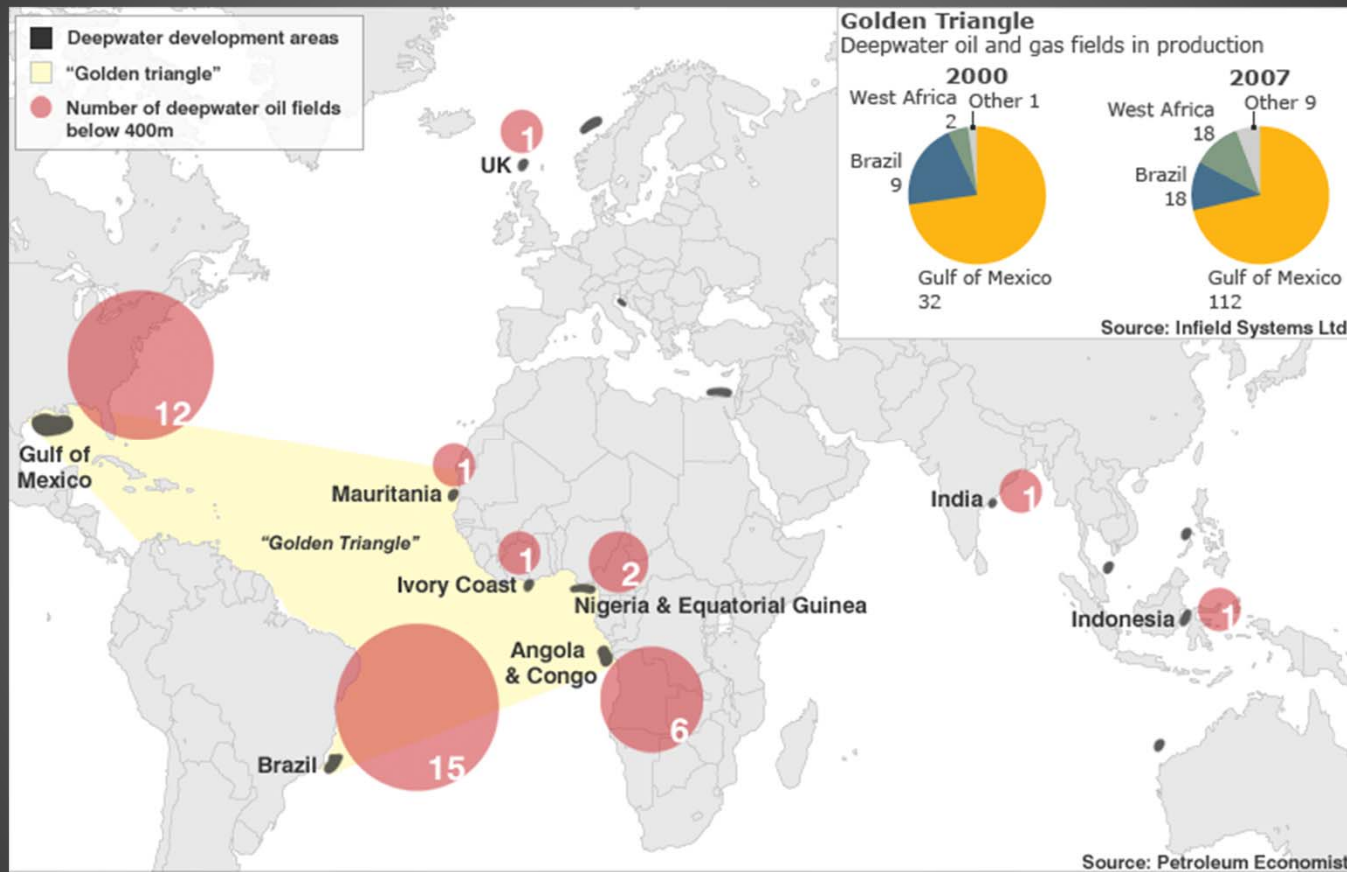


The value of collections – lessons from the oil & gas industry

Tammy Horton

The Oil & Gas Industry in deep water?

