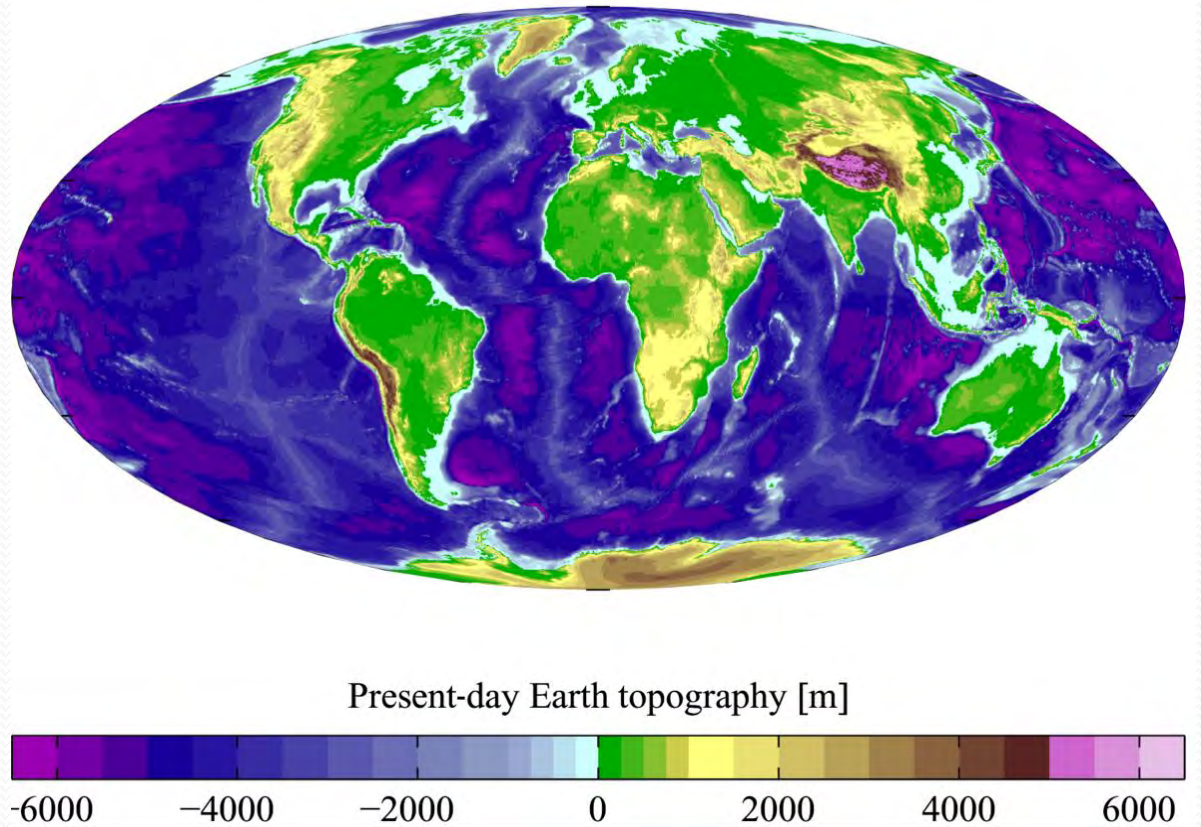


Does deep-sea benthic ecosystem research need new technological developments?

