Environmental data: what MSR is needed, and why?

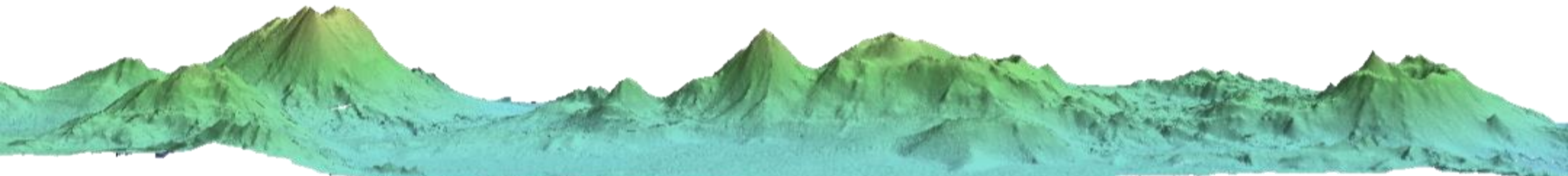
Malcolm Clark

P-SIDS Regional Training and Capacity Building workshop, Marine Scientific Research
Tarawa, Kiribati, 12-13 August 2019

Presentation Outline

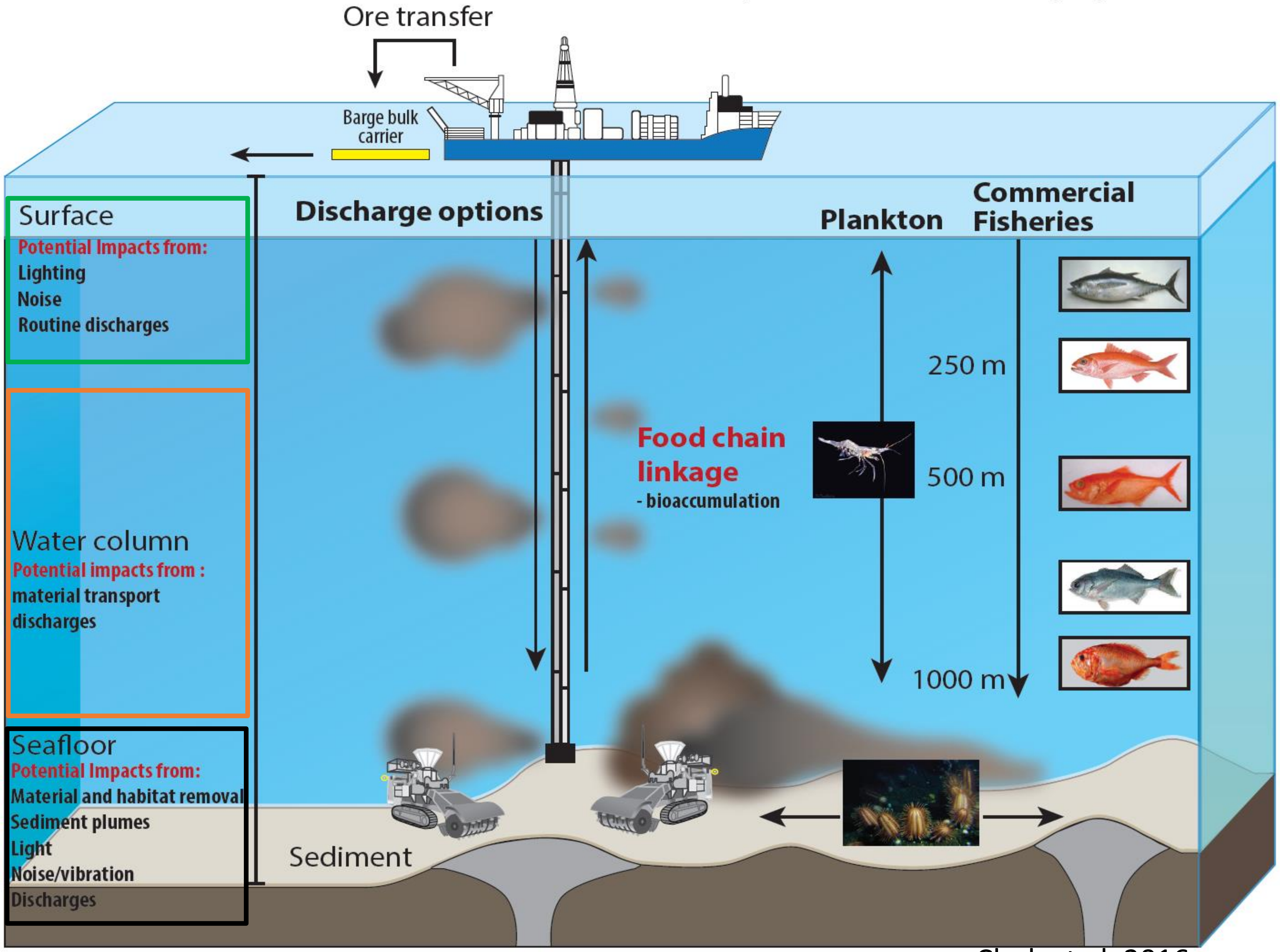
- Environmental impacts
- Baseline data
  - Requirements
  - Existing guidance
- Key Environmental Management sequence
  - Risk assessment
  - Impact assessment
  - Management and Monitoring
- Capacity issues

HIGH LEVEL
Focus on big picture issues
Not detail
Science focus, but with a management context (need both)



Deep-sea mining impacts

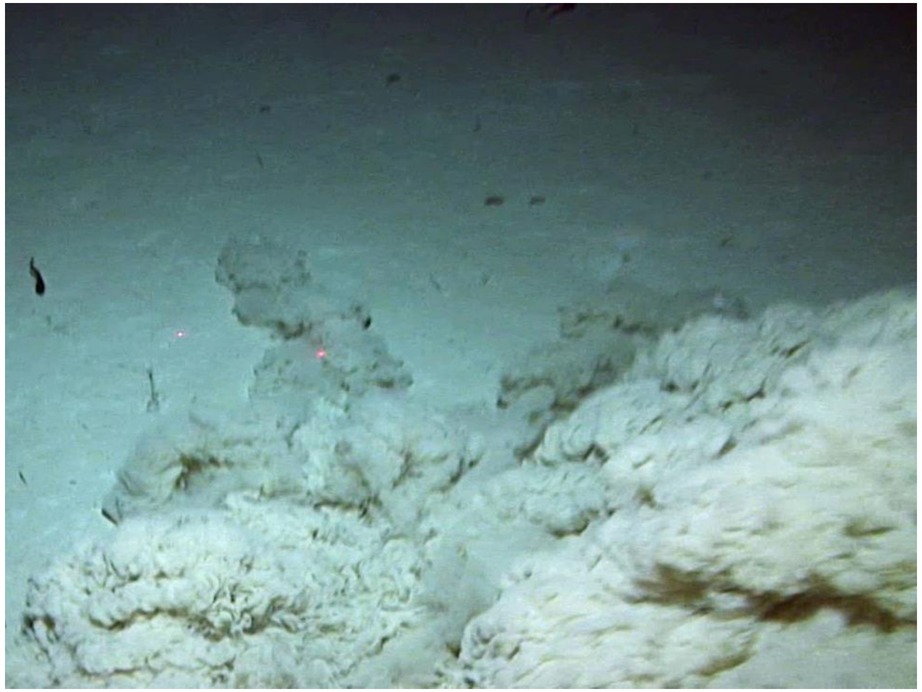
- Range of impacts throughout the water column-surface to seafloor
- Deep Sea is an open system
- Both in space (vertical-1000s m, horizontal-1000s km), and time (changes over years-decades-millenia)



