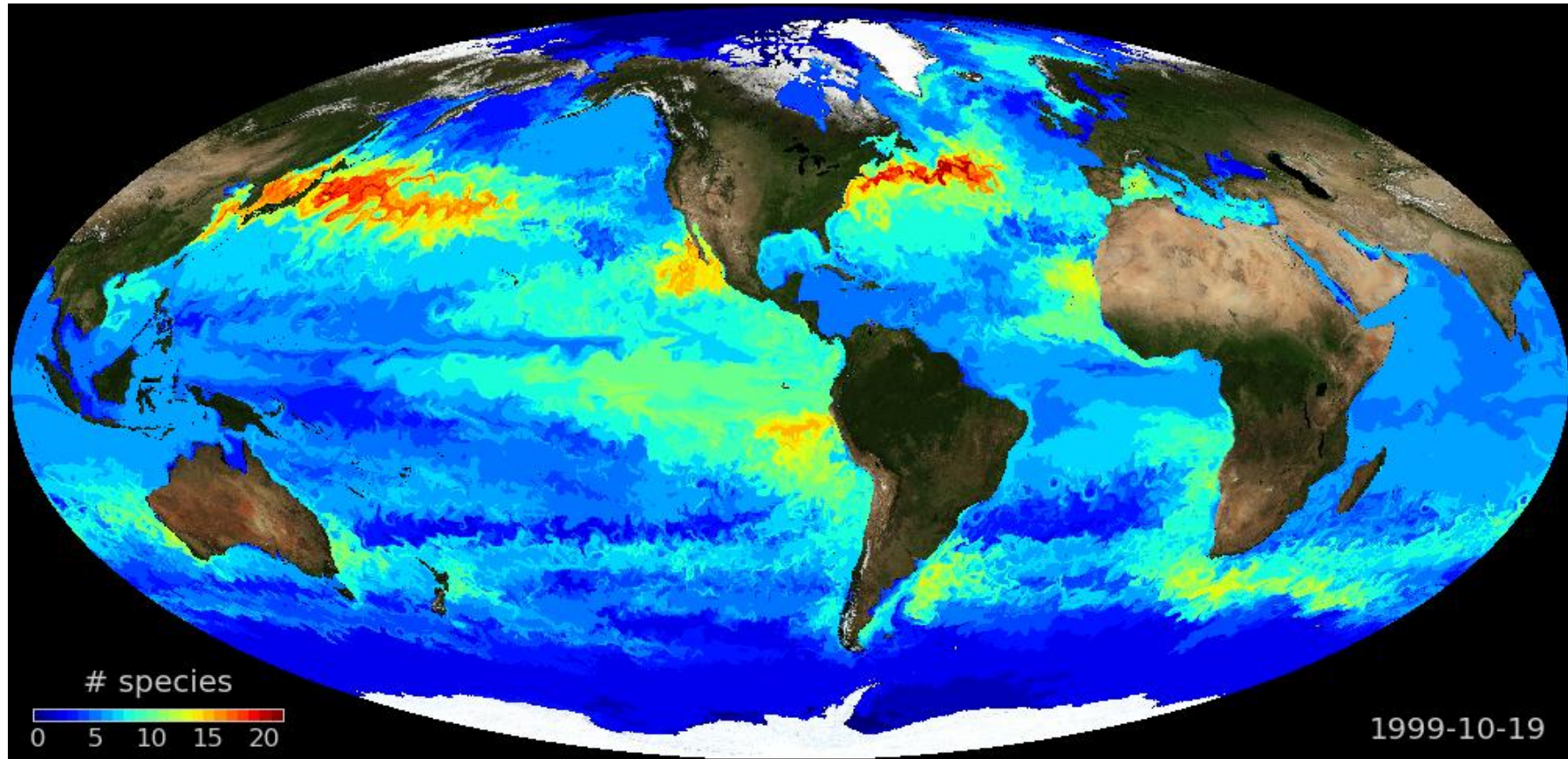


Slide modified from Hugo Sarmento

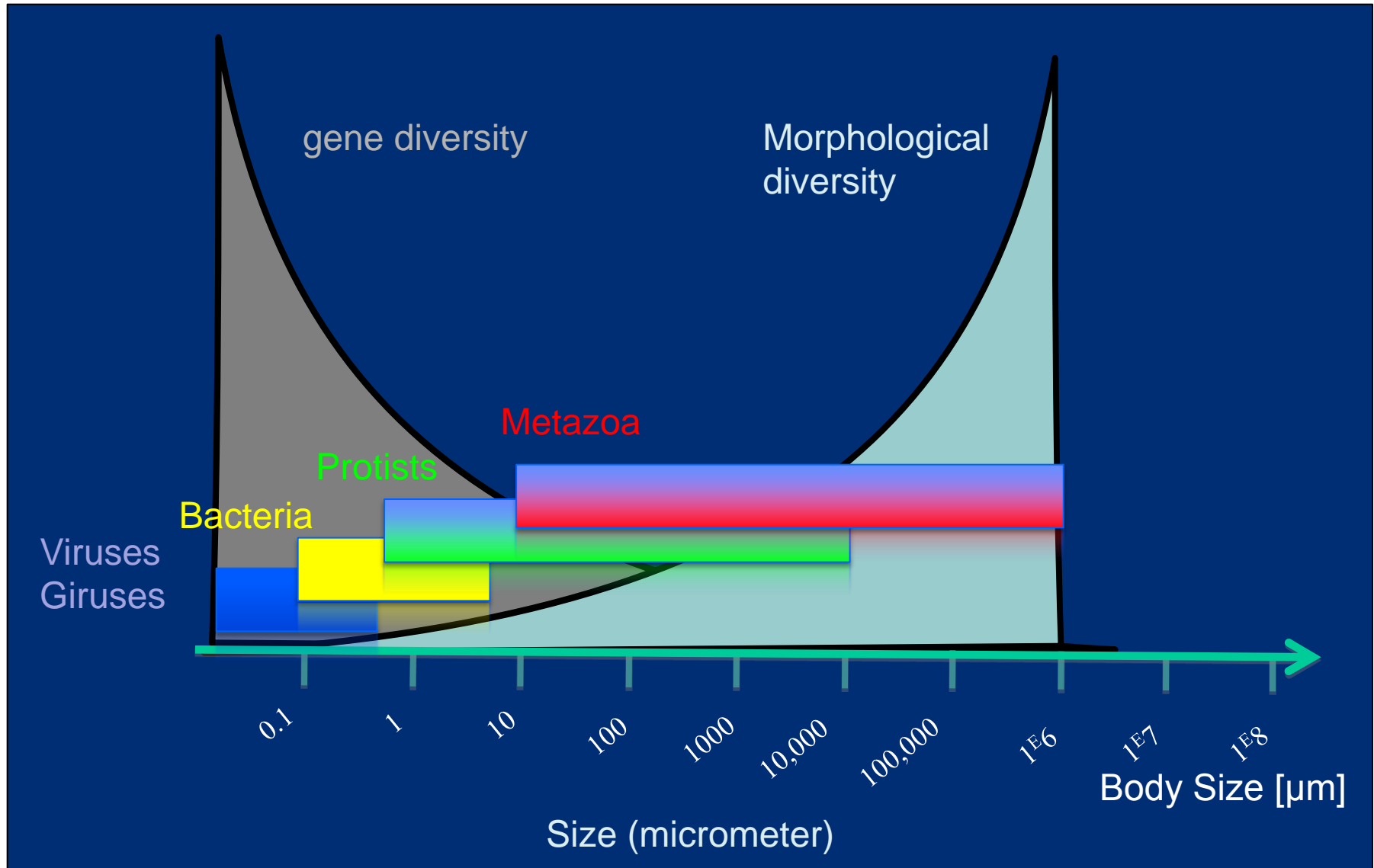
Helgoland Roads