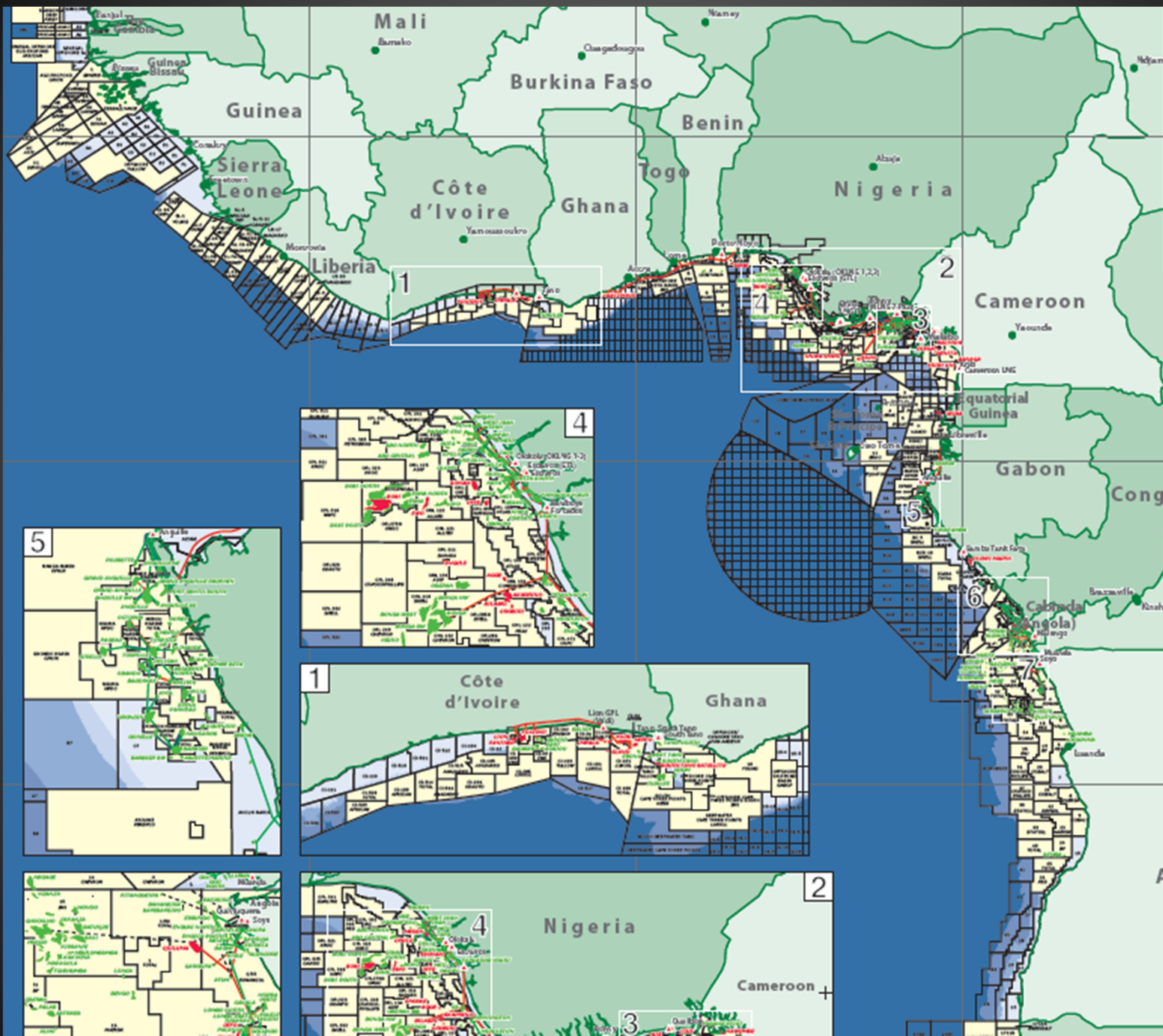
Yes. But how deep?