Clark et al. 2016

Key effects to consider

- **Potential surface impacts**
  - reduction in primary production through sediment plume shading
  - effects on behaviour of surface/deep-diving mammals and birds through changes in water clarity
- **Potential water column impacts**
  - plankton/mesopelagic fish mortality
  - bioaccumulation of toxic metals though food chain
  - sediment plume through water column
  - potential oxygen depletion
  - effects on deep-diving marine mammals
- **Potential benthic impacts**
  - direct physical impact of mining/sampling gear
  - smothering/burying of animals by sediment
  - Sediment plume clogging of suspension feeders
  - toxic effects with metal release
  - loss of essential habitat (spawn/nursery areas)







What does MSR need to provide
for sound environmental management?

I consider Contractor baseline studies as MSR

Baseline information:

- Oceanography what are the currents for spreading impacts, larvae
- Biological composition & distribution-biodiversity
- Biological characteristics- vulnerability to impact, resilience
- Enable predict response to resource use
- **Inform a robust ERA and EIA**

Monitoring:

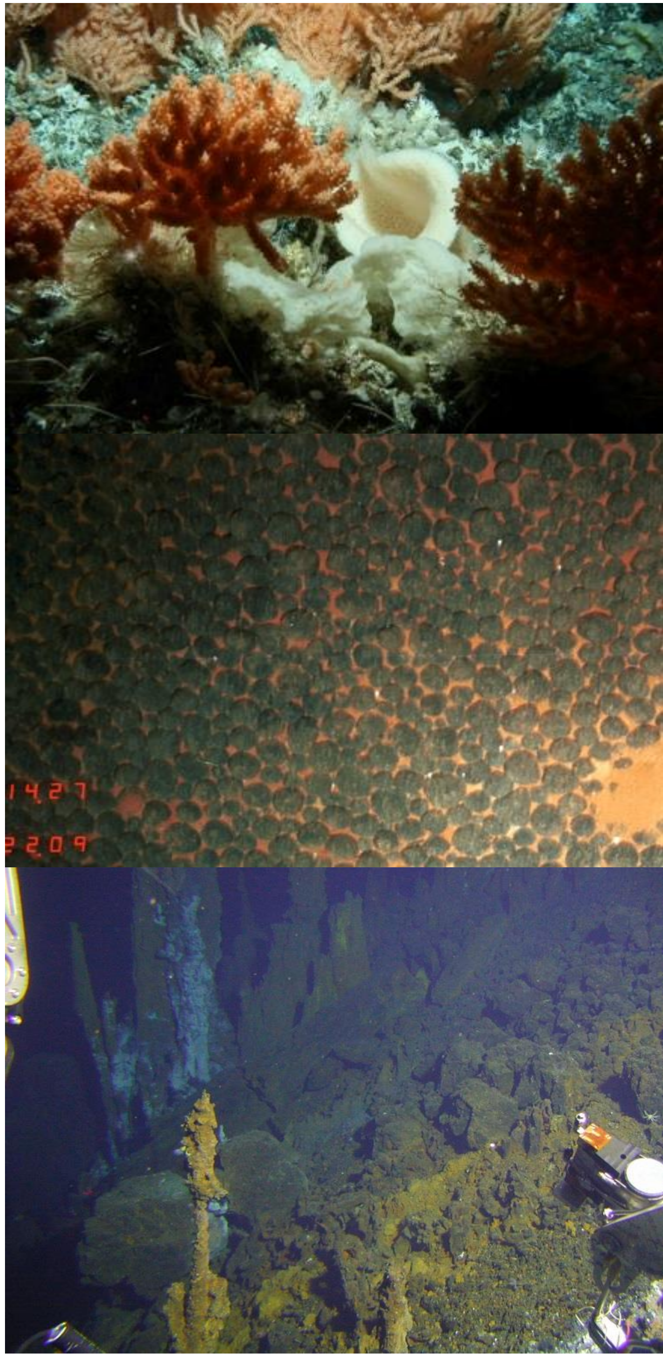
- Strategies, what to measure? (biodiversity range)
- Sampling design (spatial variability, multiple habitats)
- Repeatable surveys (Time) to separate natural from human-induced changes
- **Underpins the EMMP**

Conservation:

- Appropriate spatial units for different species
- Principles for design of conservation areas
- Methods for effective mitigation
- **A key element of the EMMP (and developing REMPs)**

Baseline data collection

- BUT, the key issue for SS and Contractors is **WHAT do you NEED to consider** out of a long list of factors
  - What are the really important drivers to describe?
  - What spatial scale is appropriate?
  - What are the key indicators of system health?
  - Can we measure them with enough precision to detect change
  - What is an acceptable level of change (thresholds)?
  - Can we describe “ecosystem” structure & function. System linkages are hard (multiple species, benthic and pelagic, life history stages). Connectivity (source/sink, changing genetic landscape)



State of environmental knowledge

	Vents	Off-Vents	CCFZ	Arctic Seeps	Black Sea
Megafauna					N/A
Macrofauna					N/A
Metazoan meiofauna					
Protozoan meiofauna					
Microbiology: Bacteria					
Microbiology: Archaea					

[MIDAS 2016]

Little or primary information only – significant gaps in knowledge

Some useful data available. Still some fundamental gaps

Good knowledge with ability to make informed predictions

Keeping it practical and realistic

- Concepts can quickly get very complicated, well beyond our data and resources to sample enough in the deep sea
- A key issue relates to developing standards, and guidelines to help determine when data (e.g., a baseline survey) are good enough?
- I don't have the magic answer, but some ideas about where we need to go
  - Keeping our eyes on the forest and not getting lost amongst all the trees