Predicted diversity hotspots



Tara-Oceans



Helgoland Roads Sampling

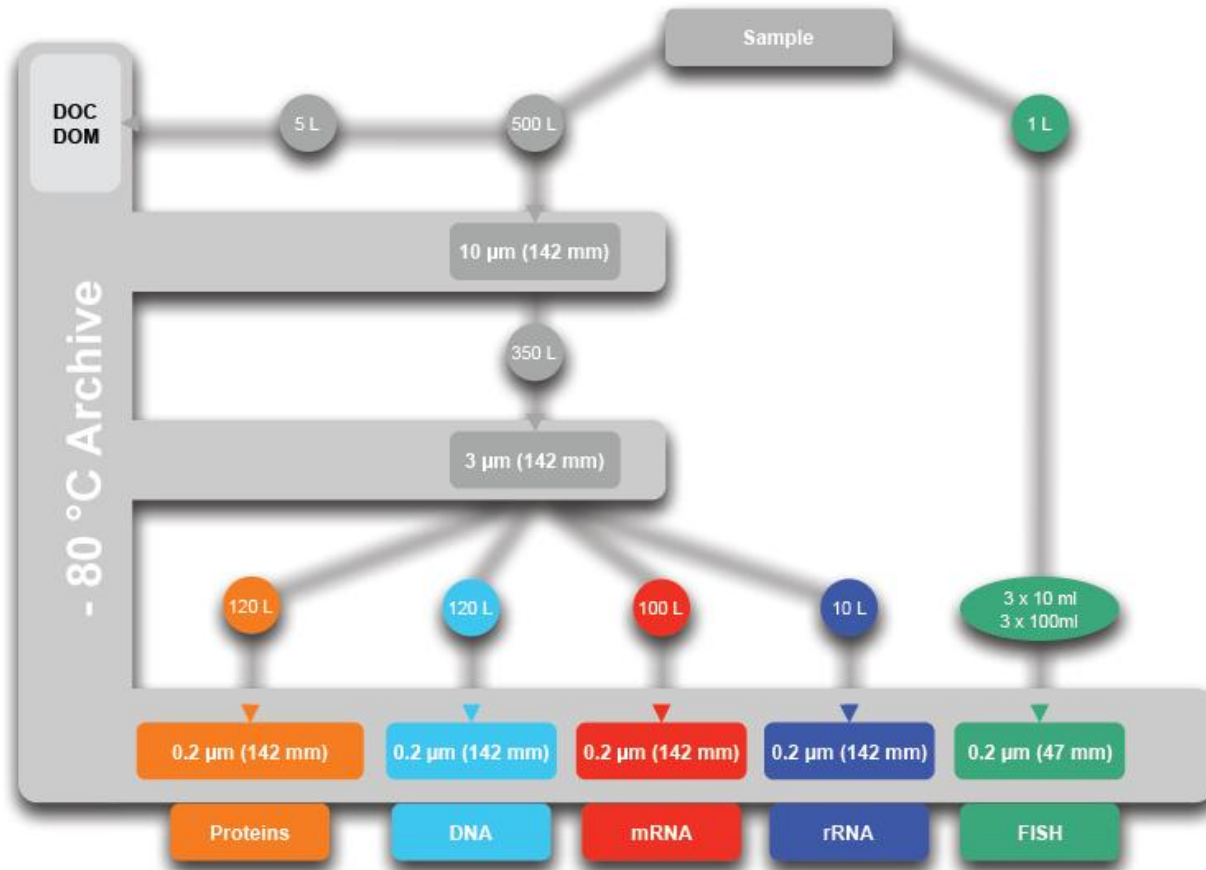
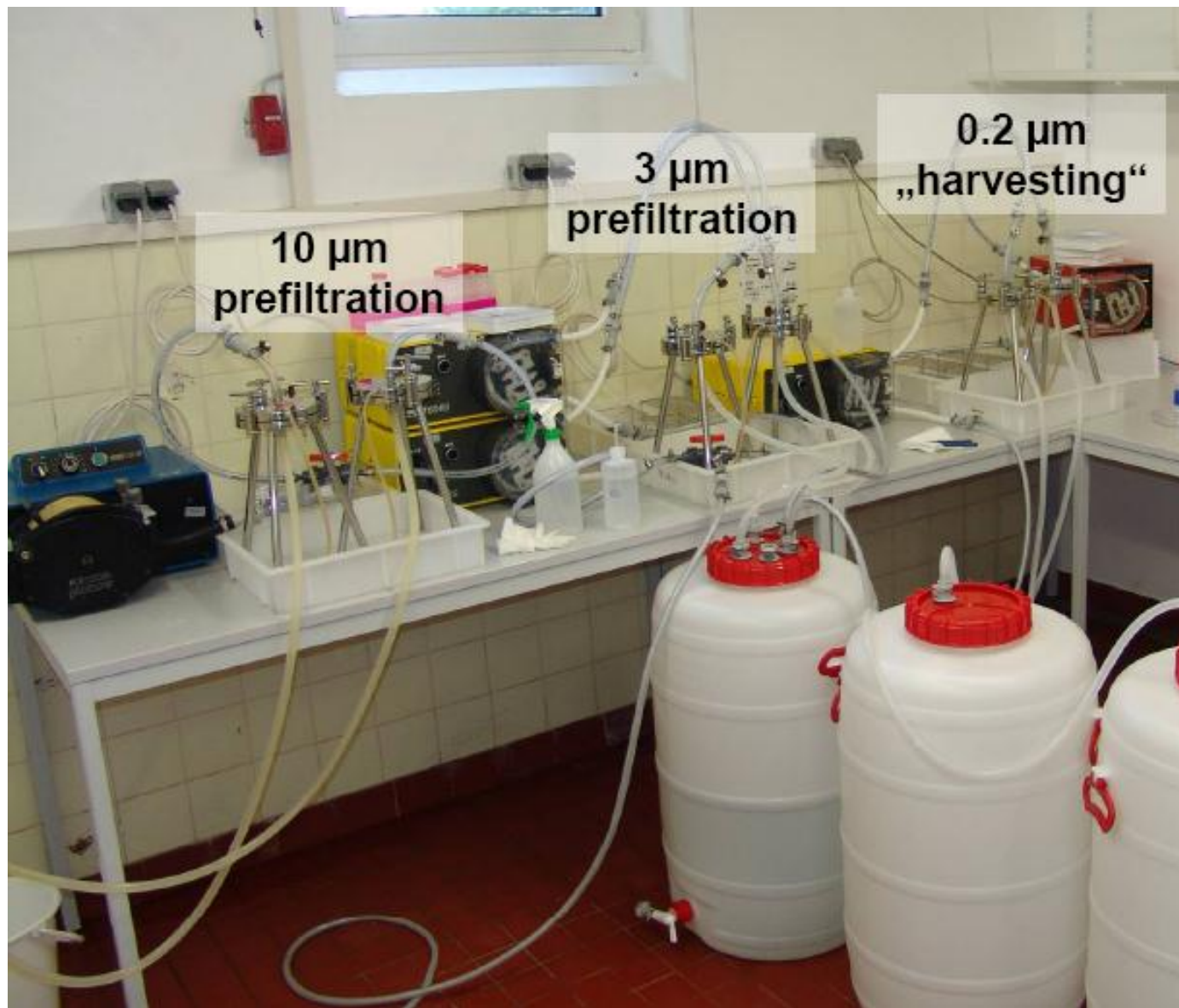


fig. S1: Workflow of the initial sample processing. Details are provided in the Supporting Online Material description of the materials and methods.