- In 2013, deepwater liquid reserves accounted for 6% of global production, rising to 11-40% by 2020.

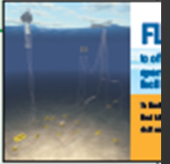
Deepwater Oil & Gas: A case study

- West African Continental Margin (Angola, Ghana, Nigeria, Gabon, Congo)
- How many companies?
 - led by BP (UK), Total (France), Chevron (US), ExxonMobil (US), Statoil (Norway).
- How many wells drilled/explored?
 - *Globally* 14,000 deepwater wells have been drilled.

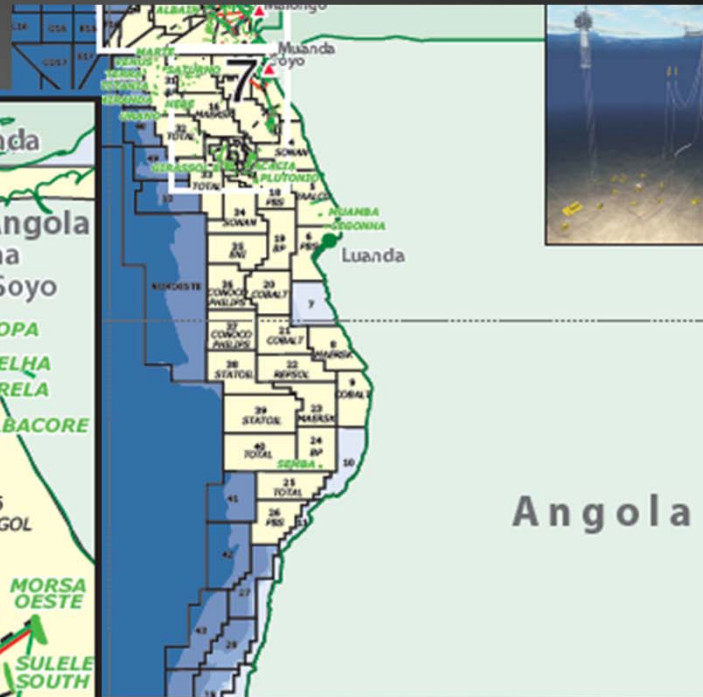
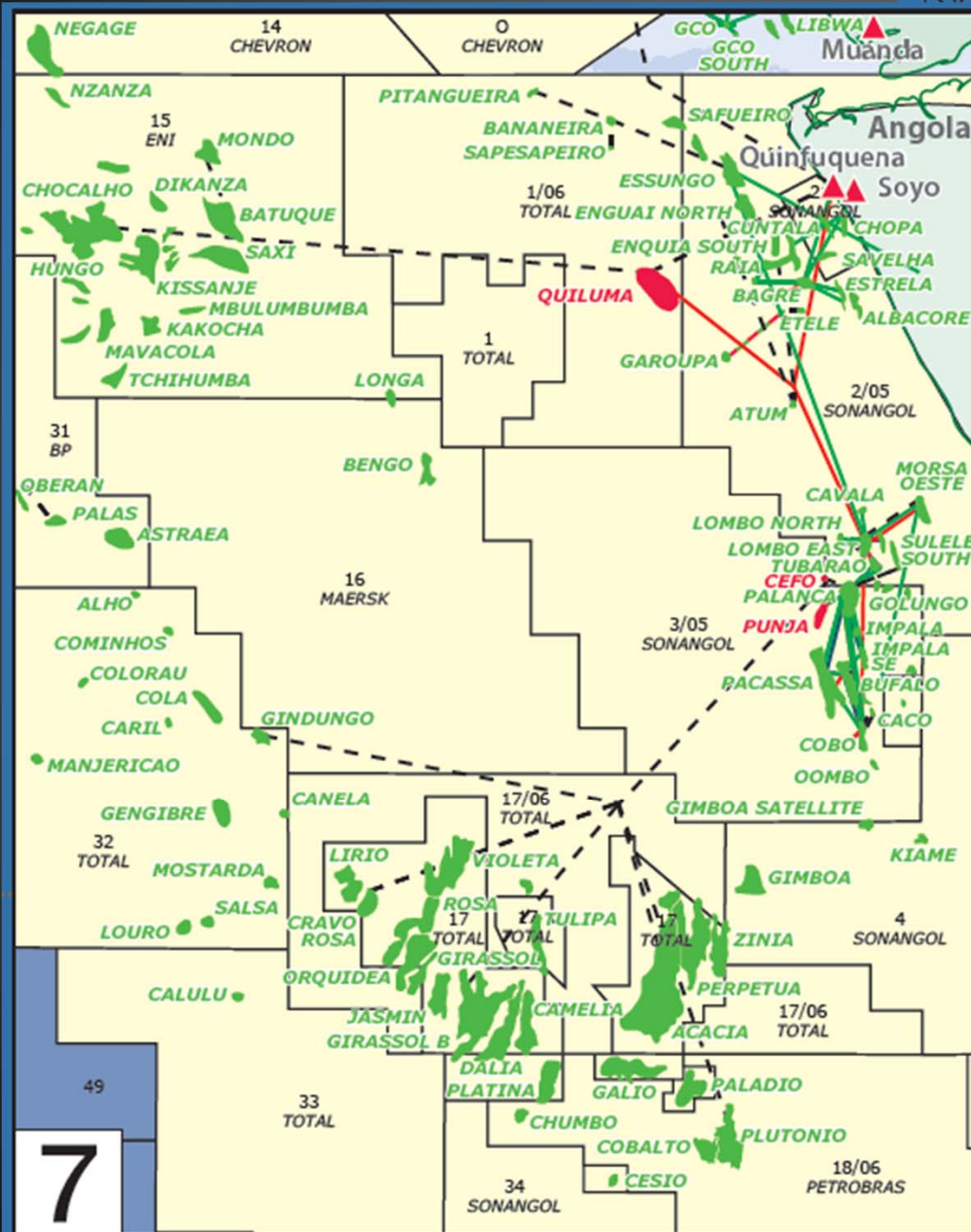


