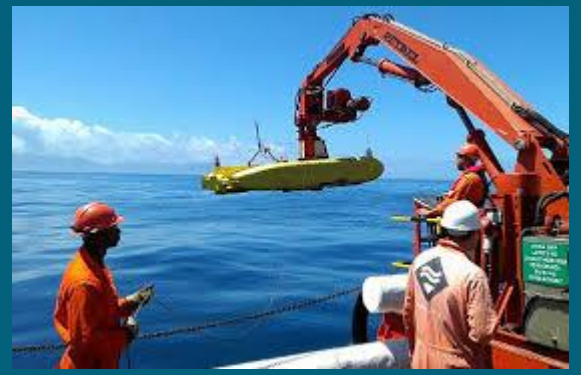
Society for Underwater Technology



水下技术学会
Sociedade para a tecnologia subaquática
جمعيه التكنولوجيا تحت الماء

你好

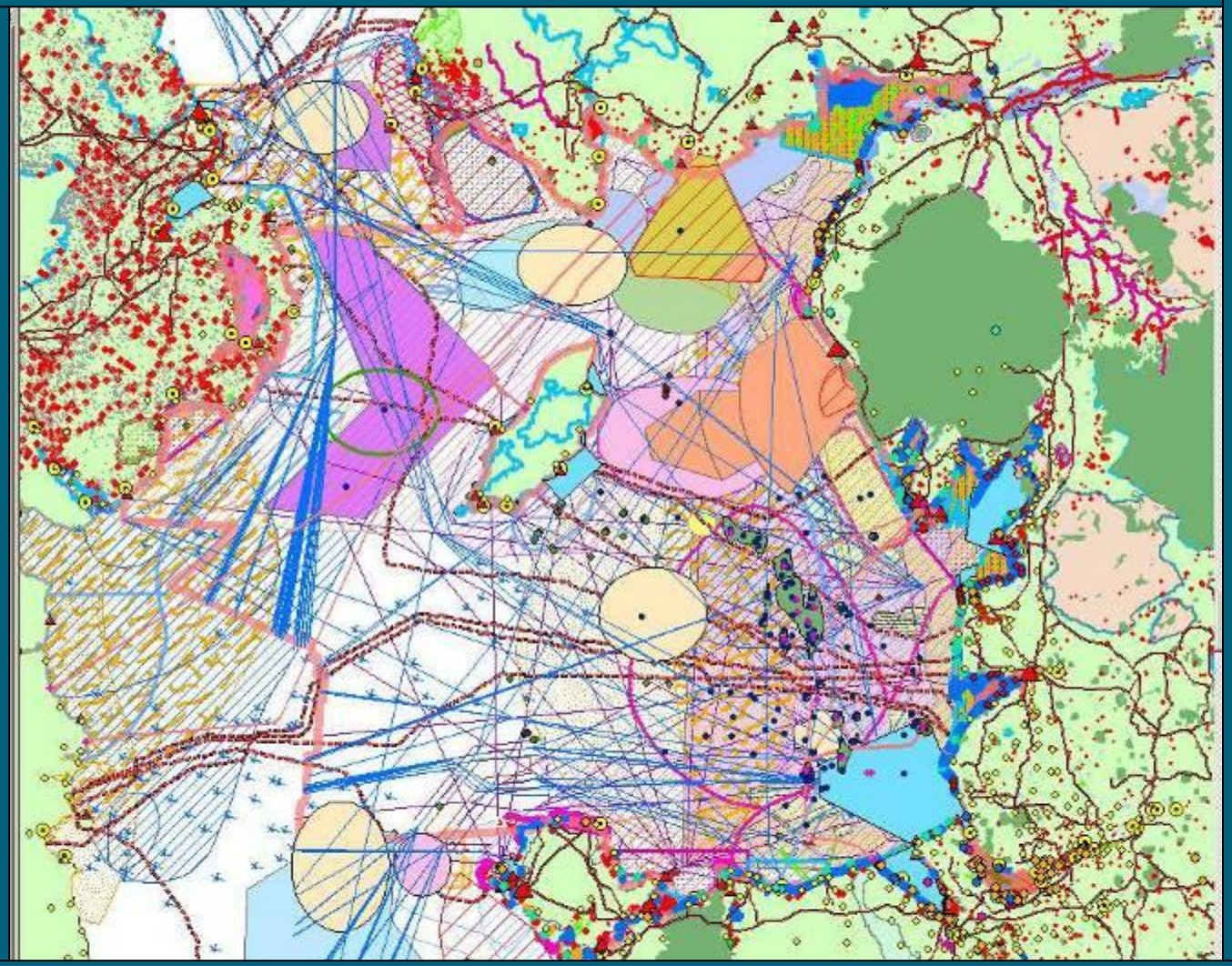
New Platforms & Sensors for near-real-time Ocean Observing

用于海洋研究和勘探的新车辆和探头

Stephen Hall CMarSci FIMarEST Chief Executive SUT

The Ocean is a busy place!

- Landuse
- Tourism
- Oil &Gas
- Aquaculture
- Coastal Defence
- Ports & Navigation
- Military Activities
- Culture
- Conservation
- Dredging & Disposal
- Submarine Cables
- Fishing
- Renewable Energy
- Marine Recreation
- Mineral Extraction