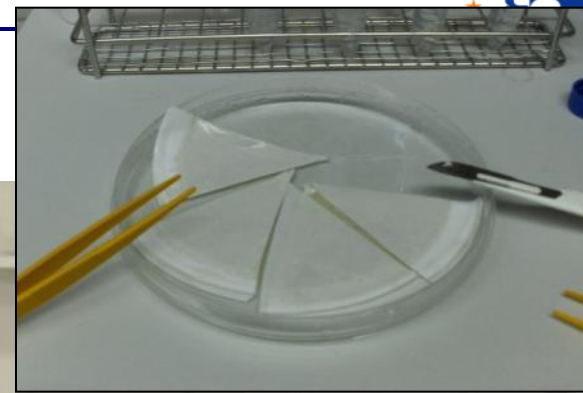




10 µm
prefiltration

3 µm
prefiltration

0.2 µm
„harvesting“

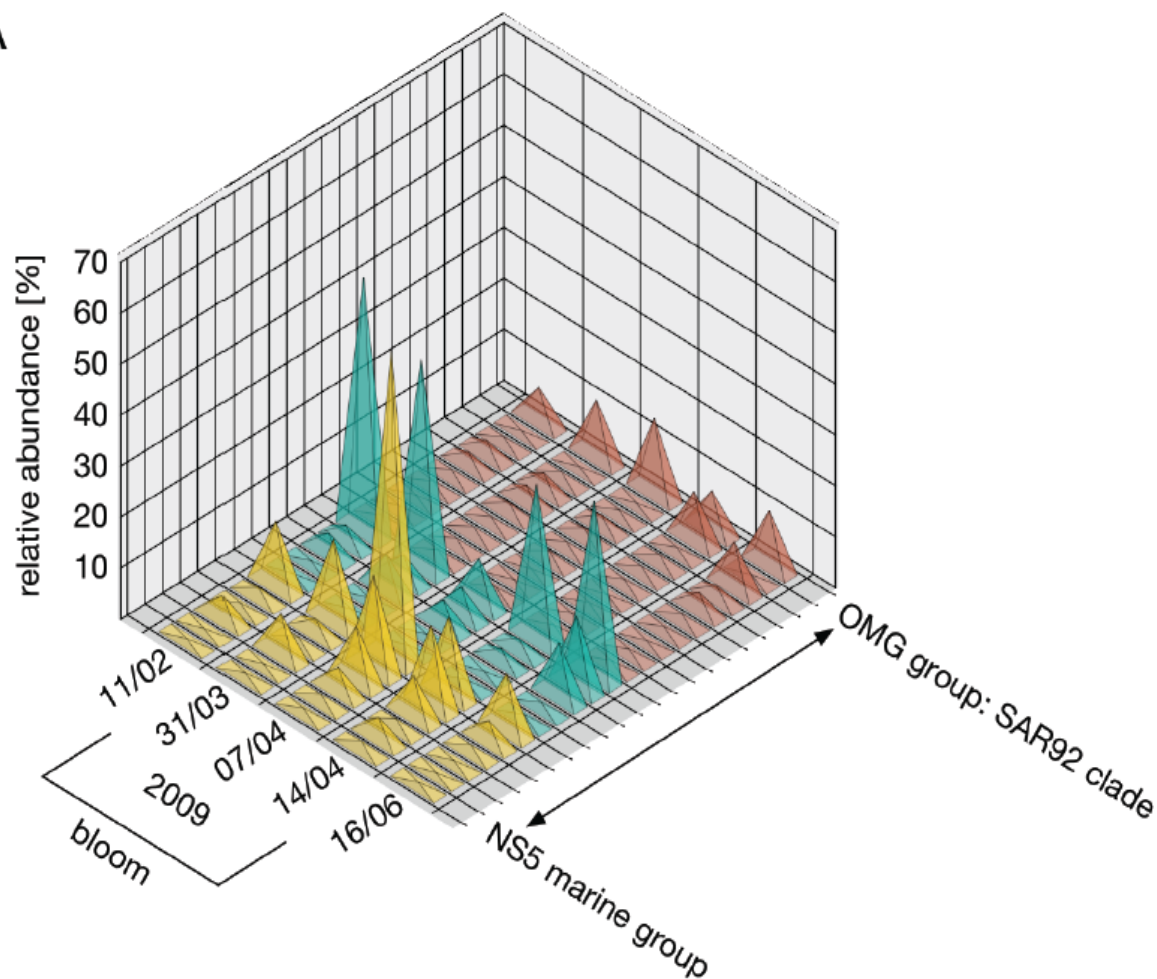


„harvesting“



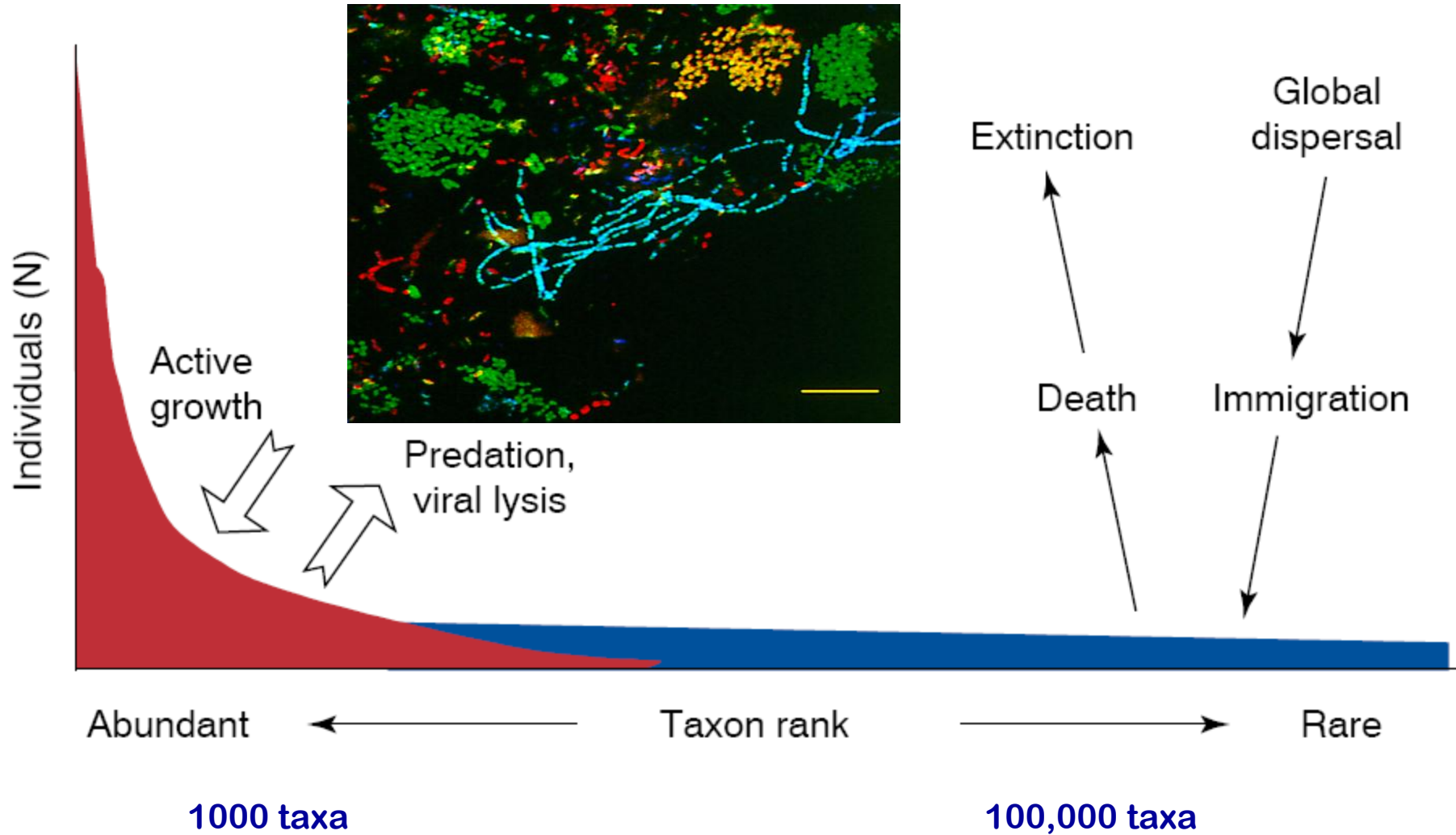
Helgoland Roads Bacterial Successions

A

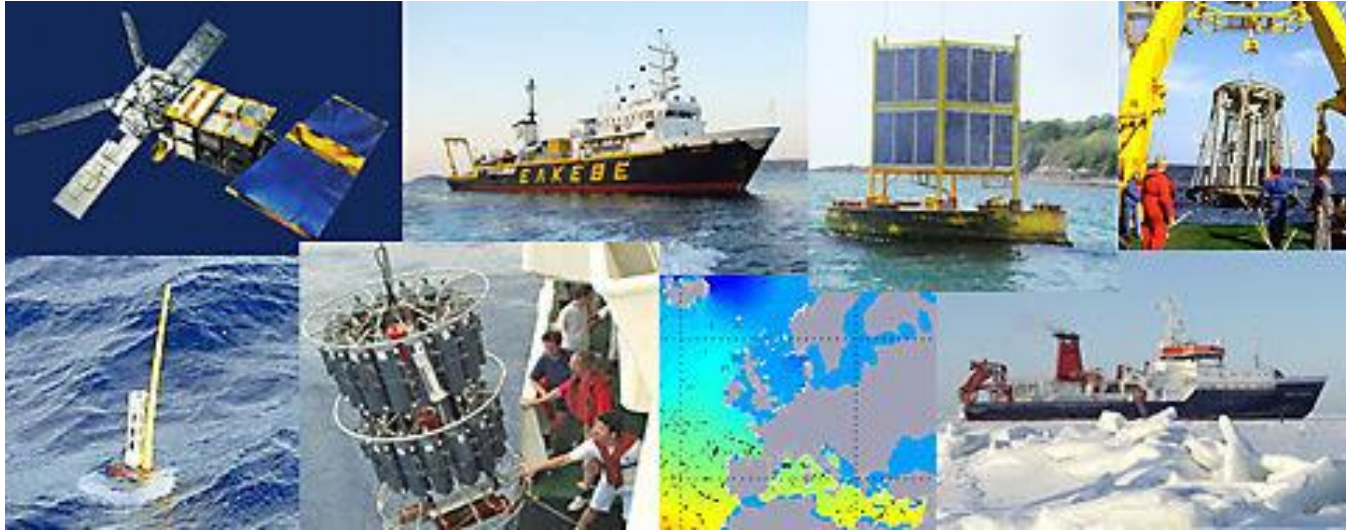


- Gammaproteobacteria
 - Alphaproteobacteria
 - Flavobacteria
-
- OMG group: SAR92 clade
 - Reinekea* spp.
 - OMG group: OM60 (NOR5) clade
 - Shewanella* spp.
 - Vibrionaceae* spp.
 - Marinomonas* spp.
 - Pseudomonas* spp.
 - Alteromonas* spp.
 - Glaciecola* spp.
 - OMG group: BD1-7 clade
 - SAR11 clade
 - Roseobacter* spp.
 - Rhodobacteriaceae* spp. | *Roseobacter* clade
 - Rhodobacterales* spp.
 - Loktanella* spp.
 - other *Flavobacteriaceae* spp. (*Formosa*-dominated)
 - Polaribacter* spp.
 - Ulvibacter* spp.
 - NS3a marine group
 - NS5 marine group