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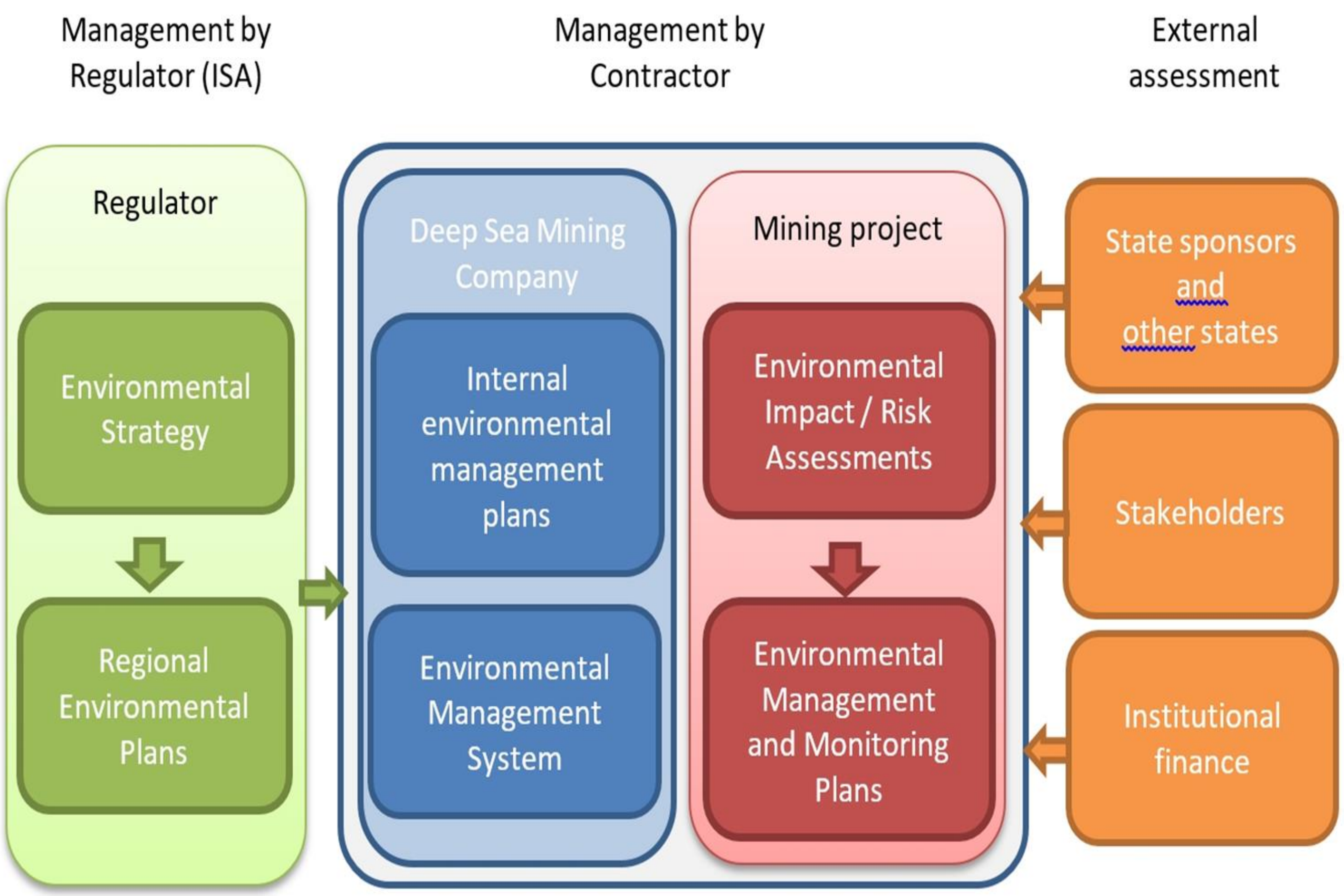
- I don’t have the magic answer, but some ideas about where we need to go
    - Keeping our eyes on the forest and not getting lost amongst all the trees
- The Exploration activities MUST have Exploitation requirements in mind
    - Baseline and hence monitoring are critical to evaluating the consequences of the operation, and adequacy of the EIA
    - Both a SS and a Contractor issue, to ensure that the quality of the science is as good as it can be (BEP concept in the Regs)
- Key to this is early identification of the risks posed by the operation
    - what is really important to know
    - what is good to know, but not critical
    - what we don’t really need to know

A complex Environmental Management seascape

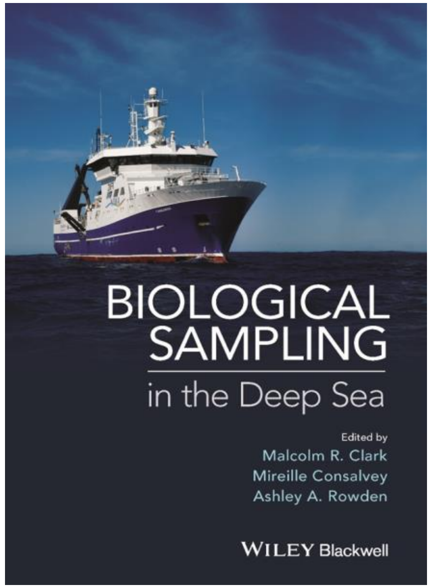
- This identification of risks and impacts starts at a higher level, with regional and multi-sectoral management setting approaches
- Strategic and Regional Environmental Assessment and/or Management Plans
- These operate at a scale beyond individual SS and contractors
- Need to consider multiple other uses and users of the space