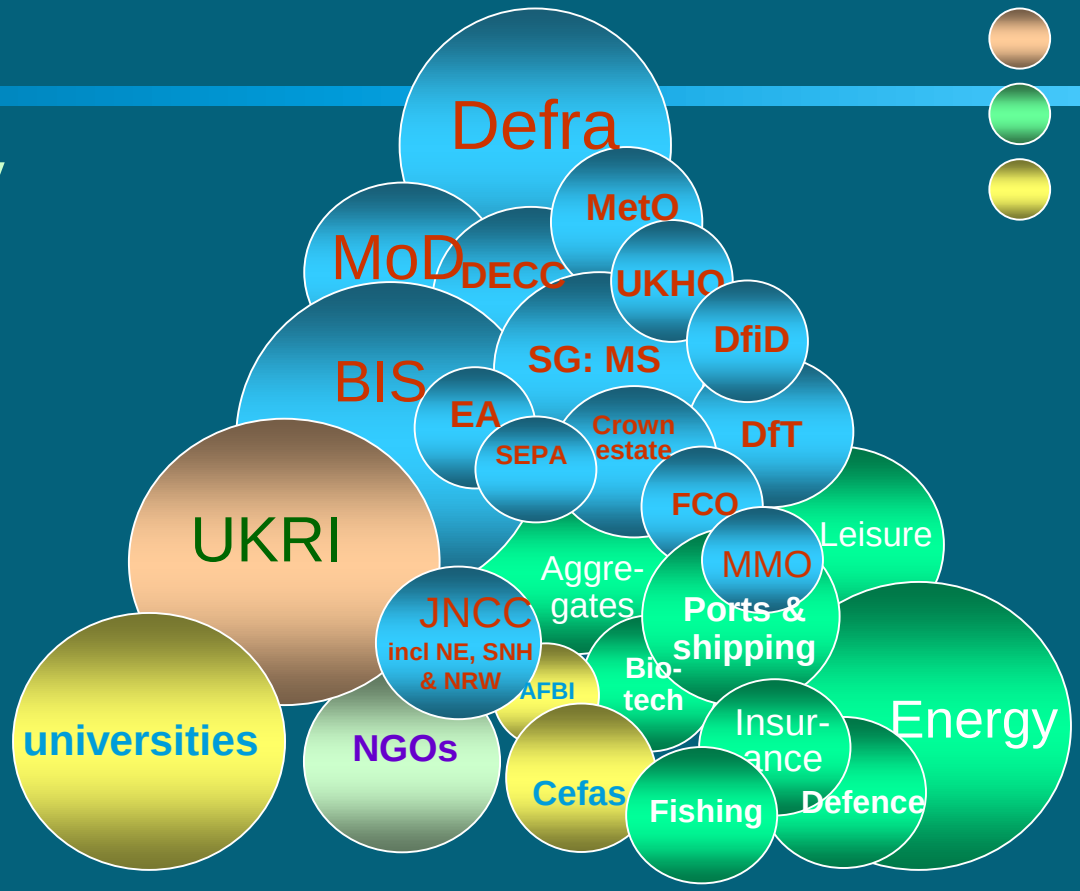
SUT
Society for Underwater Technology

Government (policy & compliance)

Govt departments
Research Councils
Private sector
R & D institutions

Just one country – UK example of the variety of sectors who require ocean data

Academia (knowledge, discovery, scientific papers)



Industry (jobs,wealth creation, products, profit & taxes)

AFBI, Agri-Food & Biosciences Instituty; **BIS**, Dept for Business, Innovation & Skills; **NRW**, Natural Resources Wales; **Cefas**, Centre for Environment, Fisheries & Aquaculture Science; **DECC**, Dept for Energy & Climate Change; **Defra**, Dept for Environment, Food & Rural Affairs; **DfID**, Dept for International Development; **DfT**, Dept for Transport; **EA**, Environment Agency; **EPSRC**, Engineering & Physical Sciences Research Council; **ESRC**, Economic & Social Research Council; **FCO**, Foreign & Commonwealth Office; **JNCC**, Joint Nature Conservation Committee; **MetO**, Meteorological Office; **MMO,** Marine Management Organisation; **MoD**, Ministry of Defence; **NE**, Natural England; **NERC,** Natural Environment Research Council; **NGOs**, Non-Governmental Organisations (incl professional bodies); NOC, National Oceanography Centre; **SG:MS**, Scottish Government Marine Sciences; **SNH**, Scottish Natural Heritage; **UKHO**, UK Hydrographic Office

The importance of data to inform policy, industry and management of the ocean

- You cannot manage what you do not know.
- Many kinds of data are required, sometimes on a very short time scale.
- It is too expensive to use ships for all of the necessary observations – robot vehicles & sensors are essential.

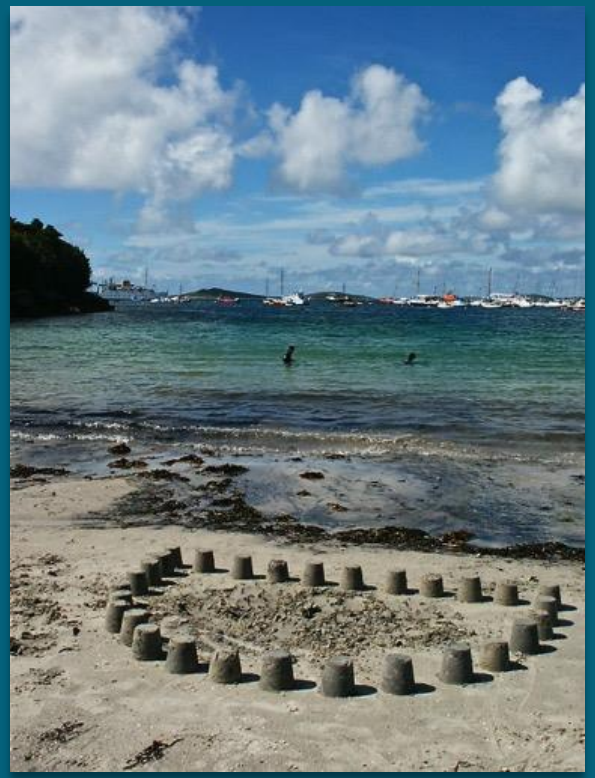
你不能管理你不知道的事情

SDGs

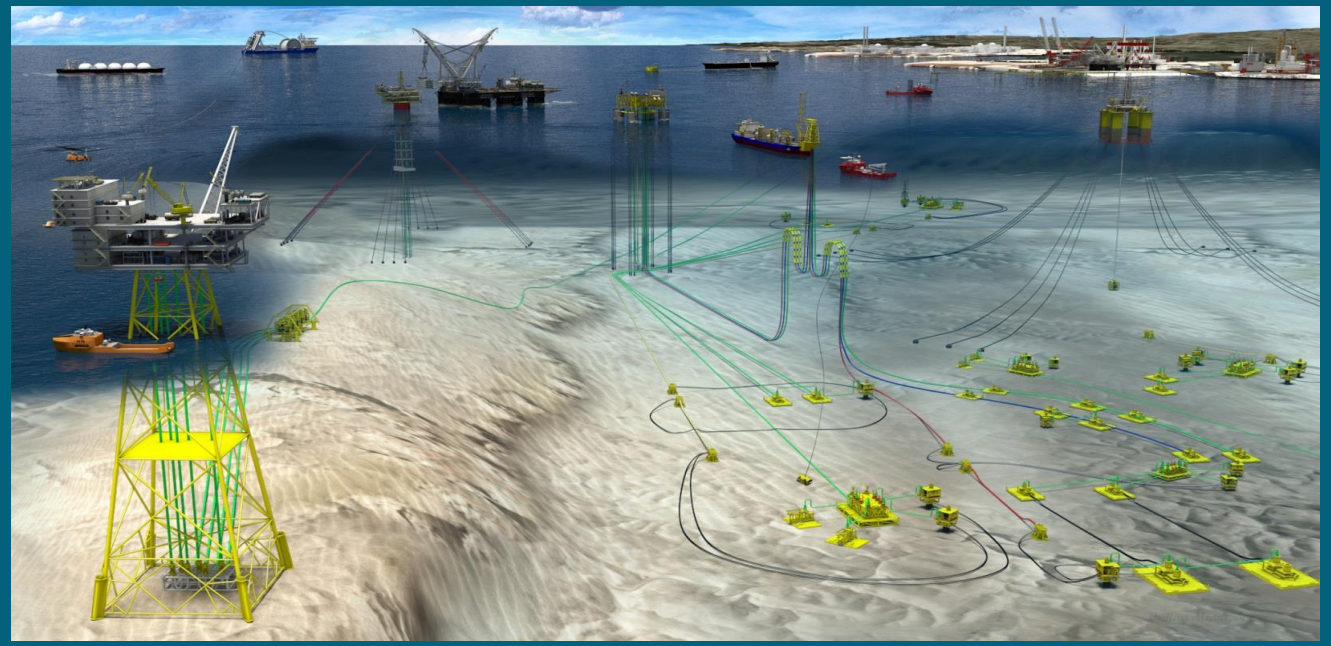
1 NO POVERTY
2 NO HUNGER
3 GOOD HEALTH
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 CLEAN ENERGY
8 GOOD JOBS AND ECONOMIC GROWTH
9 INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION
13 PROTECT THE PLANET
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE
17 PARTNERSHIPS FOR THE GOALS
THE GLOBAL GOALS

