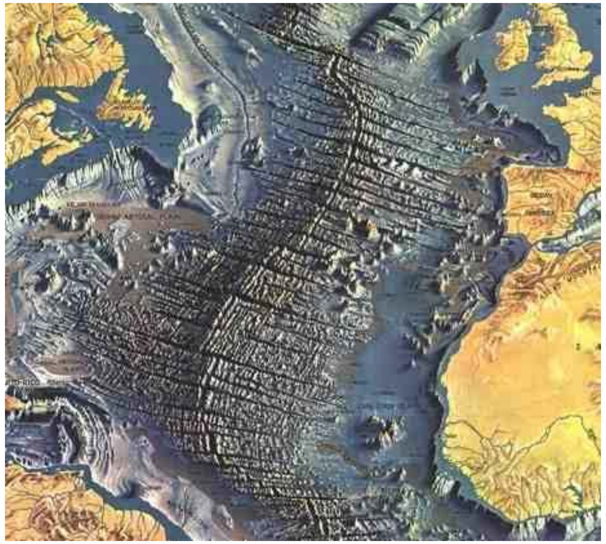
Approaches for spatial planning

Area Based Management Tools

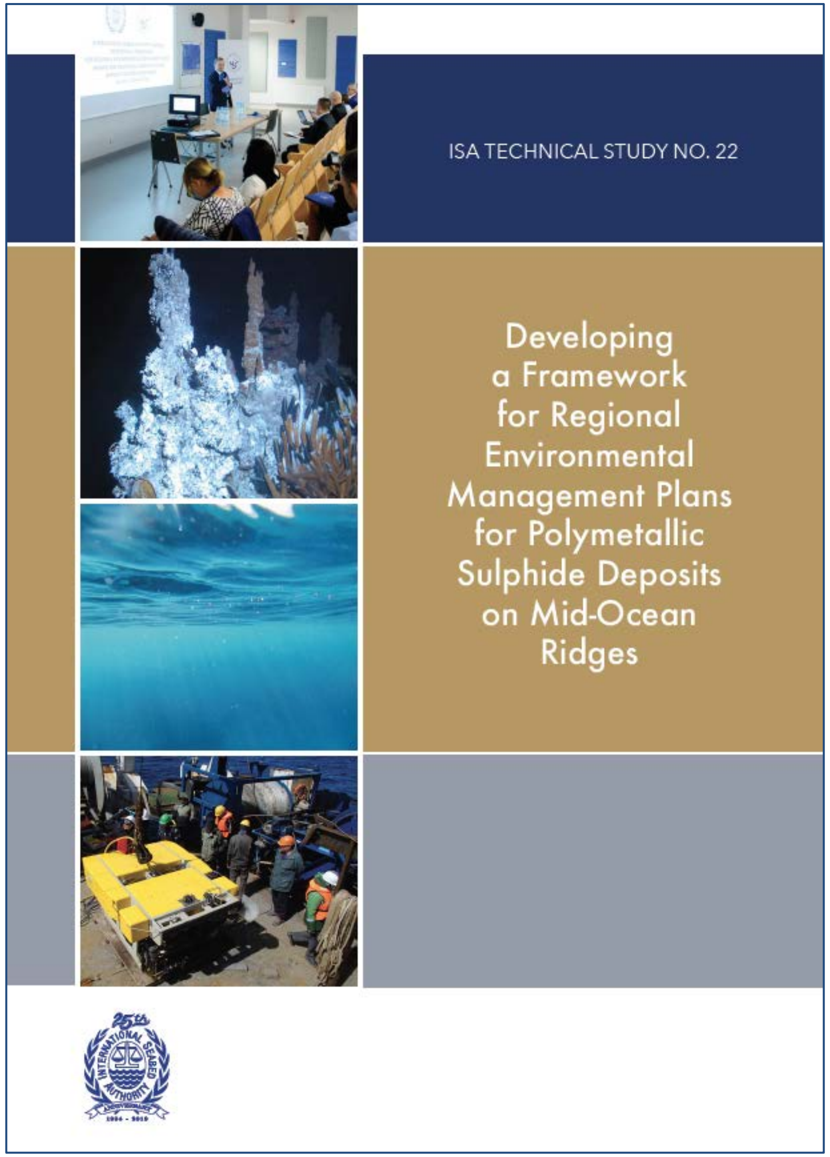


Patrick N Halpin
Marine Geospatial Ecology Lab
Duke University

WORKSHOP ON THE REGIONAL ENVIRONMENTAL MANAGEMENT PLAN FOR THE AREA OF THE NORTHERN MID-ATLANTIC RIDGE
25-29 November 2019, Évora, Portugal