Bhavani E Narayanaswamy
Scottish Association for Marine Science
Oban - UK

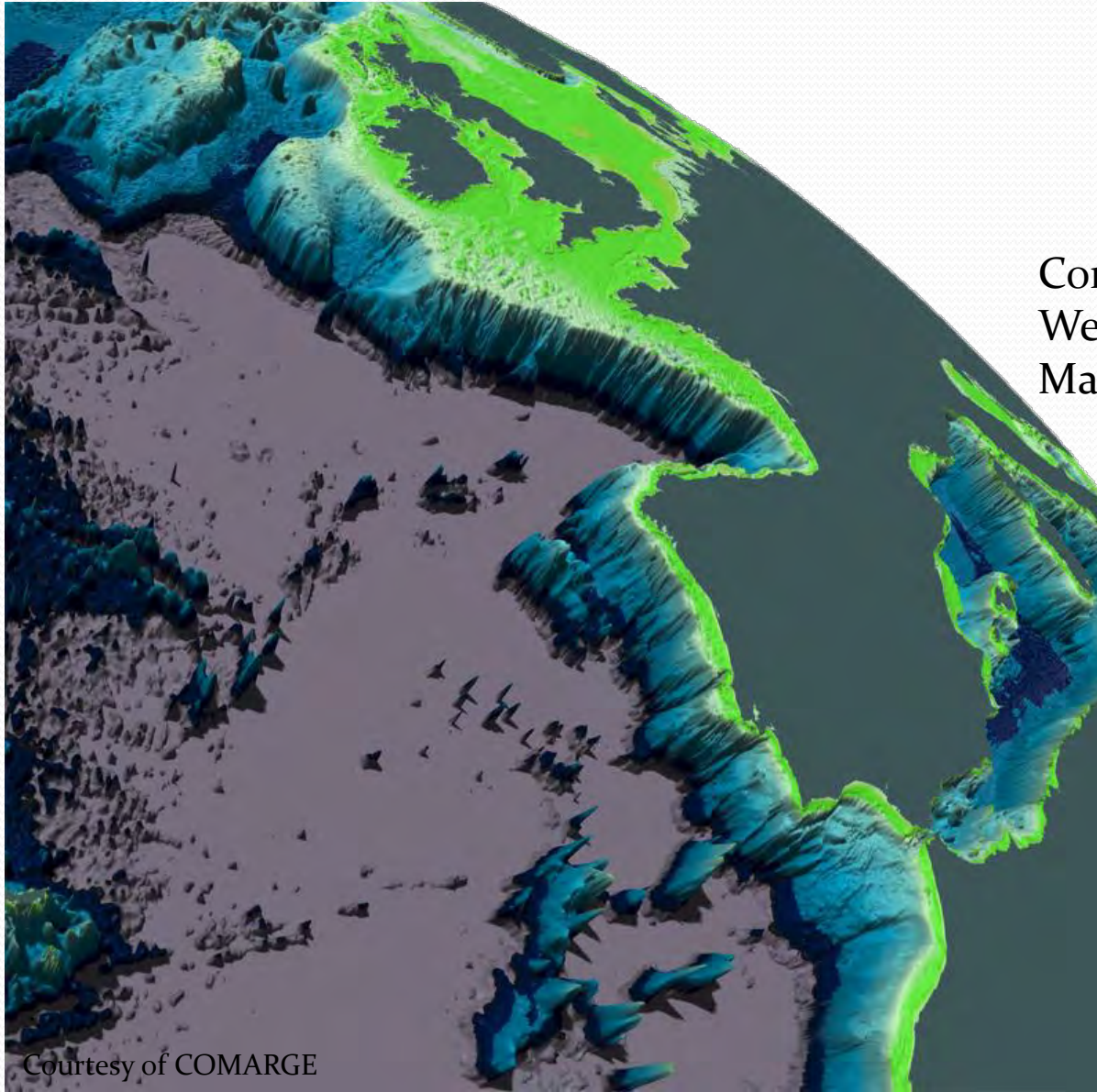
The Deep Sea

About 30 different deep-sea habitats described. From soft sediments on continental margins and abyssal plains, through to seamounts, canyons, mid-ocean ridges, trenches, oxygen minimum zones etc to name but a few.



Data from the National Geophysical Data Centre's TerrainBase Digital Terrain Model.