The Ocean provides many services for humanity…

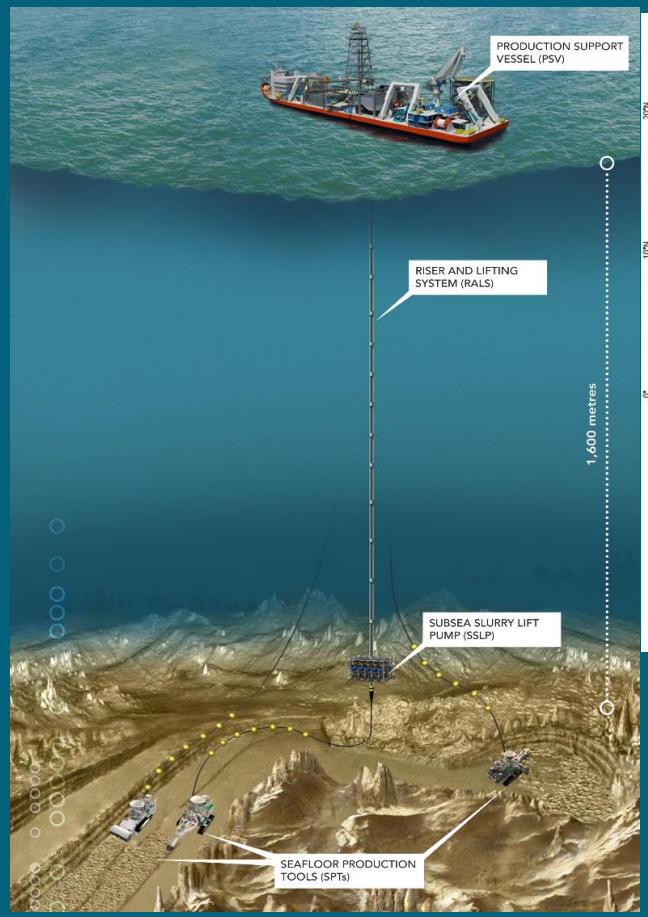
- Energy.
- Raw materials.
- Food.
- Somewhere to live.
- Clean air & water.
- The ‘blue gym’ – space to enjoy, to experience life & companionship.

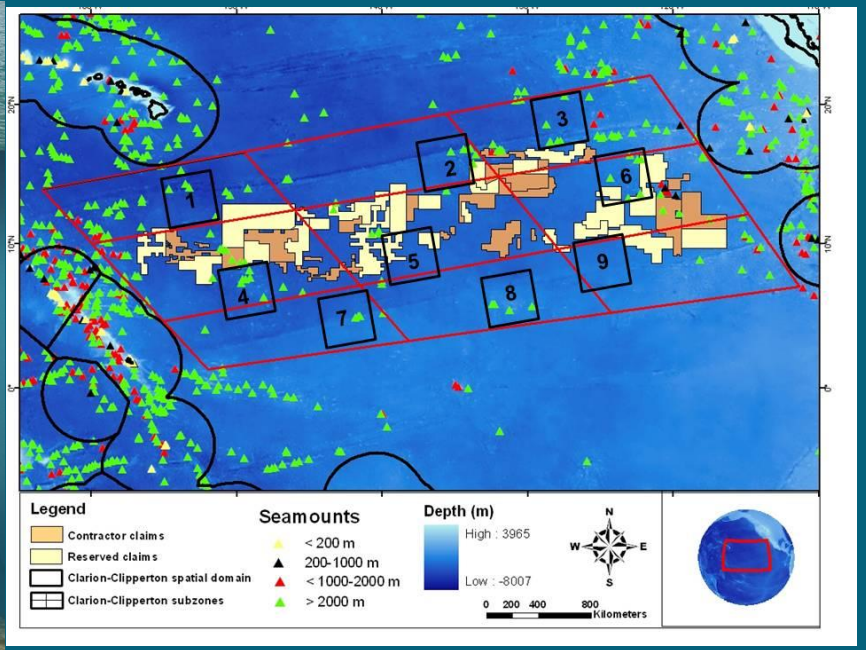


Offshore Energy – technology trend towards automated systems placed directly on sea floor.