ABMT *vs* Non-ABMT approaches

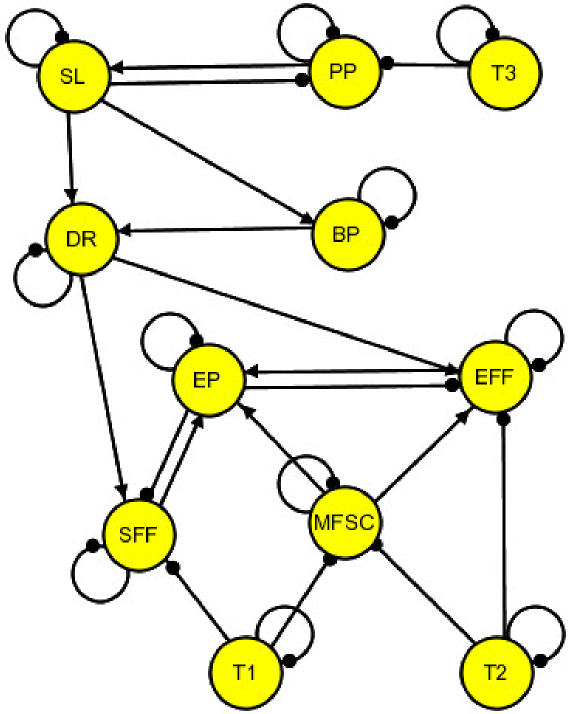
June 2018, Szczecin, Poland



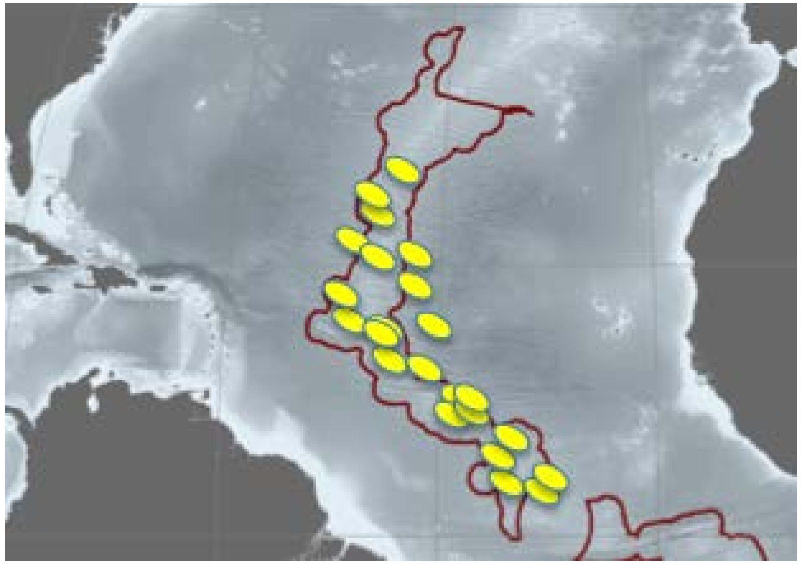
"...including the primary goal of facilitating seabed mining while maintaining biodiversity, protecting unique and representative habitats, and preserving ecosystem function through ***both*** **area-based management tools (ABMTs)** ***and*** **non-ABMTs (e.g. ...management measures)."**