Variety of habitats



Continental Margin:
Western European
Margin

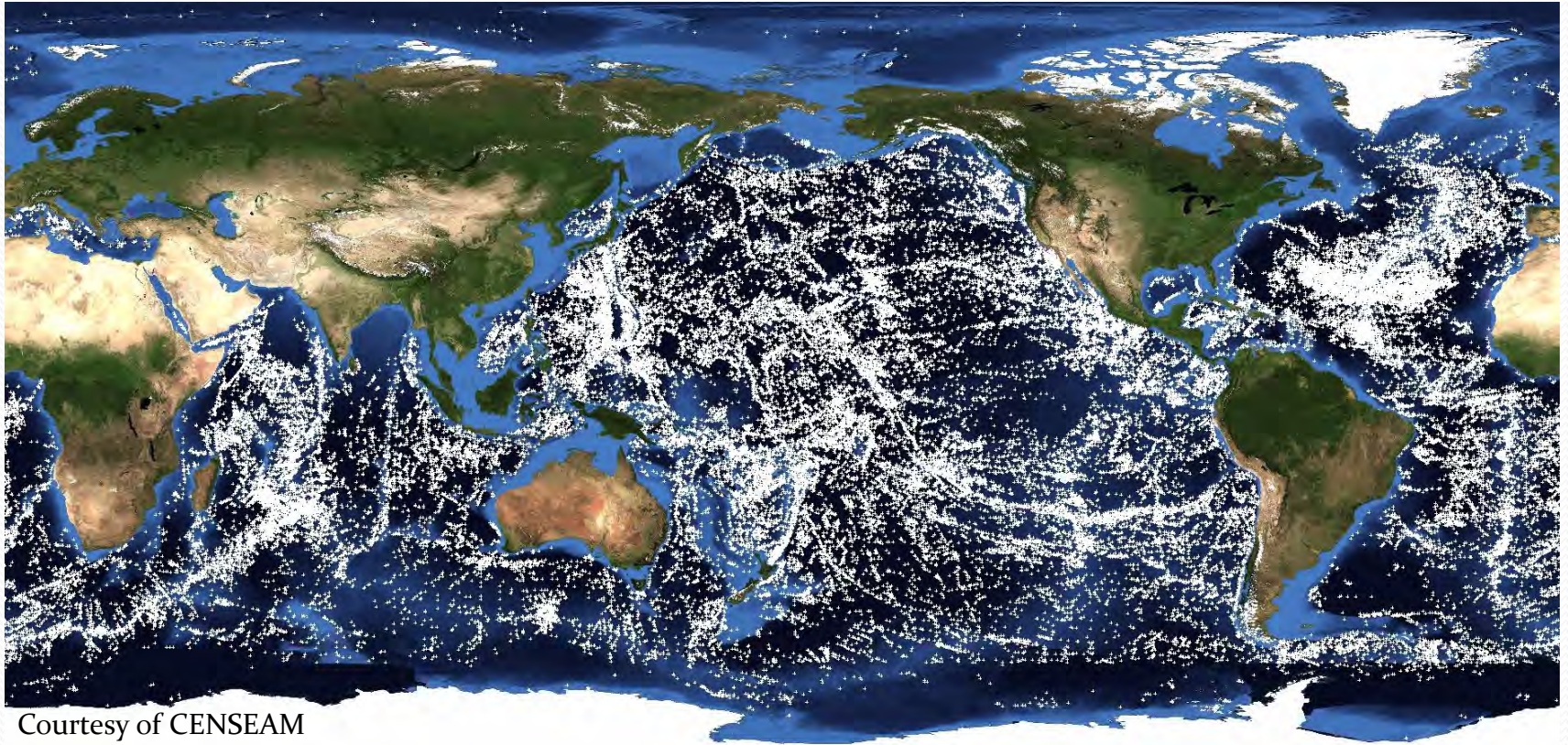
Courtesy of COMARGE

AMS



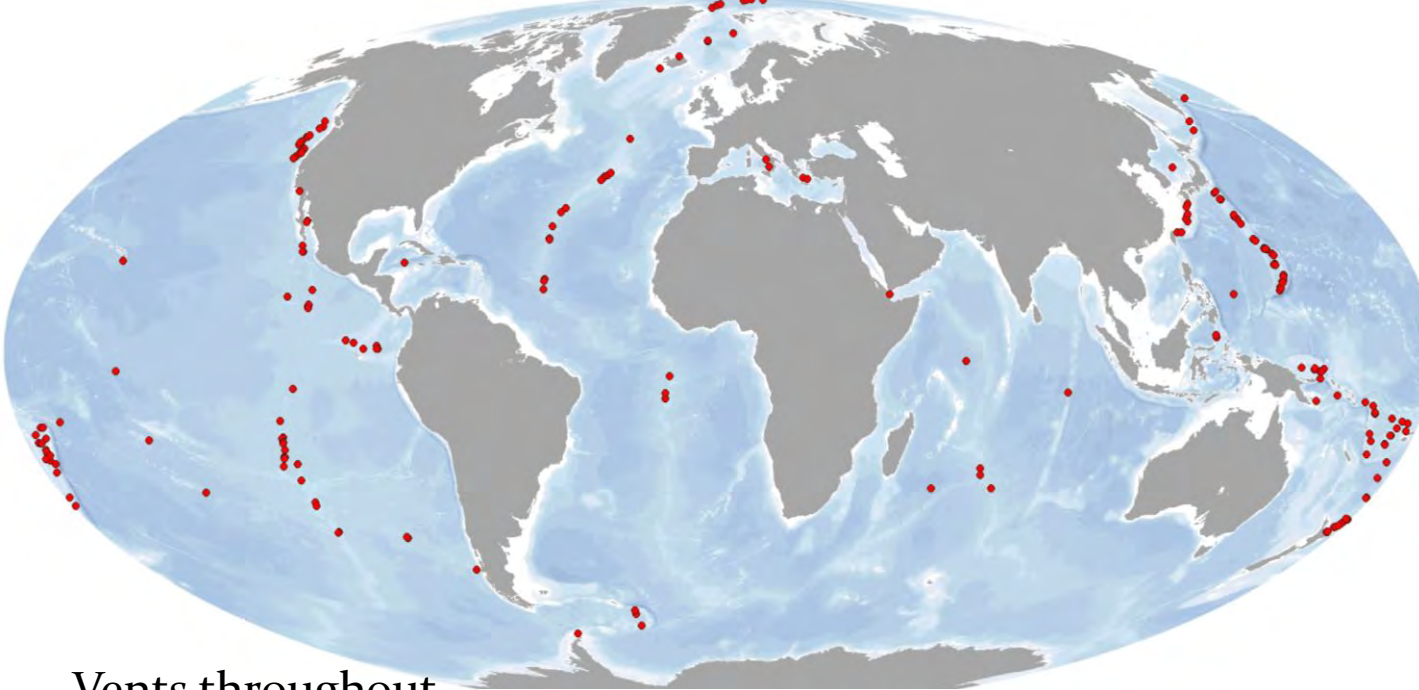
Variety of habitats

Global seamounts

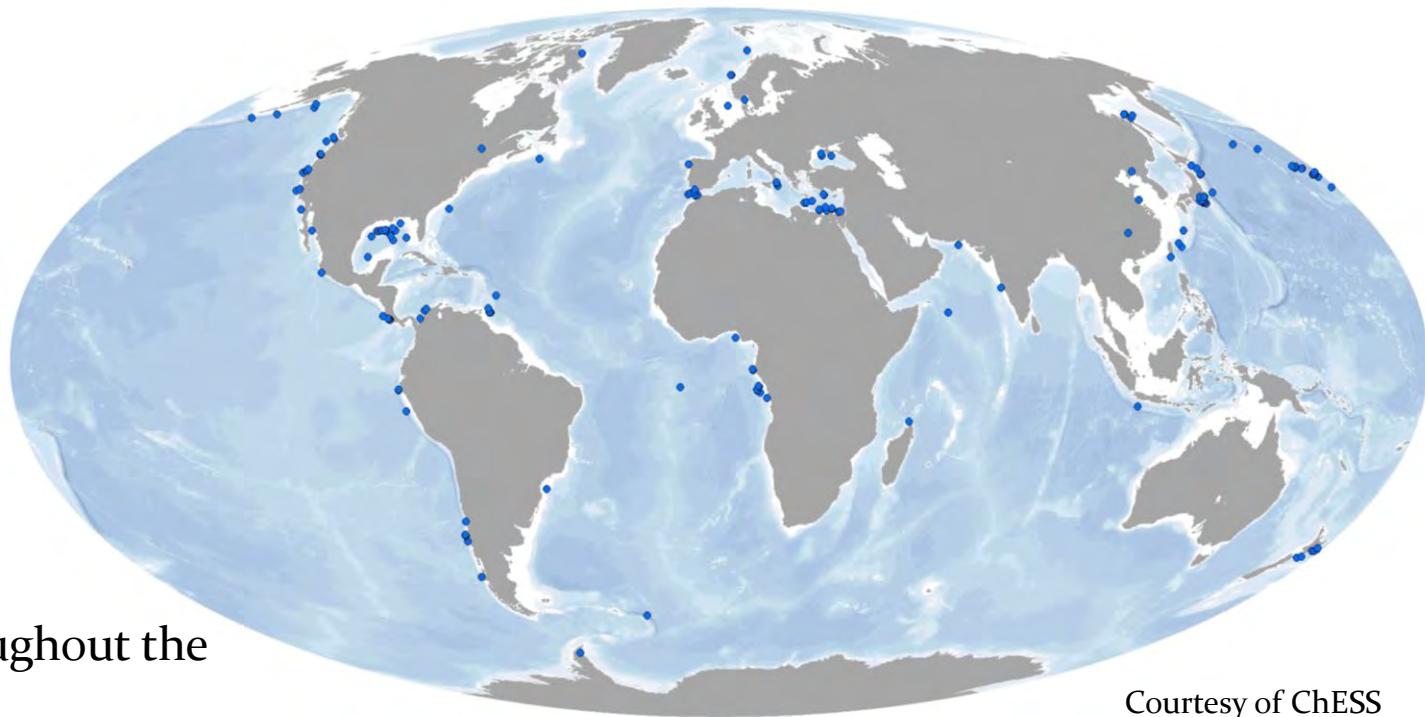


Courtesy of CENSEAM

Habitats



Vents throughout
the oceans



Seeps throughout the
oceans

Megafauna



Courtesy of NERC – SWIOR project





Courtesy of UK Dept BIS



Courtesy of NERC – SWIOR project



Courtesy of NERC – SWIOR project

Macrofauna

JC086_ES_1673_Tanaidacea_x1'6



2 mm

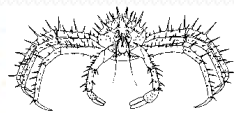
SAMS - Margaux LLAPASSET



Macrofauna



Macrofauna



Macrofauna

CF_168_Brachiopoda_3



Macrofauna

JC086_ES_1673_Tanaidacea_x1'6



2 mm

SAMS - Margaux LLAPASSET

Meiofauna



A wide range of habitats and a different sized fauna to collect. All generally being collected “blind”

Images courtesy D Hughes

Faunal collection

Depends on the:

- faunal size
 - habitat/sediment type
-
- Number of fauna collected in a sample varies with
 - Depth
 - Sediment type
 - Organic matter input
 - Human impacts

Other questions -

How many replicates?