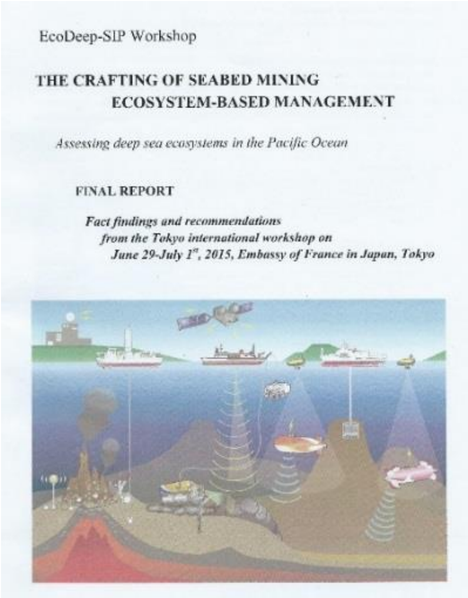


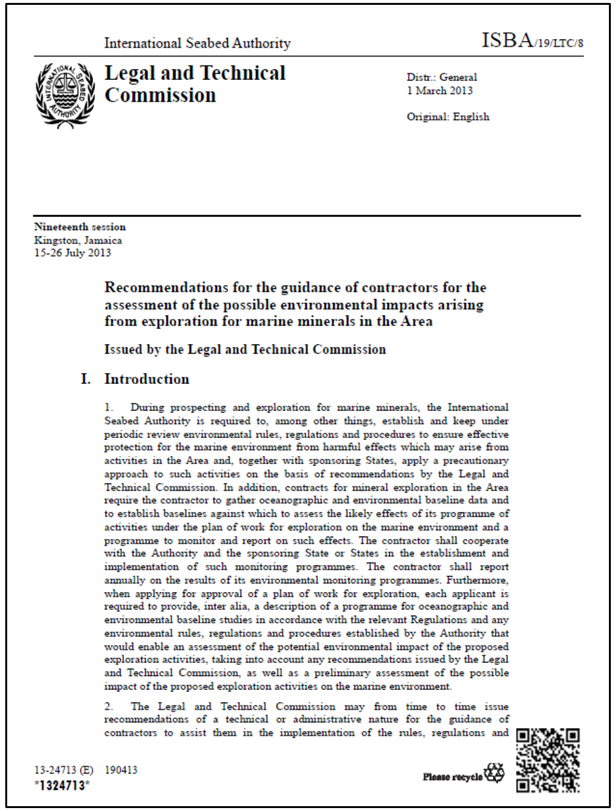
- Science also needs to work across various initiatives and policy (e.g., CBD (EBSAs), FAO (RFMO fisheries and VME regs), IMO-MARPOL Special Areas, BBNJ-??)
    - across boundaries (e.g., EEZs)-example of the NW Pacific CRC “triangle” and FSM and Marshall Is.

Baseline/monitoring data: Exploration

- To characterise the resource and environmental setting
- To collect baseline information to support determination of impacts and environmental assessments
- Developed guidance
  - **ISA LTC recommendations (ISBA/25/LTC/6)**
  - **SPC-NIWA RSRG (Swaddling et al. 2016)**
  - MIDAS (2015, WP10, 10.1)
  - Also ISA sampling, taxonomic workshops







International Seabed Authority — ISBA/19/LTC/8

Legal and Technical Commission

Distr.: General
1 March 2013

Original: English

Nineteenth session
Kingston, Jamaica
15-26 July 2013

Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area

Issued by the Legal and Technical Commission

I. Introduction

1. During prospecting and exploration for marine minerals, the International Seabed Authority is required to, among other things, establish and keep under periodic review environmental rules, regulations and procedures to ensure effective protection for the marine environment from harmful effects which may arise from activities in the Area and, together with sponsoring States, apply a precautionary approach to such activities on the basis of recommendations by the Legal and Technical Commission. In addition, contracts for mineral exploration in the Area require the contractor to gather oceanographic and environmental baseline data and to establish baselines against which to assess the likely effects of its programme of activities under the plan of work for exploration on the marine environment and a programme to monitor and report on such effects. The contractor shall cooperate with the Authority and the sponsoring State or States in the establishment and implementation of such monitoring programmes. The contractor shall report annually on the results of its environmental monitoring programmes. Furthermore, when applying for approval of a plan of work for exploration, each applicant is required to provide, inter alia, a description of a programme for oceanographic and environmental baseline studies in accordance with the relevant Regulations and any environmental rules, regulations and procedures established by the Authority that would enable an assessment of the potential environmental impact of the proposed exploration activities, taking into account any recommendations issued by the Legal and Technical Commission, as well as a preliminary assessment of the possible impact of the proposed exploration activities on the marine environment.

2. The Legal and Technical Commission may from time to time issue recommendations of a technical or administrative nature for the guidance of contractors to assist them in the implementation of the rules, regulations and

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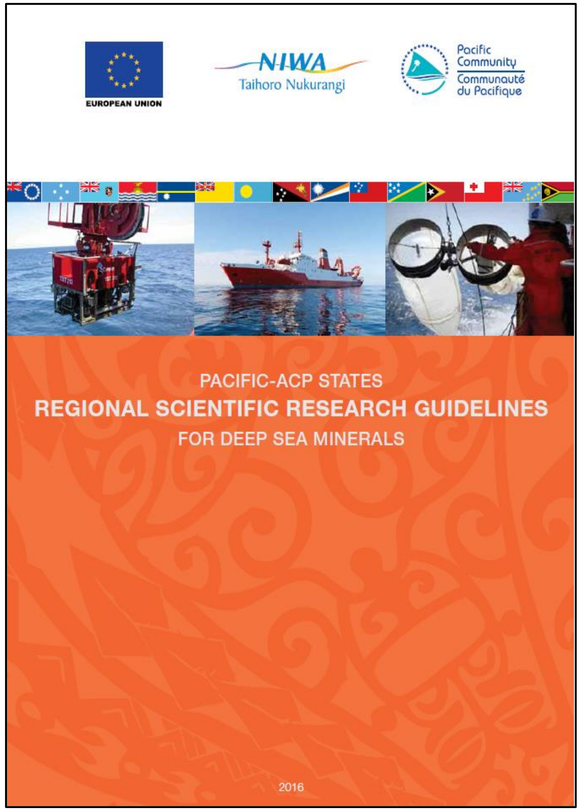
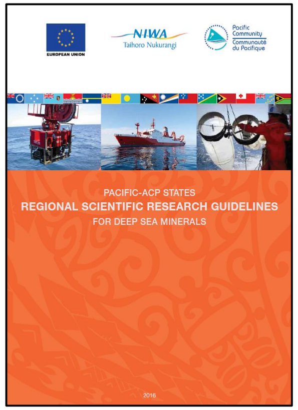


Baseline data collection details

	Aspect	Reason	Main Parameters	Sampling
Geology	Topography	Seabed characteristics, identification of habitats for assessment, survey stratification, selection of test and control areas	Bathymetry, morphometry, seafloor type	Multibeam echosounder, dredges, box-corer, drilling equipment
	Backscatter	Seabed characteristics, identification of habitats for assessment, survey stratification, selection of test and control areas	Acoustic reflectivity	Multibeam echosounder
	Sub-seafloor	Petrology, geochemistry, and mineralogy for resource characterisation	Penetration layers, rock properties, mineral and chemical composition,	Seismic, drilling, rock sampling (dredges, coring)
Sediment characteristics	Sediment properties	Sediment plume dynamics	Sediment and pore water measurements: Water content, grain size, specific gravity, porosity, depth oxic layer, carbon content, chemical composition (trace and heavy metals)	Box corer or mulitcorer
	Bioturbation rates	Natural mixing of sediments	Bioturbation depth, faunal zonation, Pb210 activity	Corer samples
	Sedimentation rates	Distribution and concentration of natural suspension, settlement rates	Particle flux, suspended particle concentrations, settlement rates	Moorings and sediment traps
Seafloor community	Megafauna	Impacts on benthic communities	Species composition, distribution, abundance. Biological characteristics (sensitivity, recoverability parameters)	Photographic surveys from ROV/towed camera; direct sampling dredge/sled/trawl
	Macrofauna	Impacts on benthic communities	Species composition, distribution, abundance. Biological characteristics (sensitivity, recoverability parameters)	Box corer or mulicorer, epibenthic sled
	Scavenger/demersal fish	Impacts on benthic communities	Species composition, distribution, abundance	Baited lander, fish trawls, traps, ROV observations