Cumulative Impact Assessment | Area Based Management | Adaptive management

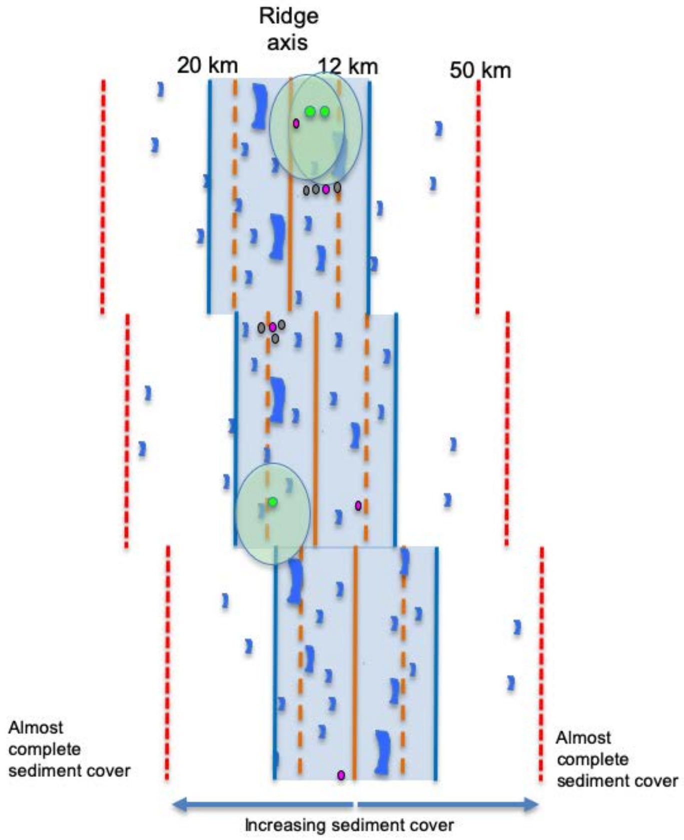
Complementary Approaches



models of pressures, impacts & risks



identified areas (APEIs, Sites, VMEs...)



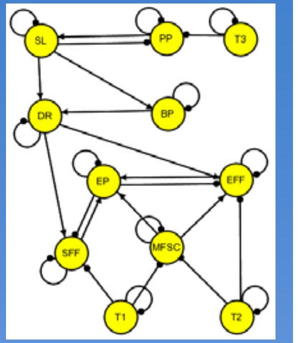
measures and procedures

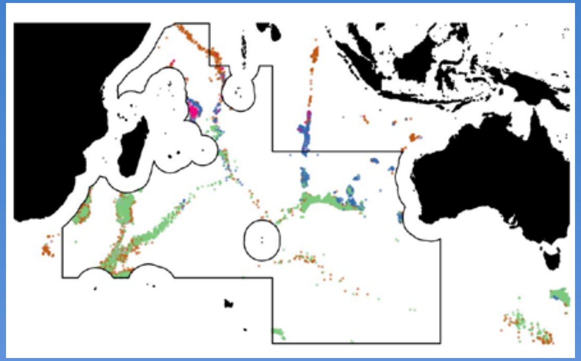
	Cumulative Impact Assessment	Area Based Management	Adaptive Management
Who (stakeholders)	multi-sectoral stakeholders	sectoral, scientific & conservation stakeholders	sectoral stakeholders, contractors
What (products)	models linking pressures to risks for biodiversity	management area maps (APEIs, VMEs...)	adaptive measures & guidelines
When (timing)	*a priori and/*or ongoing	*a priori* mapping with opportunistic or periodic updates	applied during exploration / mining operations
Where (scope & scale)	bioregional or management problem defined	ecoregional / ocean basin scope	exploration / mining areas
How (process)	risk/loss models	proactive, criteria based, data dependent	adaptive, measures based, encounter triggered
Why (benefits)	links drivers, pressures and impacts with values	provides area specific protection and buffers for representative ecosystem features	facilitates mining operations within measures and procedures

Scale

Bioregional

Cumulative Impact Assessment



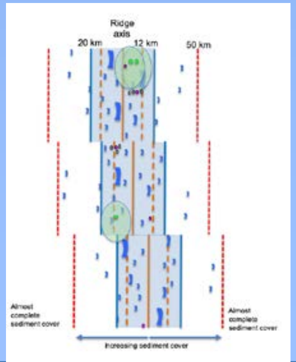


Management region (REMP)