Raw Materials for an Electric Future



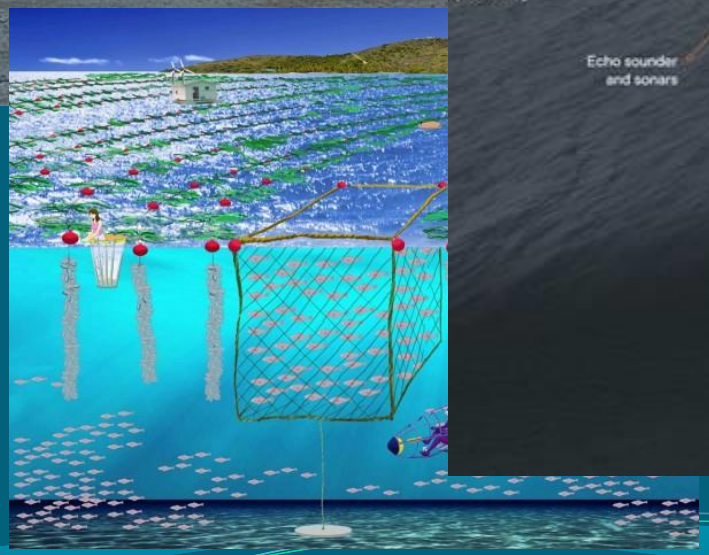


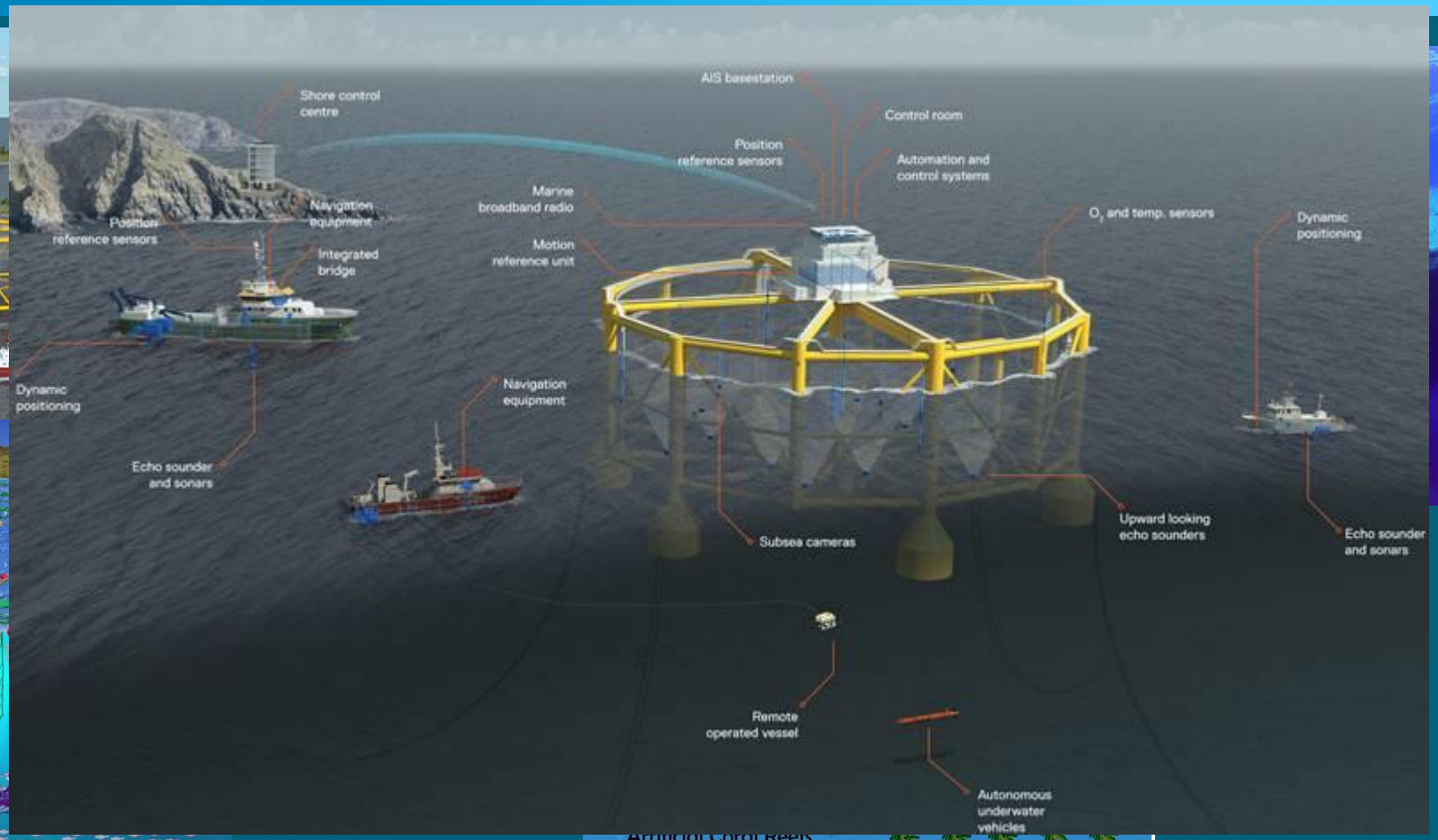
Robots as tools for ocean research, monitoring, surveillance and control

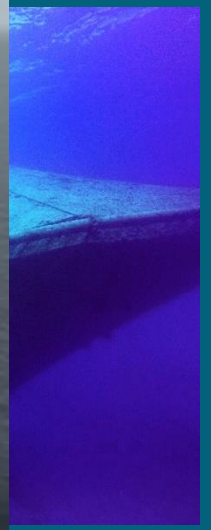
- Lower cost, high quality data for survey and surveillance.
- Ability to act as ‘force multipliers’ for crewed systems.
- Ability to go to places humans would prefer to avoid (under ice; winter storms; hostile waters).
- Stealth.
- Ever-improving reliability and intelligence.

Society for Underwater Technology

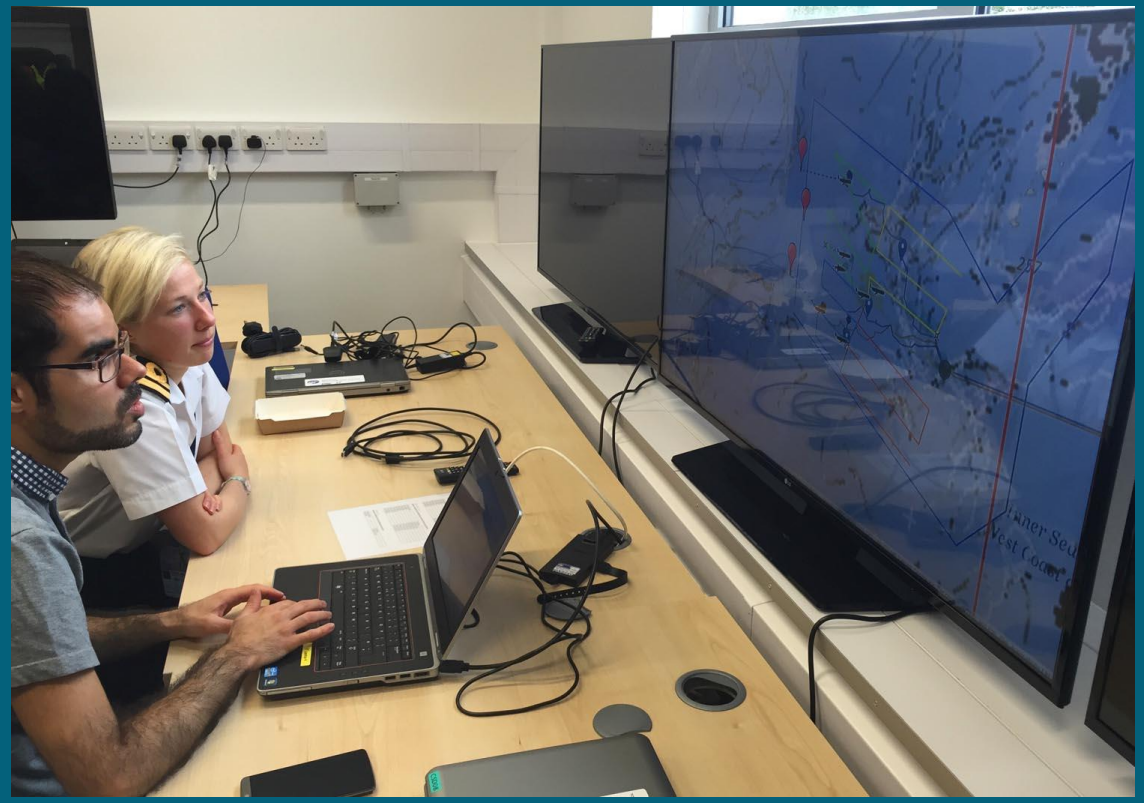
Deepwater Aquaculture







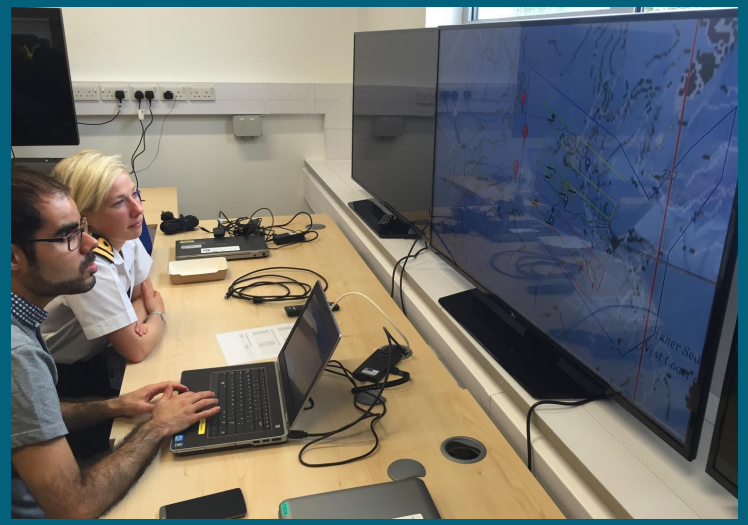
Less work actually at sea, more will be done from shore-based locations