Dependent on original question and density of organisms likely to be collected by the sampler

Equipment

Sleds, ROVs, AUVs, manned submersibles



©NERC



©J Howe



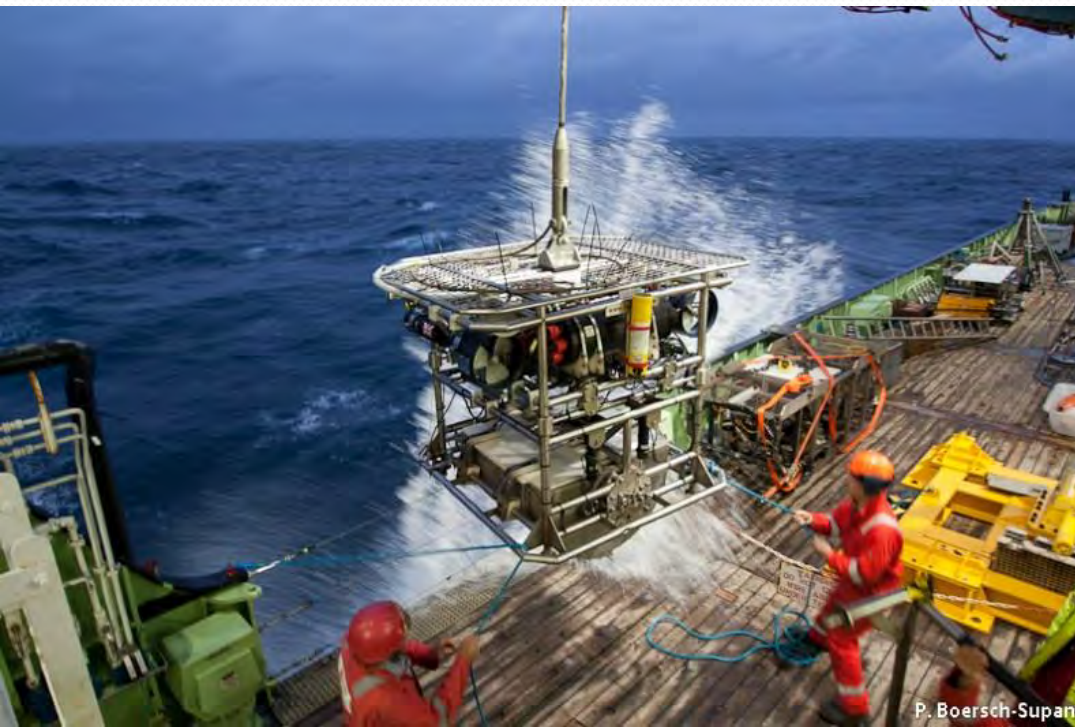
NOAA: Creative commons licence



©P Holliday

Grabs

From simple systems to TV based grabs
Several issues



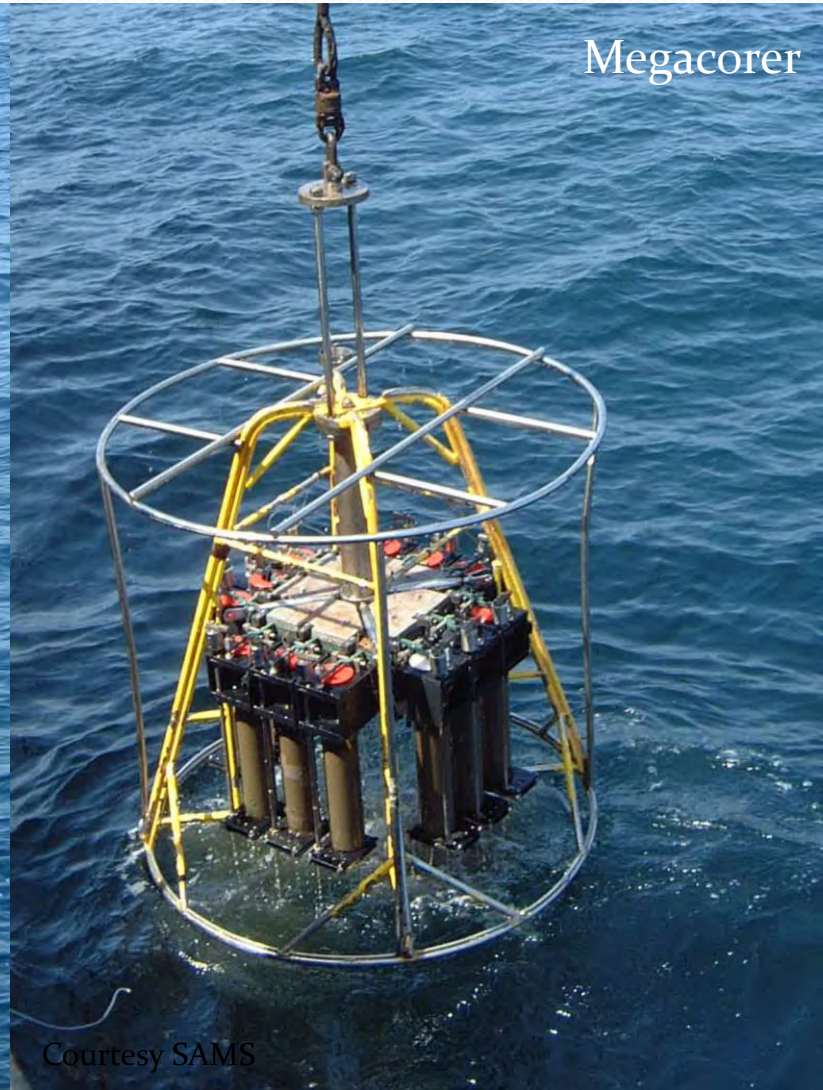
Corers

Box-corer



Courtesy B Bett

Megacorer



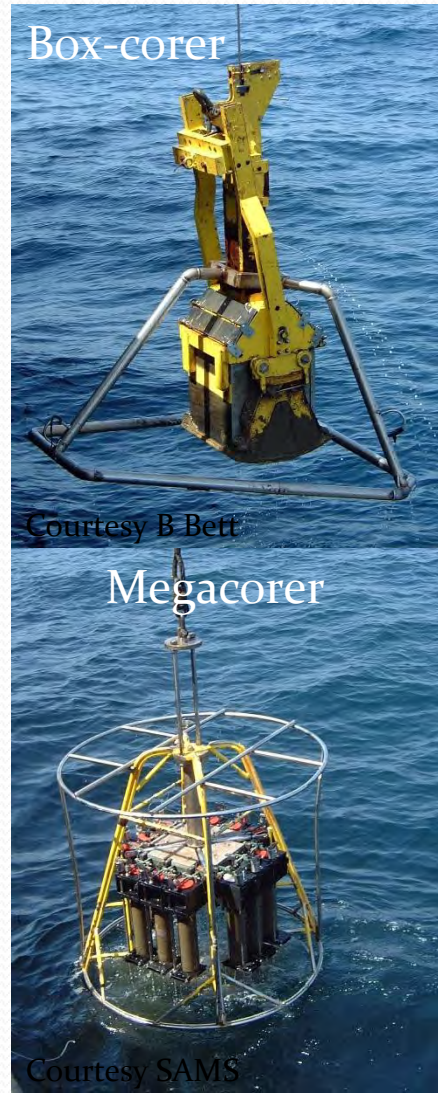
Courtesy SAMS

Corers



Problems with different gear

- Area sampled is different
 - Can standardise for a given area
- Boxcorer – bow wave effect
- Megacorer – hydraulically damped
- Standardise again - initial comparison between gear
 - Apply factor



Sieving and sorting

Material needs
to be initially
processed



Dilemma I

- What mesh size to use in the sieve?
 - 4mm? 1mm? 0.5mm? 0.425mm?
0.3mm? 0.25mm? 0.1mm? 0.063mm?
- What is your question?
- What fauna are you looking at?
- What have others looked at & are comparisons to be made?


Selection will influence answer



Dilemma II....

← www.oceannetworks.ca/learning/get-involved/citizen-science/digital-fishers 🔍 Search ☆

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Learning

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Digital Fishers



Digital Fishers. A crowd-sourced ocean science observation game.

Help to contribute to our understanding of:

- Environmental factors in the deep ocean.
- Biodiversity associated with deep-sea environments.
- How species interact with each other and with their environment.

Learning & Engagement

Learning

- » Learning Blog
- » Learning Highlights
- » Learning Events
 - » Ocean Symposium
- » Partnerships
- » Contact Us

Ocean Sense

- » Community Observatories
 - » Cambridge Bay
 - » Campbell River
 - » Kitamaat Village
 - » Mill Bay

Identifying fauna...