West
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- Areas to be explored delimited into blocks
- ~ 5,000 km²
- Concessions granted for 20 years.
- Angola has 44 blocks shared between a number of companies
- Angola's Oil company, Sonangol has shares in most blocks.

7

EIA and Taxonomy in deepwater?

What regulations must be met?

- Baseline surveys and Environmental Impact Assessments – **vary by country**
- Faunal Assessment – relies on robust taxonomy
- What do we know about taxonomy in deeper waters?
 - Are any groups known well? e.g. fish, megafauna, epifauna are better but EIAs focus on macrofauna
 - % of macrofaunal species known to science?
 - 35-95% of bathyal/abyssal macrofaunal species are **new to science** (e.g. Poore et al., 2014; Brandt et al., 2005; 2007; Bamber 2000; Wilson, 2008; Kongsrud et al 2013; Bouchet et al 2009)

How are surveys & samples managed?

- Vary by country, National waters.
- US model: BOEM – Smithsonian (SMNH)
 - funded by BOEM since 1979.
 - Staff dedicated to mgmt of collection.
<http://invertebrates.si.edu/boem/boem.htm>
- Brazilian/ Australian/New Zealand/Norwegian models.
- UK model: environmental consultancies manage survey acquisition and data & sample processing for the client.
- Methods of survey: may lead to incomparable data

UK Model

- Client (e.g. BP, Total etc) tender for survey (can be Angola, Australia, Uruguay or UK)
- Bid for by SMEs (Survey contractors & taxonomy labs, sometimes subcontracted)
- Quality of winning bid (and survey) will vary (price, willingness to pay by company, regulations of the country)
- Work completed, data passed to client.
- Samples, and data often lost for future reference.