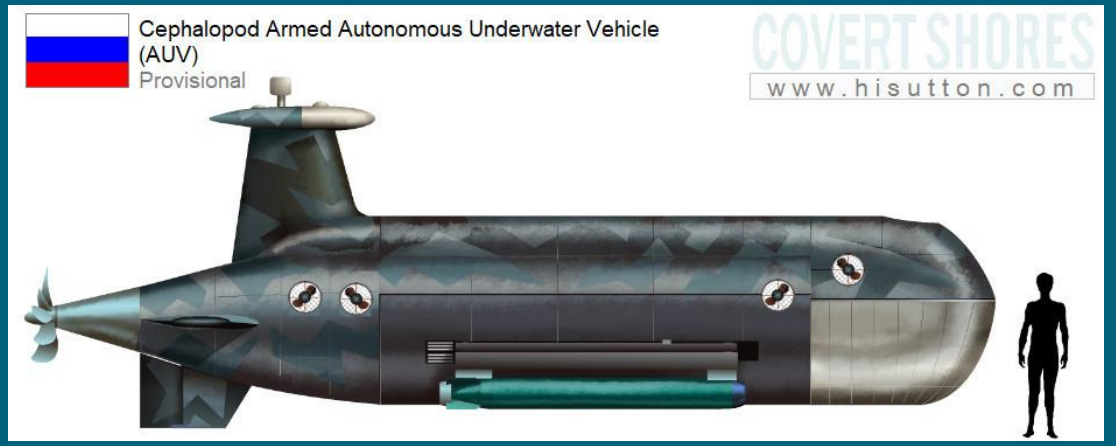


Autonomous Ships

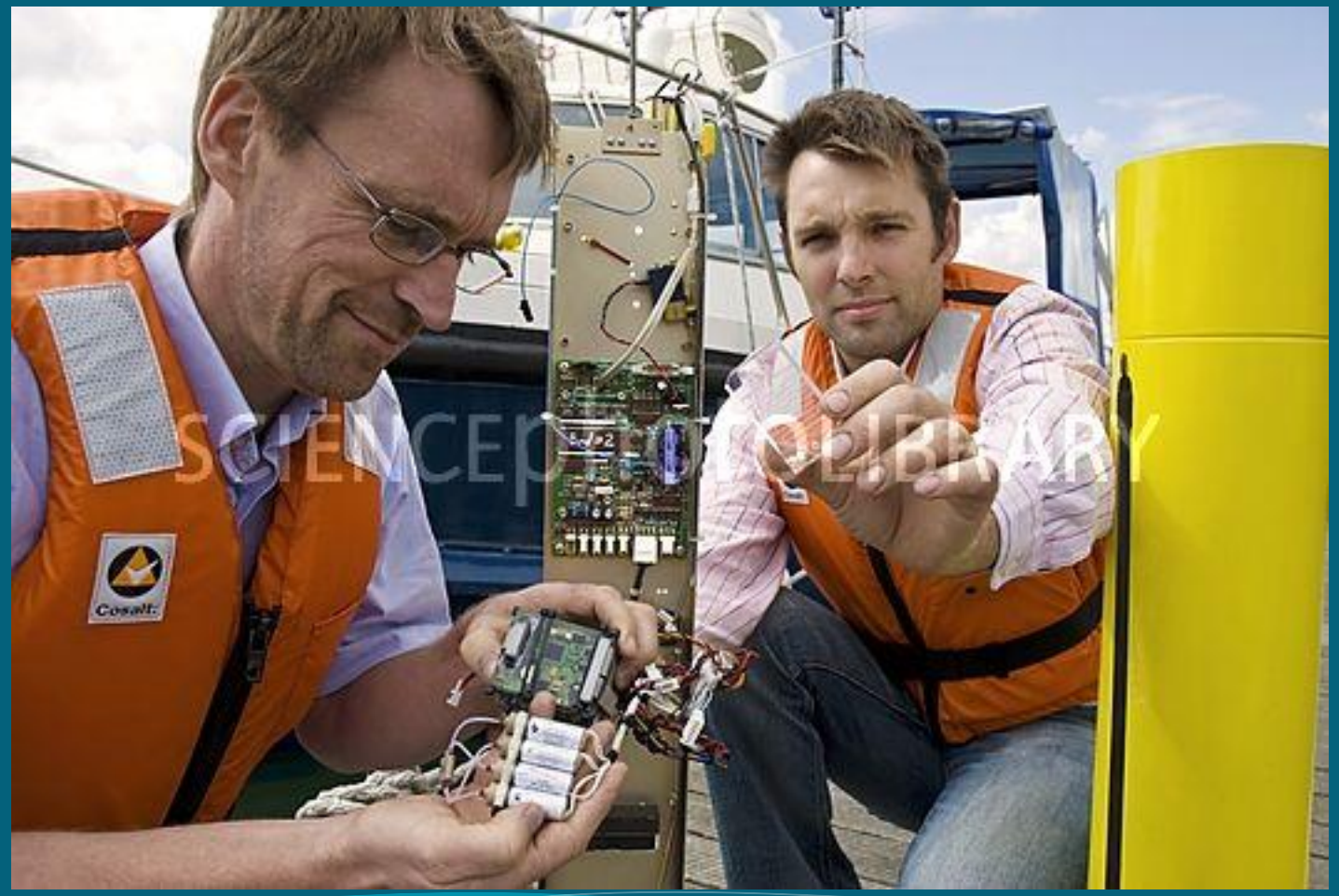
- Reliability and bandwidth of datalink
- Resistance to jamming, satellite navigation ‘spoofing’ and other criminal interference
- Resistance to hostile boarding and takeover by pirates or foreign agencies
- Ability to respond to calls for help from vessels in distress and render assistance
- Insurance?
- Port of Registry
- Ownership
- Diplomatic Clearance
- IMO regulations
- SOLAS regulations
- Agreed training standards
- Tracking