Area Based Management

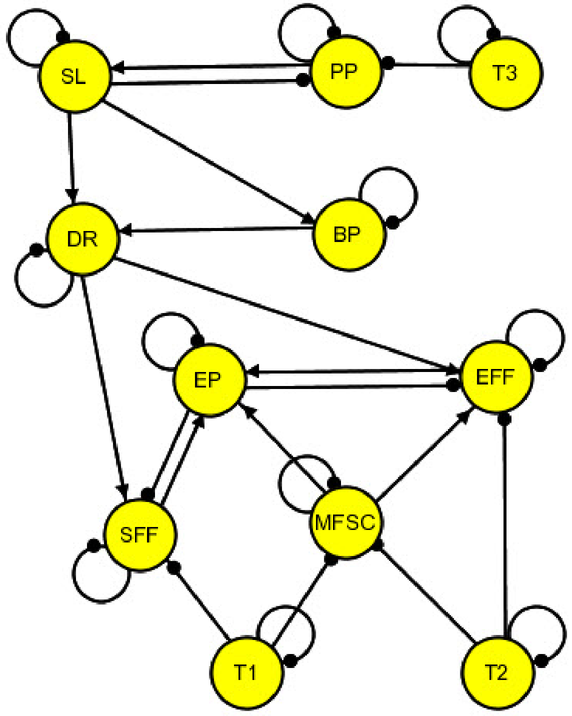
Active exploration or extraction areas

Adaptive management



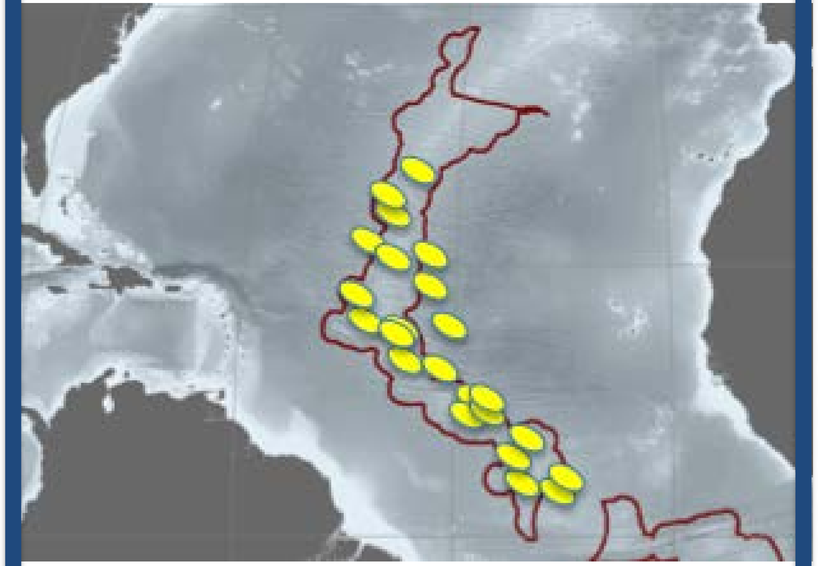
nested & complementary approaches

Cumulative Impact Assessment



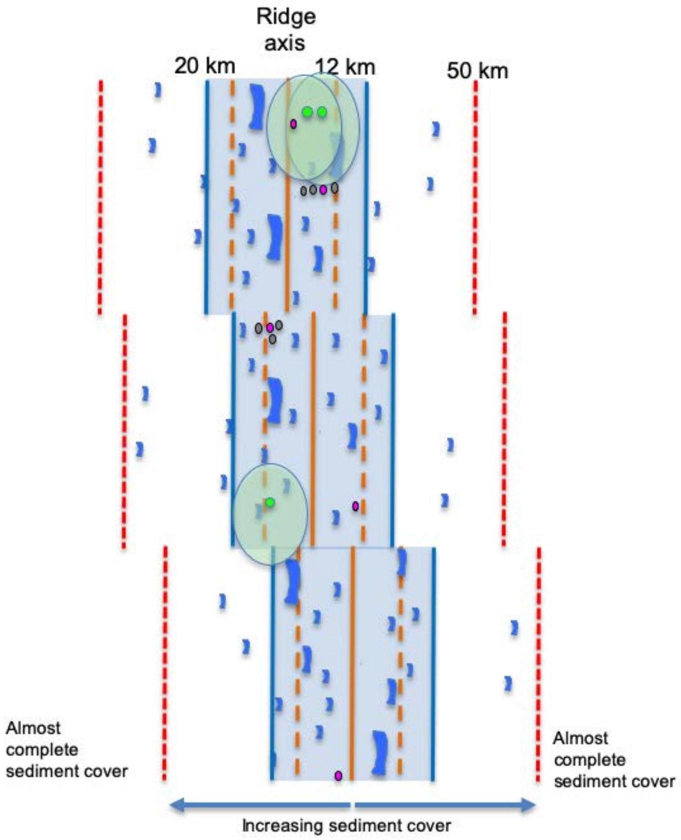
models of pressures, impacts & risks

Area Based Management



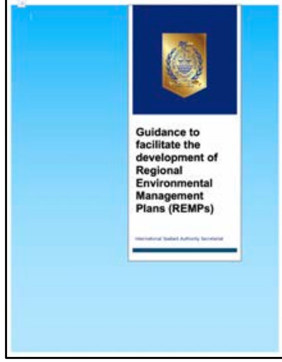
identified areas (APEIs, Sites, VMEs...)