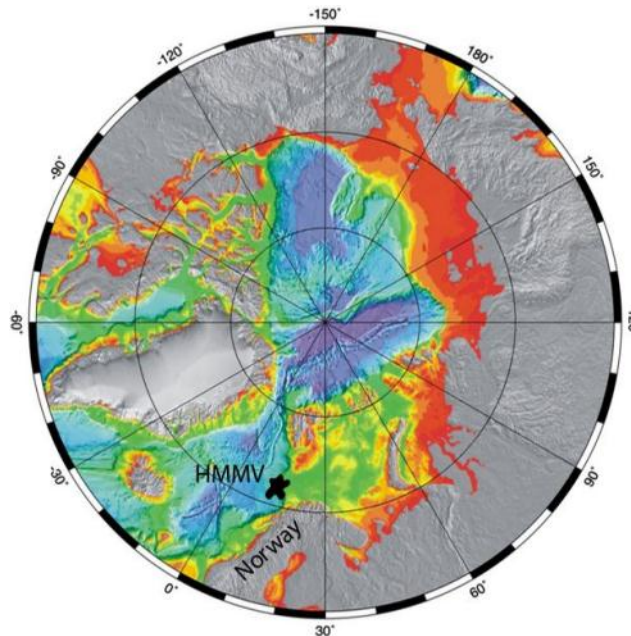
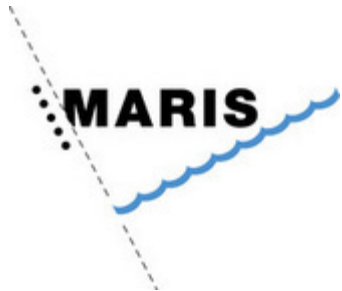
Diversity



Oceanographic Data



myOcean



Biodiversity

WP 2
Ocean
Sampling
Day
UOXS

WP 3
Oceanography
&
Environmental Data
MARIS

WP 6
Exploring
Ecosystems
Biology
CNRS

Bioinformatics

WP 4
Standards and
Interoperability
EMBL-EBI

WP 5
Bioinformatics
&
Data Integration
MPIMM

WP 1
Management
&
Coordination
JacobsUni

Biotechnology

WP 7
Function
&
Biotechnology
UGRO

WP 8
Intellectual
Property
Management
UCL

WP 9
Dissemination
&
Outreach
EMPA

Involvement of stakeholders, esp. companies

PharmaMar, MATIS, BIO-Iliberis, Bio-Product, Interworks, Ribocon, EuropaBio, CIESM

Function & Biotechnology



- ▶ Explore integrated datasets
 - Genes of unknown functions
 - Biosynthetic gene clusters in marine organisms
 - New genes from metagenomes
- ▶ Laboratory experiments
 - Confirmation of functions
 - Pre-enrichments
 - Functional screening of large-insert libraries
 - Micro-colonies and micro-cultures
 - Heterologous expression
 - Bioassays



Intellectual Property Management for Marine Bioprospecting

- ▶ Model agreements for pre-competitive access to microbial materials and exchange of materials and data within research networks.
- ▶ IP model agreements for pre-competitive access to large-scale microbial genomic research databases
- ▶ Outreach workshop on topics like IPR, scientific potential, biotech options, environmental impact to inform and discuss application and protection options for marine microbial diversity with stakeholders from regional, national and international policy-making bodies



Dissemination and Outreach

- ▶ **Timely dissemination of relevant information**
 - to industrial sector including SMEs
 - to policy makers & advisors in field of biodiversity protection
- ▶ **Capacity building through training of next generation of scientists**
 - By establishing a dedicated bioinformatics training pipeline consisting of three courses
- ▶ **Outreach to general/interested public on our three topics**



Highlights 2012

Tasks

- ▶ **Sampling site registry**
 - Survey
 - Commitments

- ▶ **Consistency**
 - Best practices
 - Standards

- ▶ **Legal framework**
 - Access and benefit sharing
 - Model agreements



Ocean Sampling Day registration of interest Exit this survey

1. Overview and Contact Details

Please give a name to your sampling site(s), list details of main contact person and provide basic location information.

*** 1. Short Title of Sampling Site you wish to register for Ocean Sampling Day (e.g. "L4 in the Western English Channel").**

2. Please give an URL of the web page of the sampling site

3. Is there a primary publication for the site or a website listing publications? If so, please add the URL below.

*** 4. To which networks does the site belong**

WAMS

LTER (Long Term Ecological Research network)

ILTER (International Long Term Ecological Research network)

DRAFT of MicroB3-WP8

Ocean Sampling Day Model Agreement on Access to Marine Microorganisms, Benefit Sharing and Subsequent Treatment of Materials/Data

¶

¶

THIS AGREEMENT is made on [insert date] ¶

BETWEEN: ¶

¶

[Insert the name of the provider state institution and its representative and the full contact details] - ¶

("the Provider State") ¶

AND: ¶

¶

[Insert the name of the recipient institution and its representative and the full contact details] ¶

("the Recipient") ¶

hereinafter referred to as "the Parties", ¶

Pilot OSD June 20 2012, next 21 December 2012



- 1 L4
- 2 Roscoff
- 3 Helgoland
- 4 Naples
- 5 Greece
- 6 Blanes
- 7 Moorea
- 8 BATS
- 9 SPOTS
- 10 HOTS
- 11 Rothera
- 12 Churchill
- 13 Thames
- 14 Banyuls
- 15 Villefranche
- 16 Kristineberg
- 17 VLIZ
- 18 North Cyprus
- 19 Red Sea
- 20 Iceland



Moorea Ocean Sampling Day (20 June, 2012)

The island Moorea (French Polynesia) is the home to OSD participant Moorea Ec combines the two research stations on the island: UC Berkeley's Gump Station and CRIOBE. The Moorea Ecostation leads the Moorea Genomic Observatory, with OSD first actions

Like Rothera have the same calm, a pod started our filtering voyage

Ocean Sampling Day- Summer solstice Faxaflói, Iceland – Matis

Viggó Thór Marteinsson, Eyjólfur Reynisson and

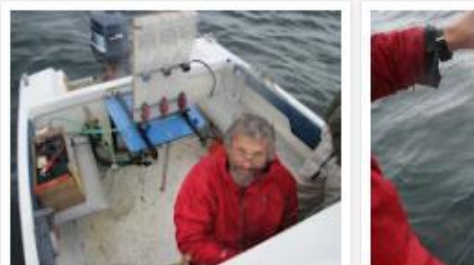
Sampling was performed in Faxaflói, a bay Reykjanes and Snæfellsnes. A small boat was Long: 22° 07,50' V) to the bay at 10:45 o'clock replicate samples from one sampling station cleaned bucket. Three water samples (1 L) Sterivex filters (Millipore). Filtering time was a other three with total filtration time of 90 min. °C in individual zip-lock bags.