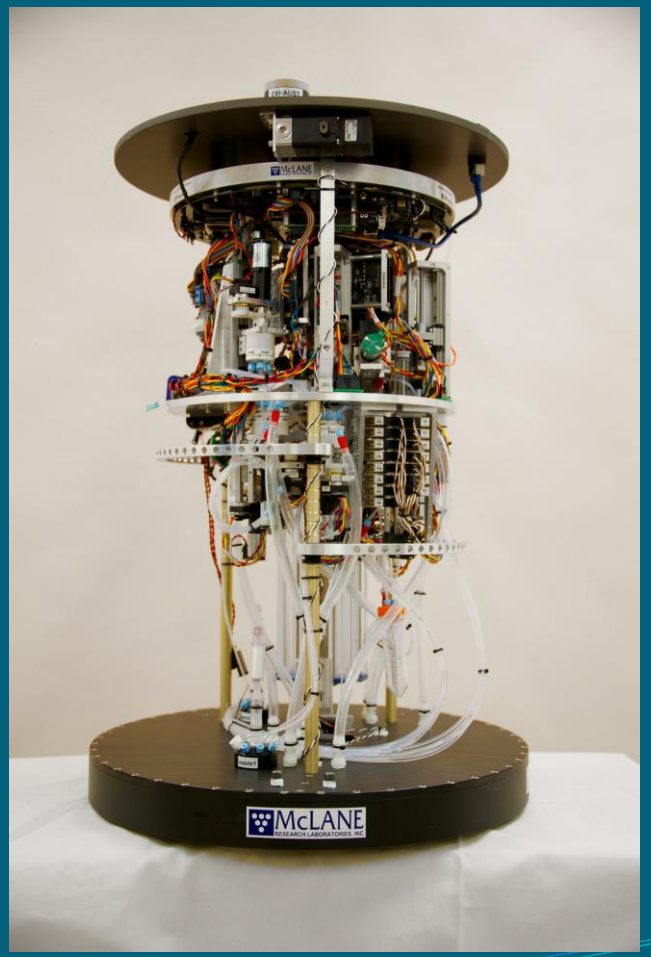
Naval conflict without sailors





Lab on a Chip





Vehicles Design

The BRIDGES Project

DEEP EXPLORER
ALSEAMAR

- 2400m / ≈220 kg
- L 2655 x w 1500 x h 820 mm
- Pressure hull (Aluminum)

ULTRA-DEEP EXPLORER
ALSEAMAR

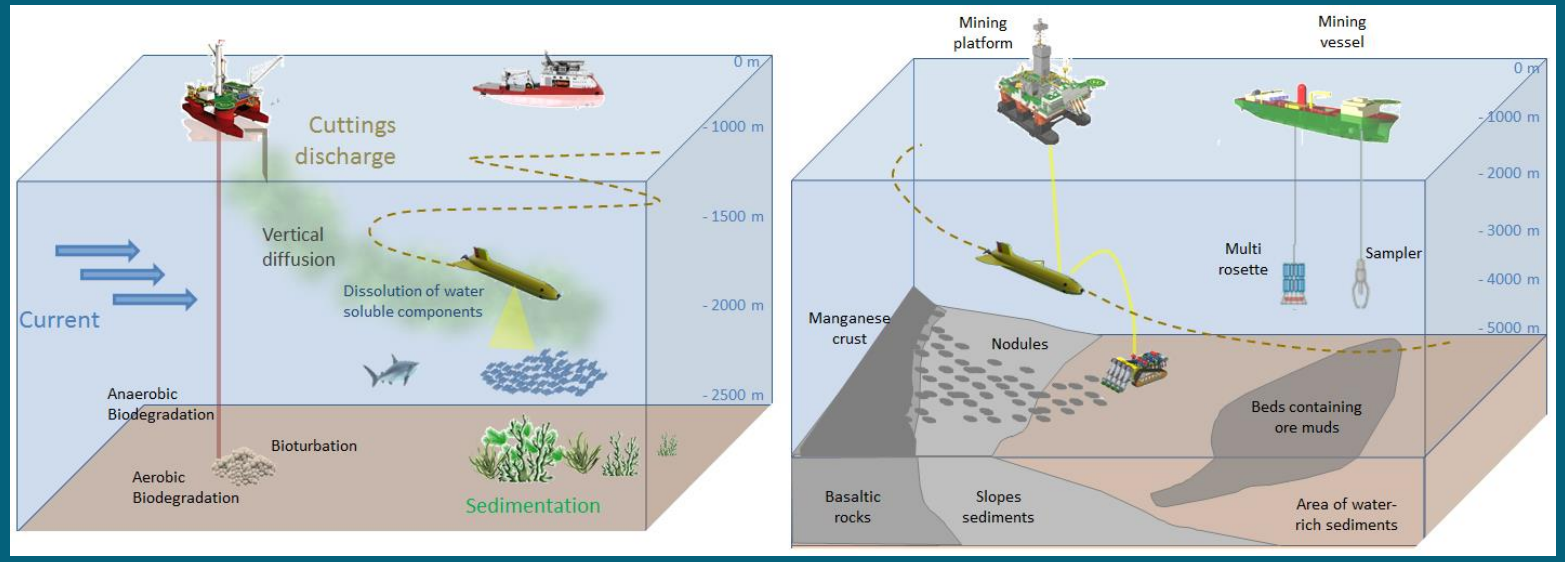
- 6000m / ≈360 kg
- L 2655 x w 1500 x h 820 mm
- Pressure hull (Titanium)

Society for Underwater Technology

The BRIDGES Project

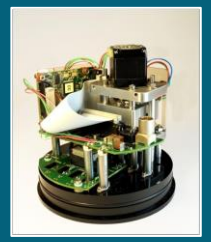
Multi-mission vehicles providing services for key markets:

- Marine science research
- Long-term monitoring programmes (MSFD, Copernicus)
- Living resources, marine mammals, fisheries
- Offshore industry (oil & gas, subsea mining, renewable energy)
- Maritime security