Adaptive management



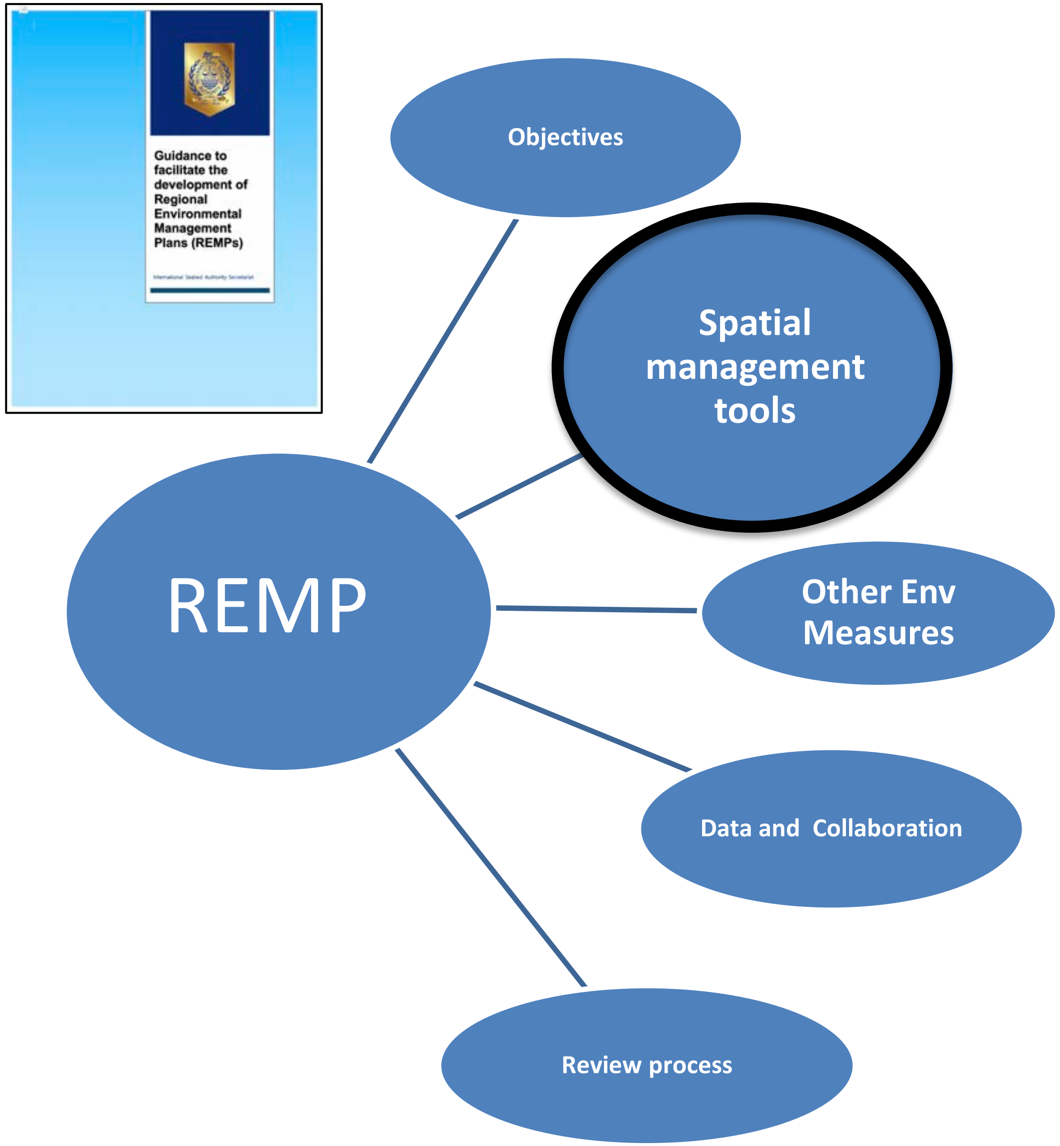
measures and procedures

First workshop will focus on scientific synthesis and description, in particular with objectives to:



- ✓ review and analyze ecosystem data
- ✓ synthesize environmental data, faunal distribution, faunal dispersal capabilities and distances, genetic connectivity, patterns of biodiversity, community structure, ecosystem function, and ecological proxy variables
- ✓ review current exploration activity within contract areas and distribution of resources
- ❑ **define the planning area**, drawing on information on mineral provinces and biogeography
- ❑ **describe potential areas** that could be protected from exploitation in order to achieve effective protection of the marine environment, through the designation of **areas of particular environmental interests (APEIs)** and/or **potential sites in need for protection** to maintain ecological balance of the marine environment from harmful effects of mining activities, as a means to ensure effective protection for the marine environment under Article 145 of the Convention, which is further informed by Article 194 (5).