Swaddling et al. 2016

The move to Exploitation: the reality check for Exploration

Ecological Risk Assessment ⟷ **Environmental Impact Assessment** ⟷ **Environmental Management Planning**

Ecological Risk Assessment

- Risk Scoping
- Identify threats
- Determine their importance for EIA

Environmental Impact Assessment

- Focus on main risks
- Ecosystem approach
- Cumulative Impacts
- Identify mitigation options

Environmental Management Planning

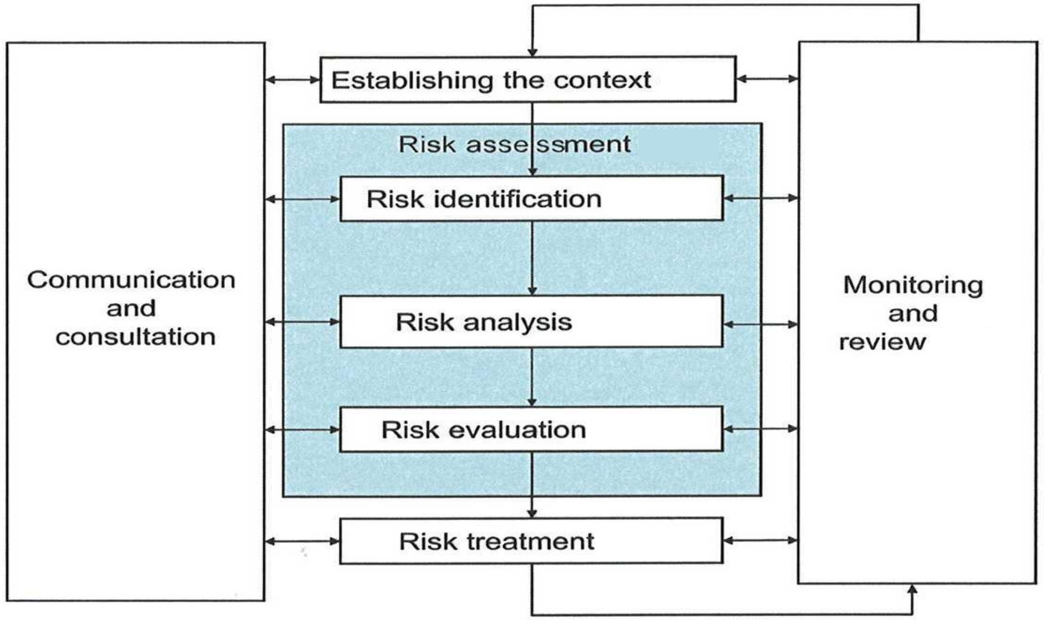
- How to handle the impacts
- Monitoring
- Mitigation
- Adaptive Management
- Appropriate temporal/spatial scale
- Precaution

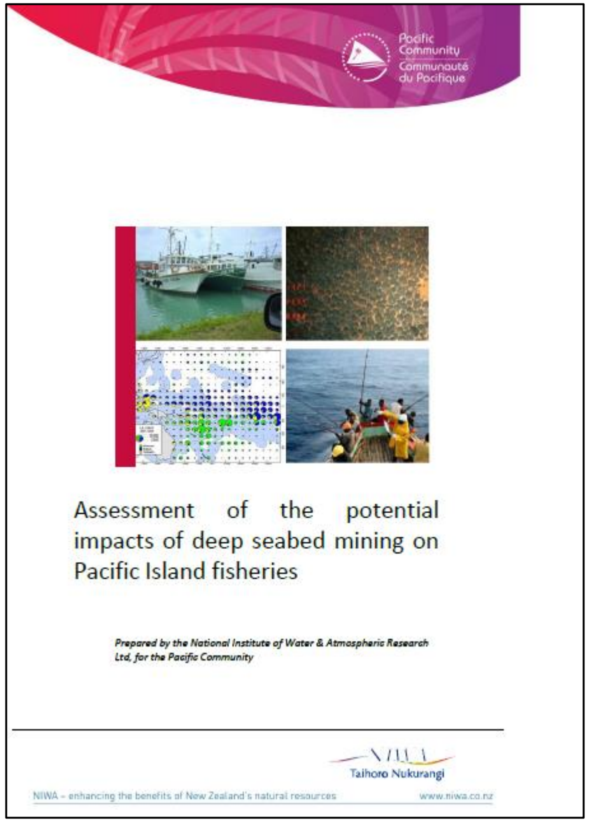
EIA Report (EIS)

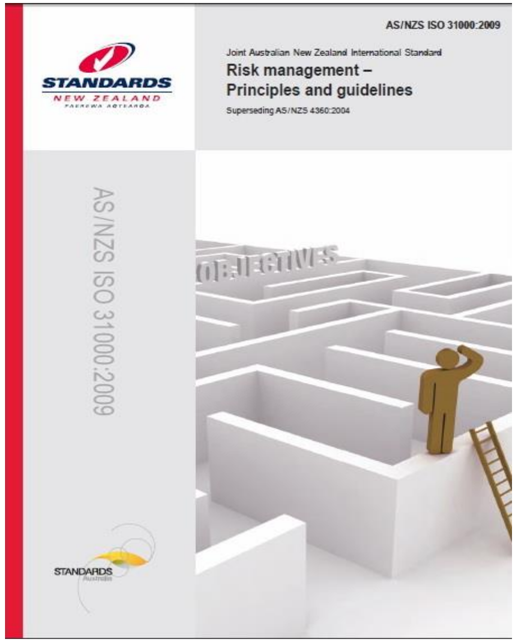
EMMP

Environmental Risk Assessment

- Determining the risk to environment from DSM
  - And of not meeting management objectives
- Well established process
- Several phases
  - risk identification
  - risk analysis