Time consuming and challenging

- From photographs – often critical features are not observed
- Smaller fauna – often damaged & missing crucial elements, e.g. legs, antennae etc.
- Keys not always available in language required
- New species' - no key available



ISSUES BEGIN TO ARISE

Identifying fauna...



Gorgoniapolynoe caeciliae (lives with primnoids, bamboo corals etc.)



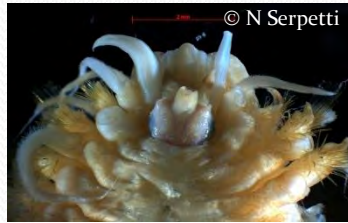
Gorgoniapolynoe corralophila
(lives with a stylasterid)

How many species?

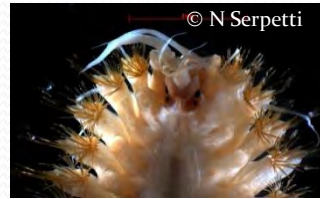
- Depends on number of samples collected
- Location of samples
- Number of people identifying
 - Where are people located i.e. same lab, different lab etc?



How many species?



Brychionoe sp. 1



Eunoe sp. 1



Harmothoe sp. 1



Brychionoe sp. 2

Eunoe sp. 2

Harmothoe sp. 2



Brychionoe sp. 3

Eunoe sp. 3

Harmothoe sp. 3

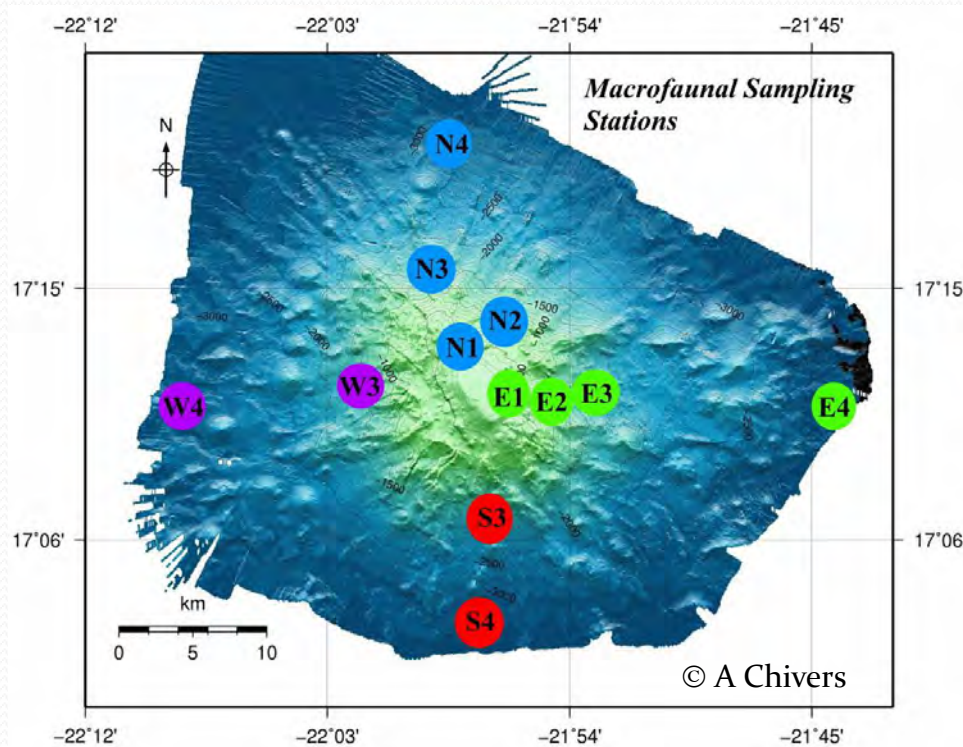
Not 3 species but now 9 species

Combing databases

Problematic at species level!

Even if species names known – time limited

- e.g. Study on Senghor seamount
- ~2000 individuals collected – 12 stations



Combining databases

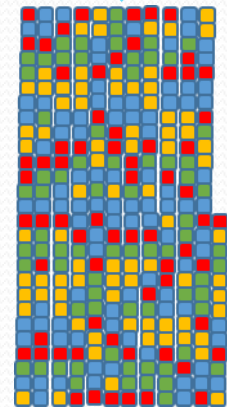
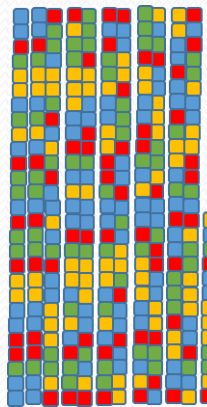
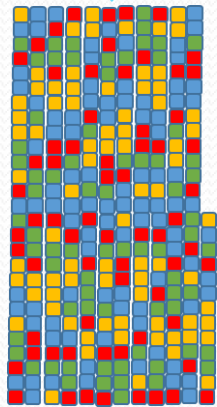
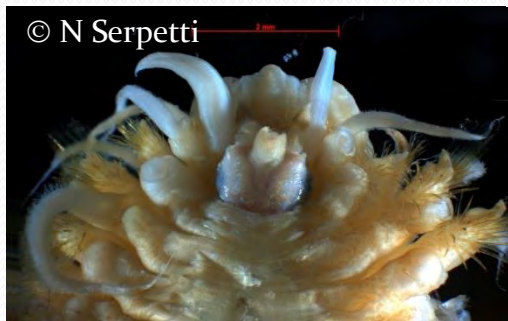
Problematic at species level!