Problems with the model?

- Where/who are the taxonomists?
- Identifiers vs taxonomists...
 - Lack of robust taxonomy in deep water surveys.
 - Lack of access to expertise/information and identification resources
 - Poor information sharing – consultants are businesses in competition with each other
- Combine to produce a lack of comparability on a regional basis
- No strong baseline data. How do we assess impact??

Identifying deep-sea fauna: problems and differences

Shallow NE Atlantic

Well-known fauna

Many specimens

Good condition

Previous studies/reports/papers

Good Keys

W. Africa Continental Margin

Poorly-known or completely unknown fauna

Few specimens

Poor condition

Few/no previous studies/reports/papers

No Keys

- Guidance on modern techniques for deep-water specimen collection and preservation methods. Traditional practice is formalin. – No molecular!
- Guidance on management of identification in unexplored areas.
- Guidance on processing and creating voucher collections – i.e. not recombining identified samples

Understanding OTUs: Prepare to be surprised!

- Most of the fauna will be new to science
- New genera as well as species
- Genera & species from outside known ranges/depths



Why is a robust taxonomy important?

- **Baseline Survey**

50% – Amphipod sp. A
25% – Amphipod sp. B
15% – Amphipod sp. C
8 % – Amphipod sp. D
2% – Amphipod sp. E

- **Post-drill Survey**

– Amphipod sp. A 50%
– Amphipod sp. B 25%
– Amphipod sp. C 15%
– Amphipod sp. D 8 %
– Amphipod sp. E 2%

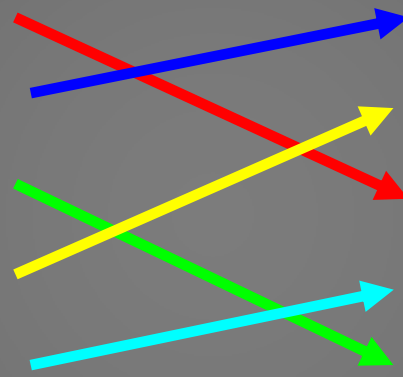
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15% — Amphipod sp. C
8% — Amphipod sp. D
2% — Amphipod sp. E



If we do not know which species is which, we cannot say how the environment is changing.

Example: Angola Survey (2005)

Top ten most abundant species

Tachytrypane sp. C

Onchnesoma steenstrupi

Kelliella atlantica

Falcidens sp.

Pholoe sp. A

Thyasira ferruginea

Thyasira tiny decal

Ninoe sp. A

Nemertean indet.

Aricidea sp. B

Aglaophamus sp. A

Tharyx sp. A

Fauveliopsidae sp. A

3 species named

Some of the 24 Amphipod species

Lysianassidae sp. A

Lysianassidae sp. B

Lysianassidae sp. C

Lysianassidae sp. E (?*Orchomene*)

Lysianassidae sp. F

Hippomedon sp.

Synopiidae sp. (aff *Syrrhoe*)

Metaphoxus sp. A

Harpinia sp.A

Harpinia sp.B (?*laevis*)

Harpinia cf. *excavata*

Harpinia sp. D

No species named



Working with the Oil & Gas Industry

- Protect and ensure the long-term value of deep-water environmental survey data
- Promote and improve the knowledge of deep-sea biodiversity and taxonomy
- Improve access by *identifiers* to taxonomic information, taxonomists, and taxonomic literature



Guidance on Curation

Specimens are of greater value within an organised, curated, accessible collection, than isolated or dispersed across several places.

They become available to other researchers.

Deepwater samples are valuable (costly to collect) and rare and cannot be resampled.

Older samples can provide information about what lived where...before impact from exploration / fishing / environmental change.