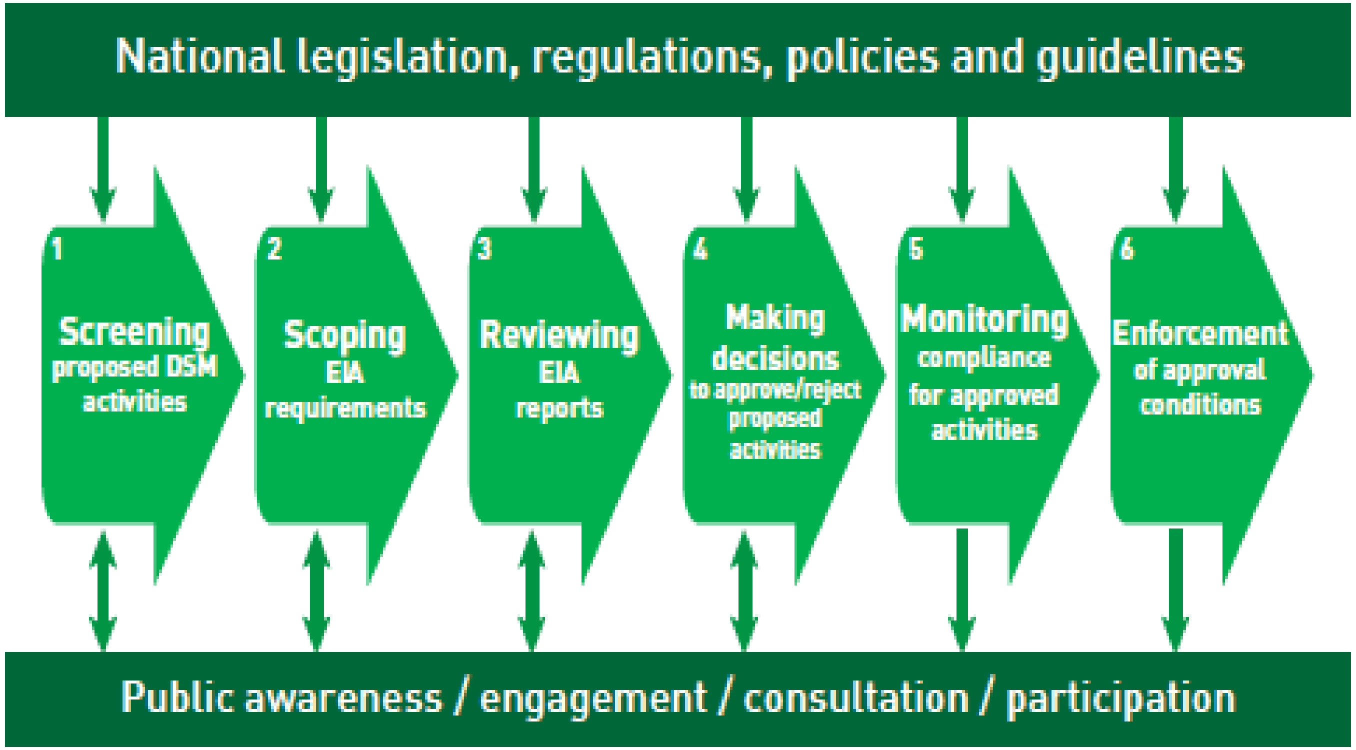
ERA: tiered approach

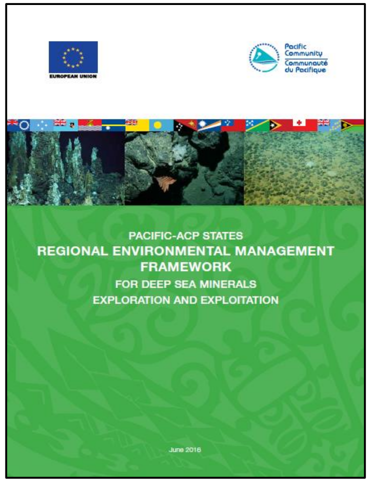
- **Level 1: QUALITATIVE**. First cut, brief assessment, literature, panel
  - Screening procedure to identify low and high risks of activity
  - If risk is high, then more detailed data and assessment will be required
  - Informs what it is important to learn during EXPLORATION
- **Level 2: SEMI-QUANTITATIVE**. More robust data and formal analysis
  - Based on more detailed analysis of specific data
  - There are a number of approaches (ISA-MIT workshop)
  - Critical to ensure the data can support the EIA (EXPLOITATION phase)
- **Level 3: QUANTITATIVE**. Uses stock assessment or ecosystem models.
  - Absolute estimation of risk
  - Unlikely to be feasible for **deep-sea** mining

- So multiple ERAs, develop over time as a key element of the EIA process

Environmental Impact Assessment-the key role of MSR

- EIA is "the process of **identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects** of development proposals prior to major decisions being taken and commitments made”
- Not just an EIS report, it is a process, from scoping through to approval conditions
- External input, engagement, feedback loops





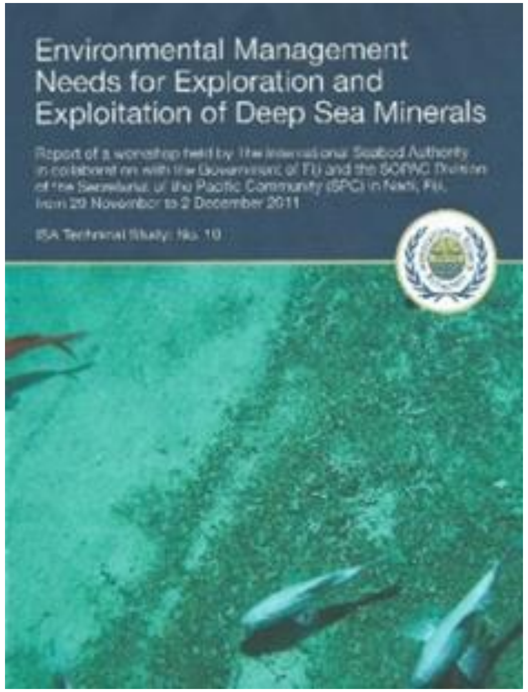
[Swaddling 2016]