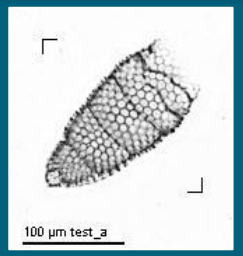


The BRIDGES Project

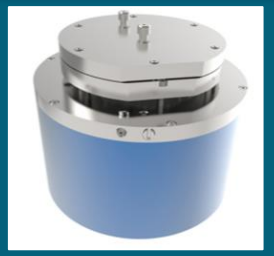
NOC Lab-On- Chip



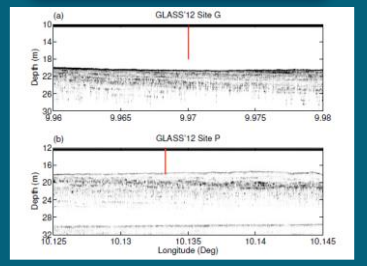
OCTOPUS Imaging



Mini Water Sampler



Sea-Bed Acoustics



Pumped CTD

Temperature
Depth
Salinity

Optode

Oxygen

Optical Sensors

Biology
Turbulence
Hydrocarbons
Methane

Hydro-phone

Acoustics

ADCP

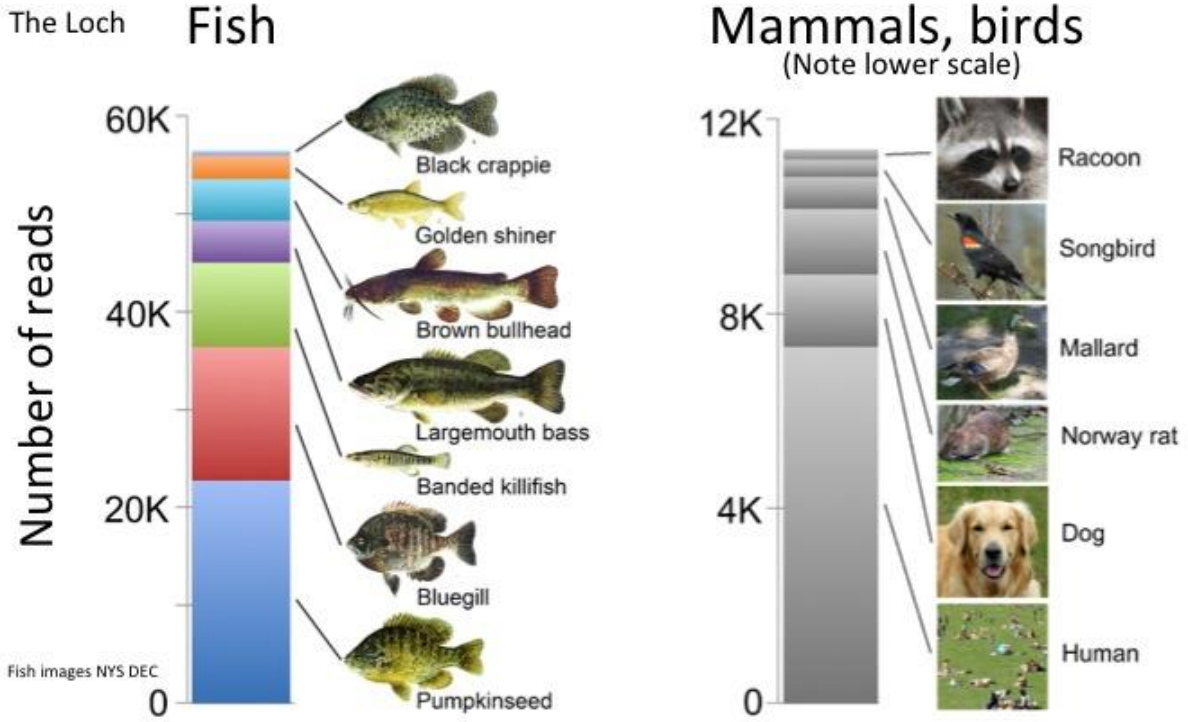
Current

The incredible possibilities of eDNA

- The ability to sample water for strands of DNA rather than catch individual fish.
- Already demonstrated in the laboratory – now to get it working on small sensors for mounting on instruments and autonomous systems.

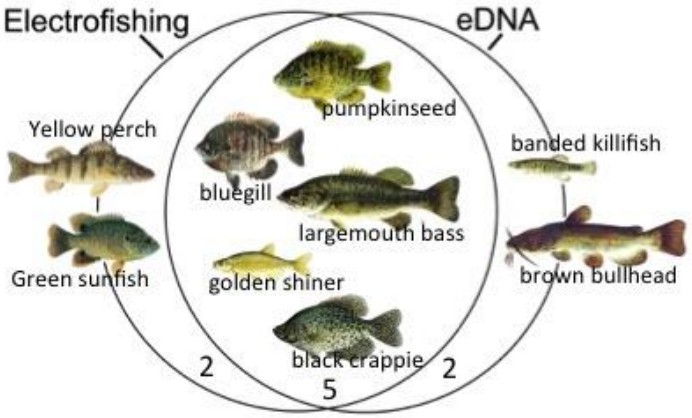
A dozen species in ¼ cup of water

- Analyze 6.33 ng DNA (roughly 60 mL H2O); 7 x 10^4 reads
- Detected 7 species of fish, also mammals, birds



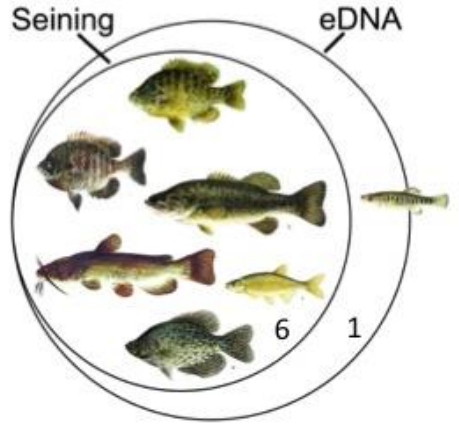
eDNA detected most species found by traditional methods, plus some not found