The older samples in your institutes have immense value! Do not dispose.



Specimen Collections

- Digitisation and curation of specimen collections will allow access to specimens and associated data for:
 - Molecular & morphological taxonomic studies
 - Biogeography
 - Linking new surveys to old
- Need to incorporate data into a single database – to allow searching of the holdings by station or taxon.
- Loans/visits can be made to study the samples.
- Operational Taxonomic Unit (OTU) level data



NOC working with Industry

- Guidance document for the Oil & Gas Industry (BP) on the importance and preparation of voucher collections from deep-water environmental surveys.
- A voucher collection from all deep-water surveys by BP will now be curated in the Discovery collections/NHM.
- Current work:
 - gather historical samples and data for access
 - Publish curation guidance document
 - Expand to other companies
 - PHD programmes [/taxonomy-biogeography-deep-sea-peracarid-crustaceans-african-continental-margin](#)



Bathynomus affinis @ the NHM

How should samples be curated?

- Each specimen from the survey should be placed in a separate container. **Do not recombine samples!**
- Molecular tissue sample taken and dealt with separately (see guidelines)
- For long term preservation:
 - Ethanol/Industrial methylated spirits (80%)
 - Double tubes – reduces evaporation risks
 - Push closures, glass/poly tops (recommended type)
 - Label internally, not outside of tube.



Labelling

- Resistall paper
- If printing: Durabrite ink/Epson printer
 - Survey name/Area
 - Taxon name/code
 - Station code
 - Depth
 - Position
 - Date
 - Gear Code
 - Unique Identifier Code
- Accession Code /specimen code should be written on the back – e.g. India Ink/Staedtler pigment markers

FRPB Survey of the Hound Point Ballast-water Discharge, Firth of Forth	
<i>Tubulanus polymorphus</i>	
Station: 2	Depth: 10 m
Position: 56° 0.07' N	3° 21.83' W
Date: October 1995	C.A. 7
Sediment: Medium sand; e.p.s.	
NMSZ2001172. 007	G34

Data Requirements

- Metadata
- Species Matrix
- Specimen table
- Station/Sample data
- Other data e.g.
 - Environmental data
 - Photo graphic codes
 - Molecular data

Data Requirements

- **Metadata**
 - Project/survey title and relevant project codes.
 - Client details.
 - Contractor details (including a nominated contact).
 - Survey vessel and cruise number (*e.g.* RRS *Charles Darwin* Cruise 112C).
 - Generalized description of survey area (*e.g.* seabed survey of shelf/slope west of Shetland).
 - Details of sampling methods and preservatives used.
- Species Matrix
- Voucher Specimen table
- Station/Sample data
- Other data (Photo/Molecular tables)

Data Requirements

- Metadata
- Species Matrix
- **Specimen table**
- Station/Sample data
- Other data (Photo/Molecular tables)

TAXON	Authority	Station Code	Number of Specimens	Determined by:
Eudorella truncatula	(Bate, 1856)	57008#1	15	GJ
Eudorella truncatula	(Bate, 1856)	57015#2	6	SS
Diastylodes biplicata	(G O Sars, 1865)	57018#2	1	N/A
Diastylodes biplicata	(G O Sars, 1865)	57021#2	1	N/A
Diastylodes biplicata	(G O Sars, 1865)	57022#1	1	N/A