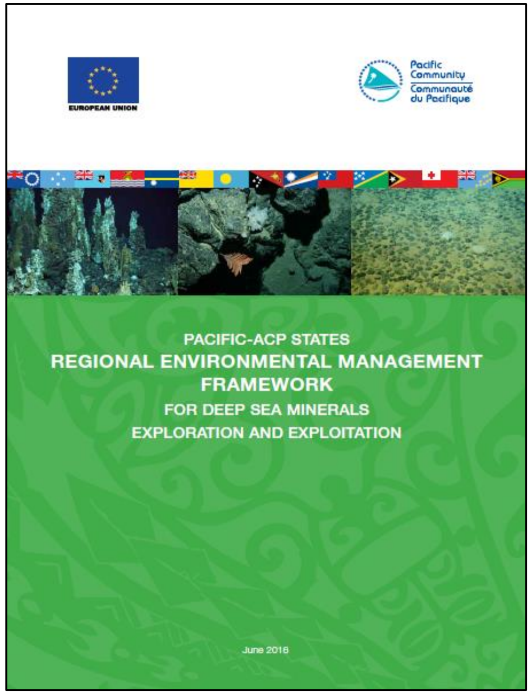
EIA/S templates

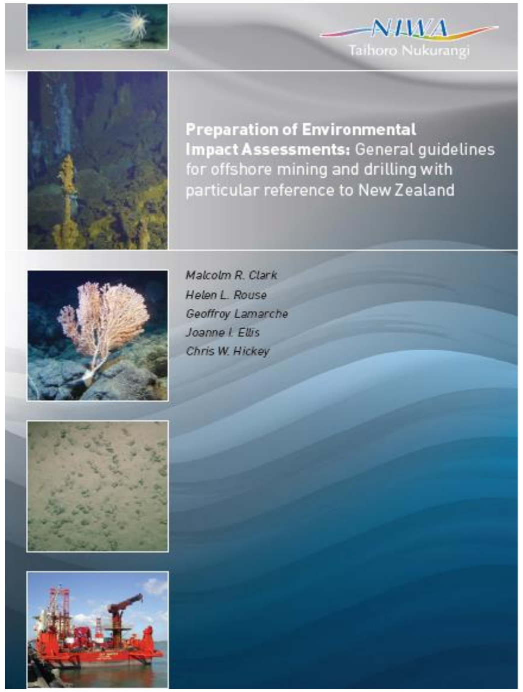
- Role to introduce consistency into EIS-the form of reporting the EIA
- Developed over time from several sources, with similar format and content
- Vary in level of guidance given

- Included as Annex IV in Draft Exploitation Regulations

- So the States and Contractors know what is required to provide, and the ISA knows what to expect for review







EIA lessons

The key outcome of the EIA is that the main impacts of the operation are identified, and options for how for deal with them are put forward

- Nautilus EIS (SMS), PNG, 2008
- Sandpiper (PN), Namibia 2012, 2016
- TransTasman Resources (Ironsands), NZ, 2014
- Chatham Rock Phosphate (PN), NZ, 2014
- JOGMEC (SMS), Japan 2015

Journal of Shipping and Ocean Engineering 5 (2015) 103-114
10.17265/2159-5879/2015.03.001

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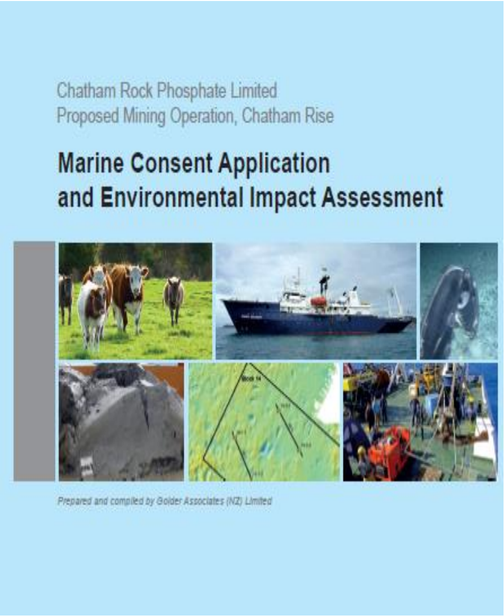
Summary of Environmental Impact Assessment for Mining Seafloor Massive Sulfides in Japan

Teruyoshi Narita[1], Junya Oshika[1], Nobuyuki Okamoto[1], Tetsuhiko Toyohara[1, 2] and Tetsuya Miwa[3]
1. Japan Oil, Gas and Metals National Corporation, Minato-ku, Tokyo 105-0001, Japan
2. (Present address) Marine Biological Research Institute of Japan Co., Ltd, 4-3-16 Yutaka-cho, Shinagawa-ku, Tokyo 142-0042, Japan
3. Japan Agency for Marine-Earth Science and Technology, Kanagawa Prefecture 237-006, Japan



EIA problems identified (Solwara1, CRP, TTR)

- Key environmental issues:
  - <u>Inadequate baseline data</u>
  - Insufficient detail of the mining operation (define impacts)
  - Insufficient <u>synthesis</u> and ecosystem approach
  - Insufficient assessment and consideration of <u>uncertainty</u> in assessments (how uncertain, <u>what to do about it</u>)
  - Inadequate assessment of <u>indirect impacts</u>
  - Insufficient treatment of combined/<u>cumulative impacts</u>
  - Insufficient Risk Assessment
  - Treatment of residual impacts to then focus the EMMP

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Environmental Impact Assessments for deep-sea mining: Can we improve their future effectiveness?

Malcolm R. Clark[a,*], Jennifer M. Durden[b,c,d], Sabine Christiansen[e]

[a] National Institute of Water & Atmospheric Research, Private Bag 14-901, Kilbirnie, Wellington 6241, New Zealand
[b] Department of Oceanography, University of Hawai'i at Mānoa, Pope Road, Honolulu, HI 96822, USA
[c] National Oceanography Centre, University of Southampton Waterfront Campus, European Way, Southampton SO14 3ZH, UK
[d] Ocean and Earth Science, University of Southampton, National Oceanography Centre, European Way, Southampton SO14 3ZH, UK
[e] Institute for Advanced Sustainability Studies e.V. (IASS), Berliner Strasse 130, 14467 Potsdam, Germany

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Environmental Impact Assessment process for deep-sea mining in 'the Area'

Jennifer M. Durden[a,b,*], Laura E. Lallier[c,d], Kevin Murphy[e], Aline Jaeckel[f], Kristina Gjerde[g,h], Daniel O.B. Jones[a]

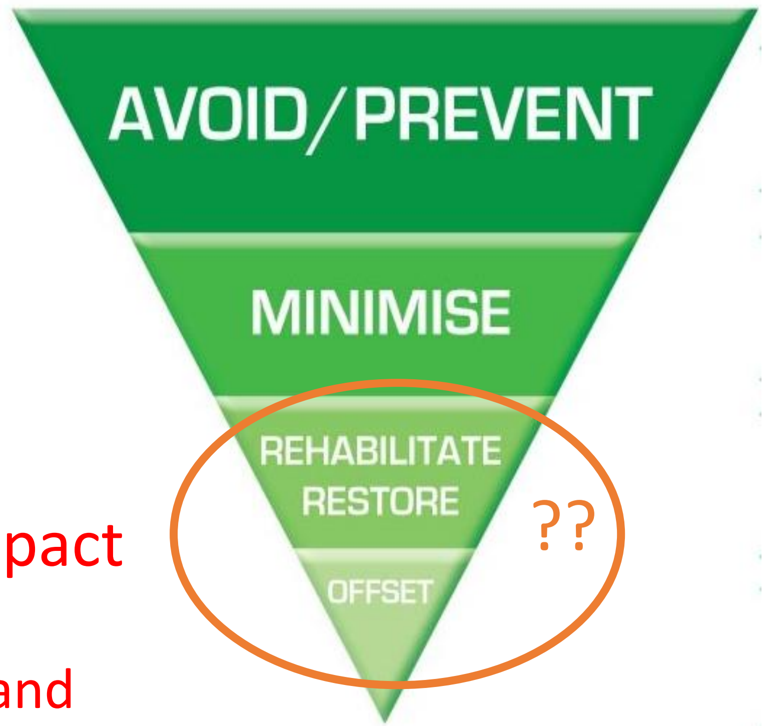
[a] National Oceanography Centre, University of Southampton Waterfront Campus, European Way, Southampton SO14 3ZH, UK
[b] Ocean and Earth Science, University of Southampton, National Oceanography Centre, University of Southampton Waterfront Campus, European Way, Southampton, UK
[c] Maritime Institute, Faculty of Law, University of Ghent, 9000 Ghent, Belgium
[d] eCOAST Marine Research, 8400 Ostend, Belgium
[e] Environmental Resources Management Limited, North Hinksey Lane, Oxford, UK
[f] Macquarie Law School and Macquarie Marine Research Centre, Macquarie University, NSW 2109, Australia
[g] Wycliffe Management Ltd., Warsaw, Poland
[h] IUCN Global Marine and Polar Programme, Cambridge, MA, USA