Additional site information:

Air temperature: 12°C

Water temperature surface: 9,6°C

Salinity 3,5%



Ocean Sampling Day - Summer solstice 2012-06-20 – Roscoff

Sampling was performed at the SOMLIT-Astan long-term observatory site (48° 46' 40 N, 3° 56' 15 W) at 10:30 local time during the 2012 summer solstice. Water was collected from a depth of 1 meter using a Niskin bottle. Water samples were transported to the lab in an acid cleaned plastic bottle within 15 minutes and filtered. Within 30 minutes, 4 replicates of 1 liter were filtered for metagenomic analyses using the Sterivex 0.22µm filters. Filters were sealed and immediately frozen at -80 °C in individual zip-lock bags.

Ocean Sampling Day – Rothera

Rothera is a British Antarctic Survey research station, located on Adelaide Island on the Antarctic Peninsula at 67° South http://www.antarctica.ac.uk/living_and_working/research_stations/rothera . The plan was to get out and sample on our Winter Solstice (20th June), which for most of OSD partners was the Summer Solstice. Unfortunately sea ice and wind were against us and we didn't manage to get out to sample until the 31st of July. The sea ice formed the week before the Solstice and was too thick to get one of our RIBs (Rigid Inflatable Boat) through, but too thin to walk on. The ice then thickened up and we were able to go for short walks and even dive through it near to the shore; however it was too dangerous to go too far offshore and get to our sampling sites. The winds picked up towards the middle of July and blew the sea ice out – but the winds remained too high to launch the boats, sometimes even blowing the ice back in. This continued for a few weeks until finally we had a window where there was an area of open water leading toward the sample site and no wind! The Rothera Oceanographic and Biological Time Series (RaTS) has been running since 1997 and continues year round – collecting data through weekly water sampling and CTD events. <http://www.antarctica.ac.uk/staff-profiles/webpage/mmm/RaTS/RaTS.html>



Call for Participation

WEDNESDAY, 21 NOVEMBER 2012

Call for Participation in Ocean Sampling Day

A Call to Join Ocean Sampling Day

You can use the simple form below to register an expression of interest in joining OSD 2014 (or prior pilot activities). Please fill in form and we will contact you.

Register your Expression of Interest in Joining OSD: <http://www.surveymonkey.com/s/Z6SX289>

Expression of Interest in joining Ocean Sampling Day

Please briefly description your interest in Ocean Sampling Day. All the fields are optional. After you make your expression of interest in participating you will be contacted by the OSD Consortium. Eventually, if you chose to join OSD, you will need to formally register to participate.

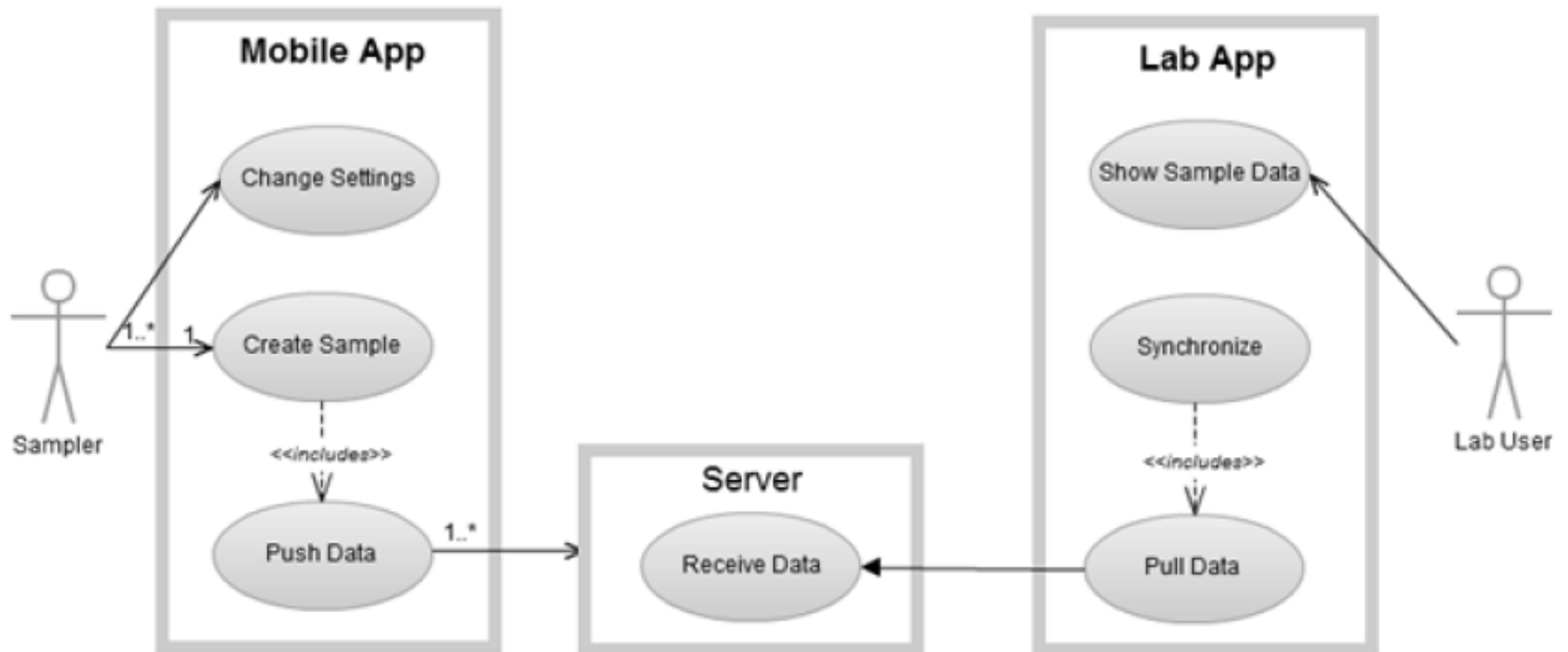
1. Contact Name
2. Contact Email
3. Contact Address (Institution)
4. Your ideas - how would you like to participate in OSD?
5. How would your contributed samples be contextualized/unique?
6. When would you want to participate
7. Do you have funding to participate?