vs. Electrofishing



NYSDEC Harlem Meer Surveys, 2008-2013

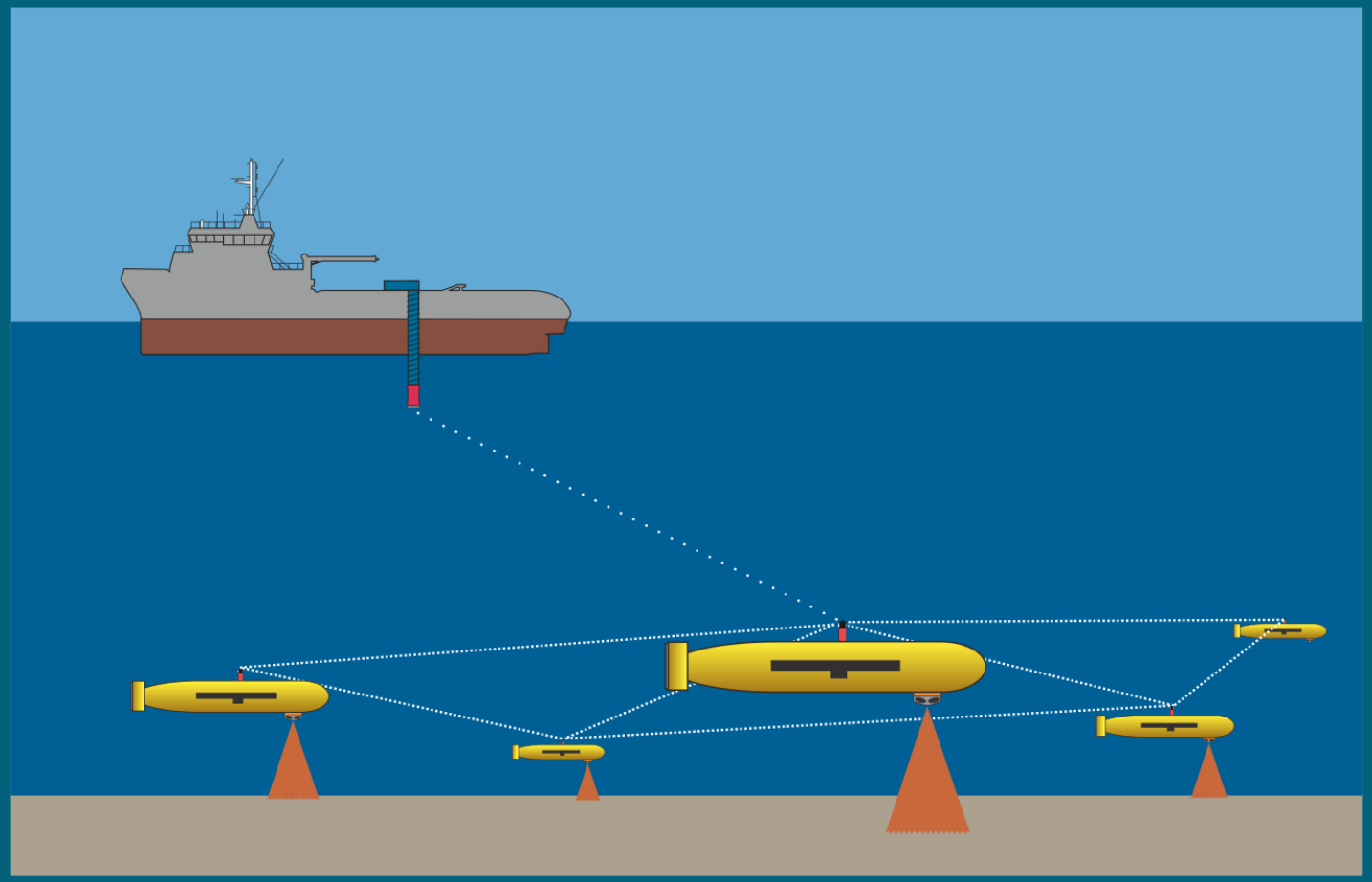
vs. Seining



2013 Bioblitz, Harlem Meer, The Pool

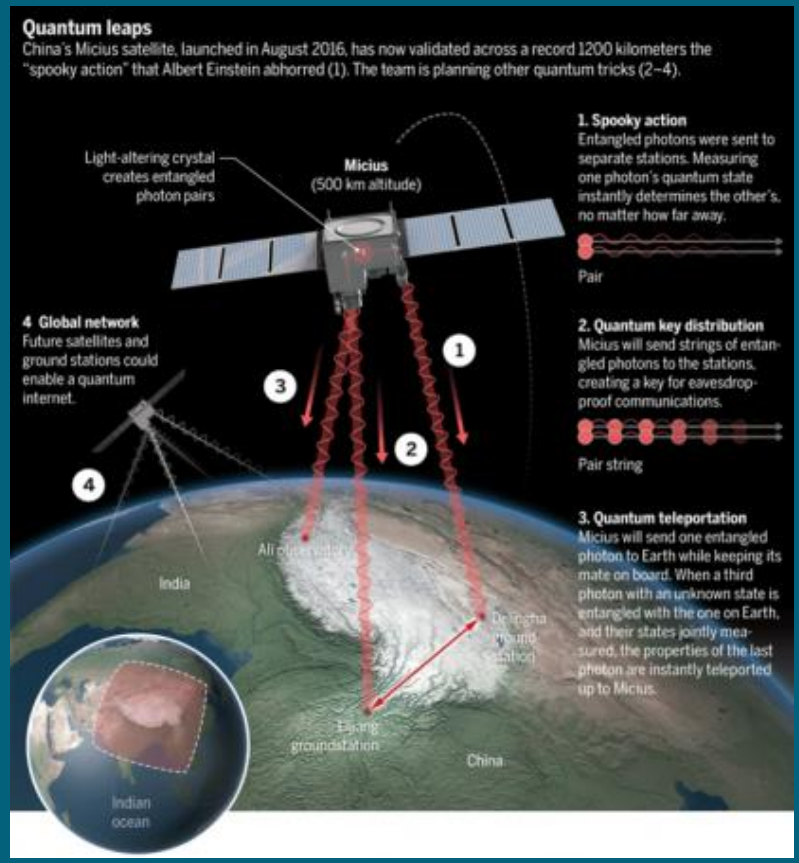
Drone Swarms:
The Buzz of the Future

AUV Swarm *Sonardyne image*

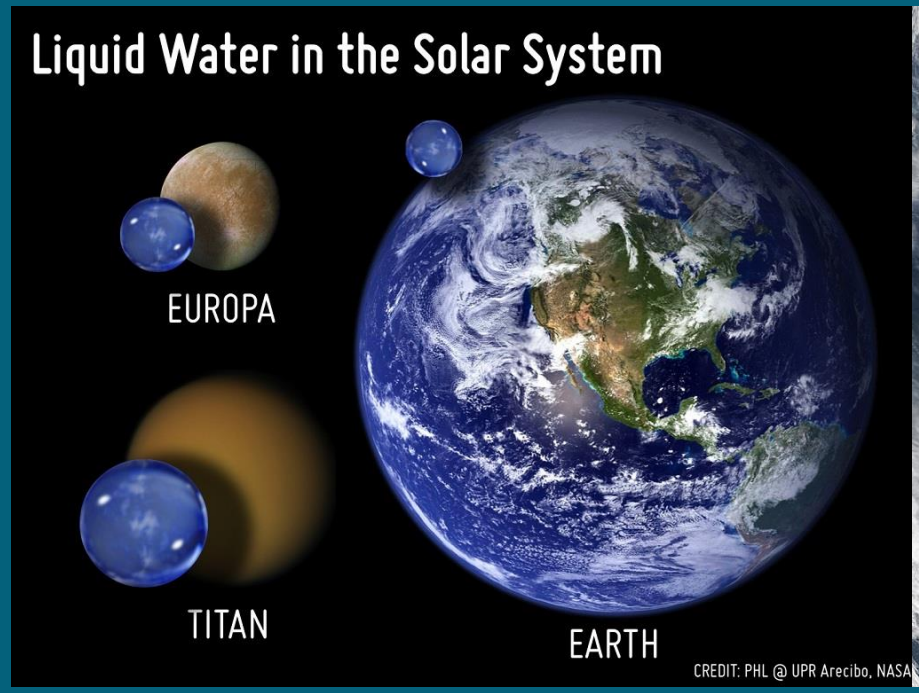


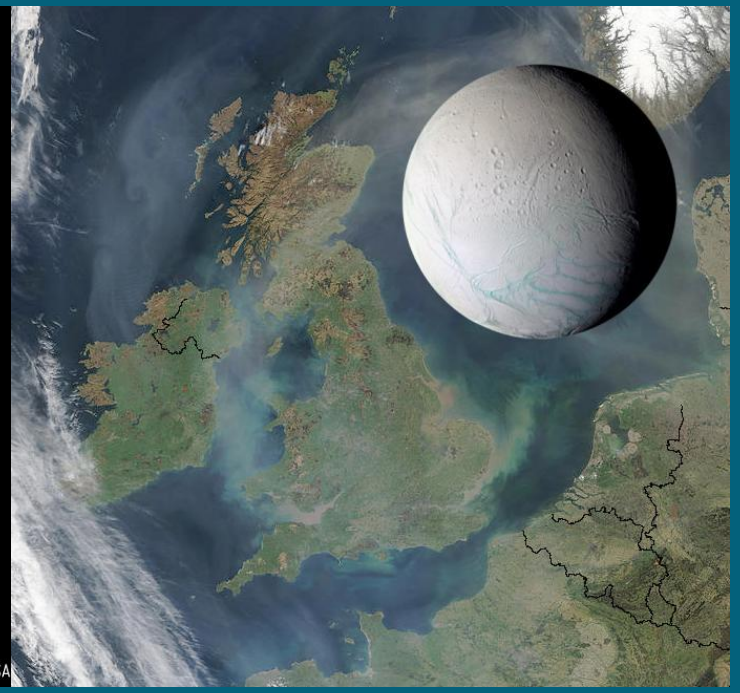
We've underestimated the coming impact of Artificial Intelligence… Or of Quantum Computing & Communications

- Society has barely begun to understand the implications of True AI, or of Quantum technologies



Moons with oceans





Knowledge about the ocean impacts the kind of Society we want to live in.

- Change is coming fast.
- No more ‘jobs for life’.
- Abundant clean energy resources are available & we will be able to feed the people – but quality living space at a premium.
- Advanced Artificial Intelligence changes everything!
- Quantum Computing & Communications makes the ocean ‘transparent’.

Thank You - 谢谢

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