Environmental Management and Monitoring Plan (EMMP)

- The EIS will emphasise there is high uncertainty in some of the data and projected impacts and key is whether that is used as an excuse to do nothing, or if it is accepted and safeguards put in place to give early warning if things are going wrong-this is the critical role of the EMMP
- The EMMP defines the measures put in place to prevent and minimise impacts identified in the EIS (or to restore the environment).
- It establishes systems and procedures outlining how the mining company plans to:
  - manage the implementation of mitigation measures and monitor their effectiveness;
  - conduct monitoring of operations and assess the actual environmental impacts (severity, extent and duration);
  - Take action when unforeseen impacts or accidents occur;
  - and provide regular and timely reporting to the regulatory authority and the public.

Environmental Management and Monitoring Plan (EMMP)

- Can we avoid/prevent a <u>significant</u> impact?
  - If Yes, then no problem
- If not, what can we do to reduce it?
  - Prevent plume, "hood" over cutting heads etc
  - Change operation (mine in strips, not continuous)
- If we can't reduce or minimise enough
  - Rehabilitate, Offsets are land/coastal options
  - Environmentally sensible in deep sea? No.
- Key question for EMMP is how to manage Residual Impact
  - If you can't, then the answer is no mining
  - Spatial management (open and closed areas, like farmland and National Parks)
  - Adaptive management (structured learning, not just "try it and see what happens)



How much MSR is required?

- Huge range of potential environmental research required
- Hence need to target resources on the issues of MOST importance
- The draft Exploitation Regulations specify elements of the PROCESS but not yet the PERFORMANCE
- There are two elephants in the room for planning and conducting MSR
  - How high is the environmental bar-so how much MSR is needed?
  - What level of resources are needed to achieve this
- This is a focus for the LTC in 2019-20

Environmental Resources required

- A number of Sponsoring States and Contractors have access to national-scale environmental research agencies
- Tonga (TOML), Kiribati (Marawa-DeepGreen), Nauru (NORI-DeepGreen), Cook Is (BGR) have good resources, but not the same scale
- Collaboration amongst companies is important, and is developing rapidly
- P-SIDS can't match these resources to do the work, even in combination
- Capacity to understand and contribute to what is happening, what is planned, is feasible

Sponsoring State	Contractor/agency	Comment
Japan	JOGMEC	Plus resources of JAMSTEC
France	IFREMER	Large national research agency
Germany	BGR	Supported by MARUM, Senckenberg, JPIO (EU)
United Kingdom	UKSR	NOC, Univ. of Hawaii, JPIO, MIDAS (EU)
Belgium	DEME-Global Seabed Resources	Very large commercial company. JPIO links
India	National Institute of Oceanology	Large national research agency

Conclusions

- Each deep-sea mineral resource has its own environmental and faunal characteristics, every situation is different
- Environmental assessment needs to operate at various spatial scales (regional to local)
- Requires collaboration and cooperation between ISA, SS and Contractors
  - And benefit from sharing, not re-inventing the wheel each time
- Complex array of impacts, direct and indirect, that require extensive multidisciplinary research and assessment-there is no escape from that
- Effective EIA process is based on a strong ERA component to focus research and resources on the main impacts and main areas of uncertainty (to satisfy precaution)
  - There is possibly no need to measure everything, can pare down the research requirements
- There is a strong link between EIA and EMMP
  - MSR can provide some answers, but not all.
  - Handling uncertainty will require spatial management, coupled with adaptive management and strong monitoring systems
- Capacity building is important, especially with MSR
  - Need for regional data coordination and management
  - Technical knowledge important, but also require higher “overview” capability as well

Kam rabwa

- This presentation has used material from NIWA research projects funded by the New Zealand Ministry of Business, Innovation and Employment: in particular NIWAs Vulnerable Deep-Sea Communities (DSCA), Kermadec Minerals (COPR) and Enabling Management of Offshore Mining (EMOM) projects.
- It also draws on outputs of the SPC-EU DSM project
- My appreciation to the organisers for the invitation to participate in the workshop, and the ISA for travel funding.

NIWA
Taihoro Nukurangi

INTERNATIONAL SEABED AUTHORITY

Capacity building: some thoughts on the what

- Scientists and scientific technicians
  - To participate in the surveys, data and sample processing, to learn the technical side of environmental science and fully engage in the research
  - To develop good overview of what is being done and why. This is moving from a team member to a team leader, to help design research, not just do it.
  - To evaluate research programmes. Linked with #2, to understand if the science is good enough or not-what is needed to meet Pacific requirements.
  - To manage the data, develop database expertise etc
- Environmental reviewers
  - Doing an EIA is not a trivial task, and many contractors have their own divisions or leave it to specialist EIA companies
  - BUT, need in SS the capability to help plan the EIA, evaluate whether it is adequate or not, and whether data underpinning it are good enough (i.e. are we ready yet), and what sort of EMMP is appropriate
- Management of legislative requirements
  - Not my area, but application development, compliance, management agency stuff

Capacity building: some thoughts on the how

- Parallel strategies:
  - Utilise outside expertise (consultants, other country advisors etc)-short-term
  - Develop internal capacity-longer term development
- Need for academic involvement and training
  - USP deep-sea mining course (?), FNU Earth Sciences –expand to environmental
  - International courses (ISA sponsorship)
  - Utilise capabilities of STAR network
  - Postgraduate opportunities (multiple funding) for environmental impact management
- Hands-on practical experience
  - ISA scholarships (many seagoing trips)
  - NZ/AUS deep-sea surveys (ROBES: June), MSR voyages in region
- REGIONAL pool: not necessary for full capacity in every country
  - role of SPC/SPREP to coordinate
- Retention of expertise
  - Availability of jobs, hence funding to support employment
  - Ideally specialist DSM, but at least as major part of a job's role.