OSD will become what the community makes it....

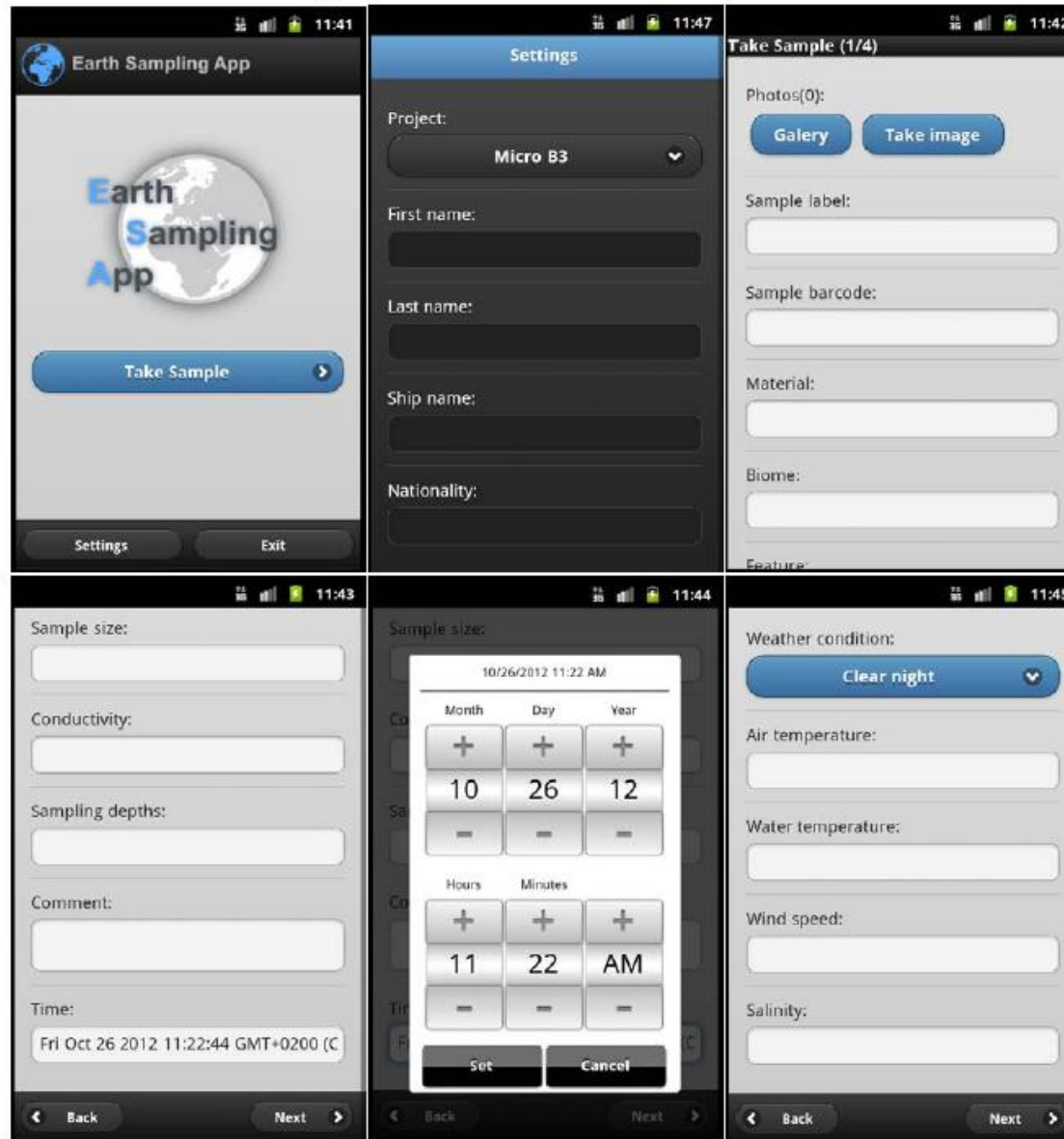
<http://oceansamplingday.blogspot.de>

Contextual Data Flow – Mobile App

Use Case: Mobile Field Information Application



Mobile App



Film about OSD & Financing of Sequencing

- ▶ **Crowd Funding Project**

- ▶ **Trailer by**



- ▶ **Target 50,000 Euro**
 - Covers the film
 - Additional money -> Micro B3 sequencing
- ▶ **Start October 1st 2013 to November 10th 2013
(UNESCO World Science Day)**

Micro B3 Connected



GLOBAL
BIODIVERSITY
INFORMATION
FACILITY



EMBRC
EUROPEAN
MARINE
BIOLOGICAL
RESOURCE
CENTRE