Even if species names known – time limited

- e.g. Study on Senghor seamount
- ~2000 individuals collected
- Total of ~230 “putative” species found
- 4 different researchers – may give >900 “putative” species

How to combine the data?

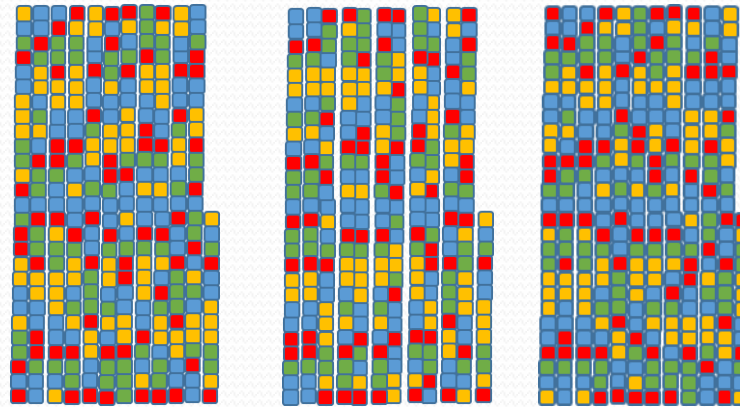
Other techniques



DNA Barcoding –
only works at species level if species sequenced &
on database

DNA barcoding

- Could barcode ALL individuals in sample...



- Information provided – “number” of species
- No information on species themselves

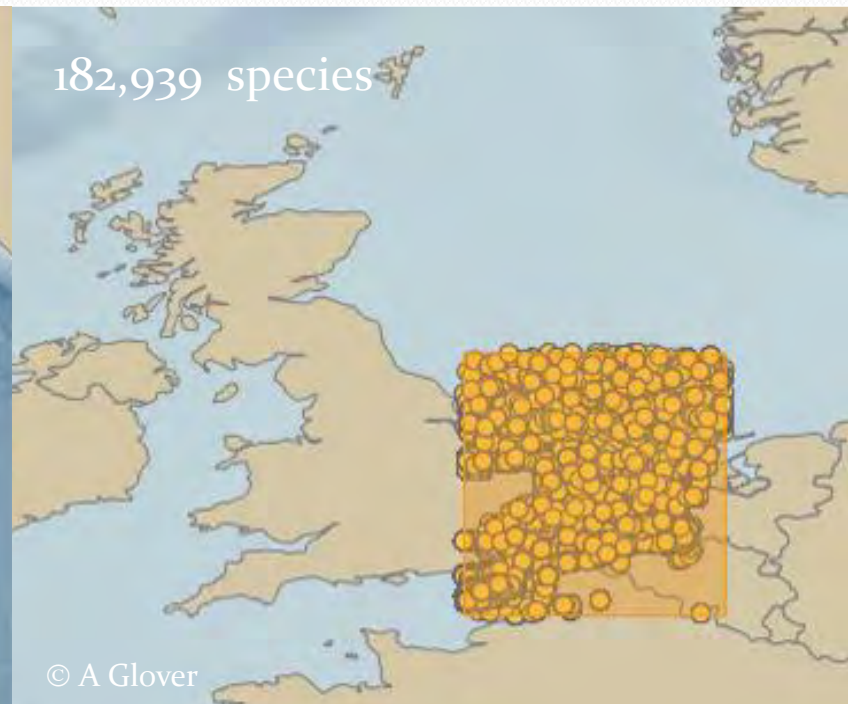
Does deep-sea benthic ecosystem research
need new technological developments?

YES!

What new technological developments are required?

- Reliable quantitative operating systems
- Systems to aid sorting of fauna
 - Mechanisms for undertaking morphological and molecular analysis on the same individual
- Device to speed up identification of fauna – both physical and images

Scale of the problem



Number of polychaete species identified from the N Sea – and same area (300,000 km²) in the Clarion Clipperton Fracture Zone – Pacific (as of OBIS) (Glover et al. 2016)