Data Requirements

Appendix 1

Station List - RRS James Cook Cruise No. 037 August-September 2009 ECOMAR

Station No.	Date	Time GMT	Latitude	Longitude	Gear	Depth (m)	Remarks
001	3 Aug	0149 0055	51°38.24'N	09°39.92'W	SVP	35	Sound velocity profile in Bantry Bay, Ireland prior to EK60 calibration.
002	5 Aug	1057 1340	49°33.92'N	17°43.11'W	CTD Cast 1	3000	CTD lowered with releases strapped on for tests. Water was collected for sediment traps
003	5 Aug	1505 1755	49°34.32'N	17°54.11'W	CTD Cast 2	3000	CTD lowered with releases strapped on for tests. Water was collected for sediment traps
004	7 Aug	1118 1352	49°02.06'N	27°41.93'W	CTD Cast 3 + Optics rig	2600	Full depth CTD plus the optics rig was cast twice over the starboard side by the stern crane
005	7 Aug 18 Aug	1427 1835	49°02.03'N 49°01.91'*	27°41.93'W 27°41.97'*	Thermistor chain	2600	Deployed on a ridge at the same site as the previous CTD. *Accurate location by triangulation
006	7 Aug 10 Aug	1525 1419	49°01.87'N 49°01.65'*	27°42.07'W 27°42.20'*	PAL Lander	2546	Deployed as part of an experiment with JC037/05, with an ADCP and CTD. *Accurate location by triangulation
007	7 Aug 8 Aug	1629 2101	49°01.89'N	27°47.29'W	ICDeep Lander	1701	Very little in the traps but good video of fishes and bioluminescent events
008	7 Aug	2125h	49°02.60'N	27°43.48'W	SE Mooring	2500	Redeployed for recovery in summer 2010. Some sample tubes on the lower trap were very full from spring 2009
009	7 Aug 8 Aug	2311 0044	49°05.39'N	27°50.24'W	Megacorer	2720	Full set of 8 cores retrieved
010	8 Aug	0248 0534	49°05.40'N	27°50.22'W	Megacorer	2720	Full set of 8 cores retrieved
011	8 Aug	0603 0840	49°05.40'N	27°50.22'W	Megacorer	2720	Full set of 8 cores retrieved
012	8 Aug	0913 1917	49°06.00'N 49°06.00'N	27°47.75'W 27°37.40'W	EK60 + EM710		Grid of 10 x 10 nautical mile parallel lines in the NS direction over the sediment trap station. Two sonars synchronised

Licences, Permits & Ownership

- CITES/DEFRA import licences
- Hazardous goods transport regulations
- Convention on Biological Diversity
 - Nagoya
 - In-country export permits
- Renner et al. 2012 (provided)
- Transfer of ownership form – Donation to Discovery Collections.
All must be provided before samples will be accepted.

How to facilitate this sample management?

- From each representative :
 - A contact in-company for dialogue
 - List of relevant deep-water surveys
 - Information about current specimen holdings – locations of existing voucher/reference collections and data
- Future samples should be managed in this way.
- Historic samples will be incorporated into database for access/information.

Lessons from the Oil & Gas industry?

- Do not make same mistakes!
 - Encourage all to follow the best model
- Critical need for improved sample curation and access and information sharing.
- Future of exploration: baselines v monitoring:
 - Will consultants or academics be doing the work?
 - Must understand the different working pressures.
 - Both morphological and molecular taxonomist experts need to be encouraged to work closely with industry (funding need).

The path ahead?

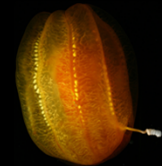
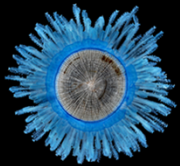
- Like the oil & gas industry, the mining industry will need both identifiers *and* taxonomists
- Two-level model:
 - Initial identification (consultancies/in-house)
 - Focussed expert taxonomic project reports
- Experts need to create new taxonomic products to aid training and work of identifiers (samples/funds)
- Taxonomic data to be shared through centralised database - Scratchpads?

The path ahead

- Access to previous reports, sample metadata.
 - Share taxonomic reports between consultants/ academics of what is known, both published & unpublished (ISA database?)
 - Species lists and specimens shared and made freely available (& traceable) on a regional basis across the CCFZ
- Improved access to identification resources and taxonomic information, access to taxonomic expert advice

Deep Sea ID

A Deep-Sea Field Guide



Presented By

The World Register of Deep-Sea Species



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