Review of scientific tools and approaches for spatial planning



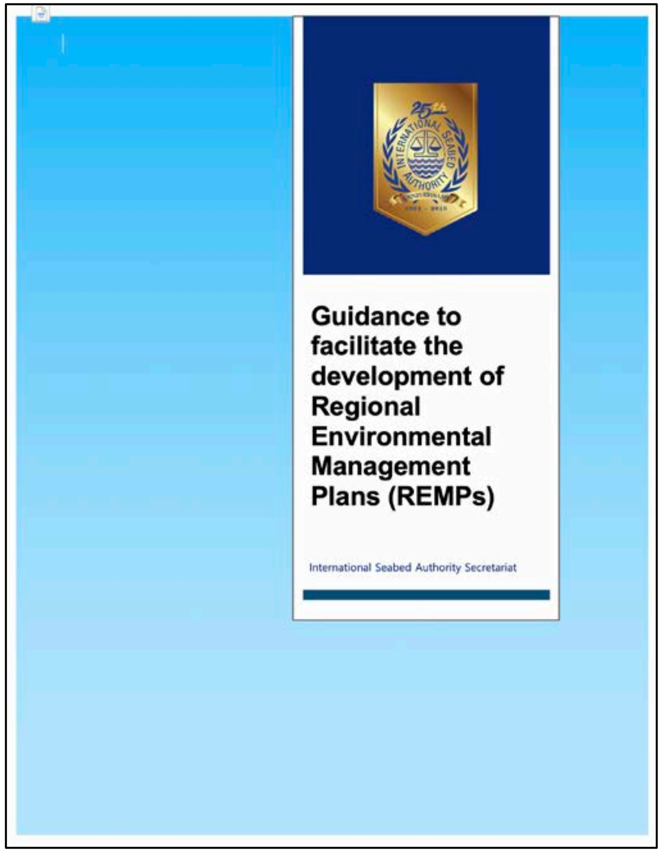
Spatial management tools will play a significant role in the development and implementation of regional environmental management plans (REMPs)

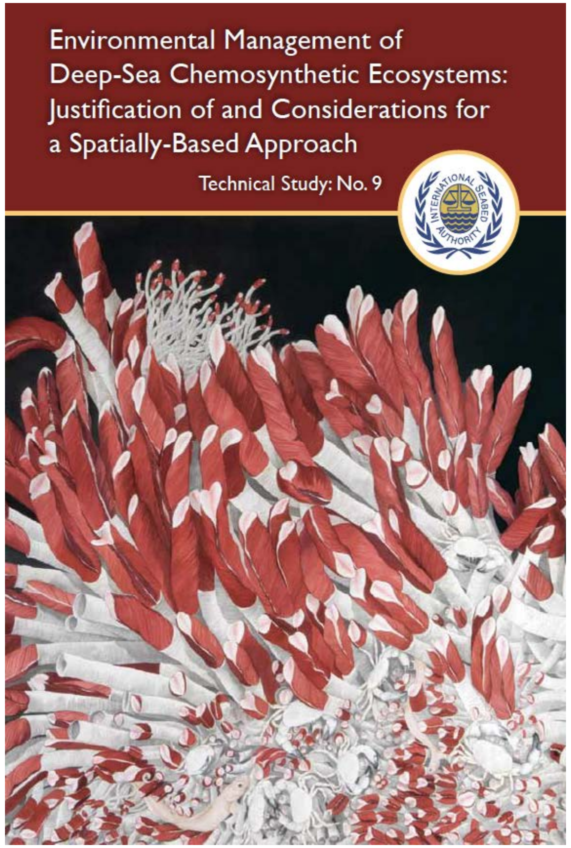
It is important and timely to discuss the types of ***available tools***, ***approaches*** and ***considerations*** required to develop robust and effective REMPs

Approaches

- Criteria based approaches
  - Site criteria
  - Network criteria
  - ABMT tools: APEIs, Sites in need of protection, Areas of elevated precaution...
- REMP ABMT implementation:
  - Expert knowledge elicitation / mapping
  - Implementing criteria
  - Evaluating ABMT configurations

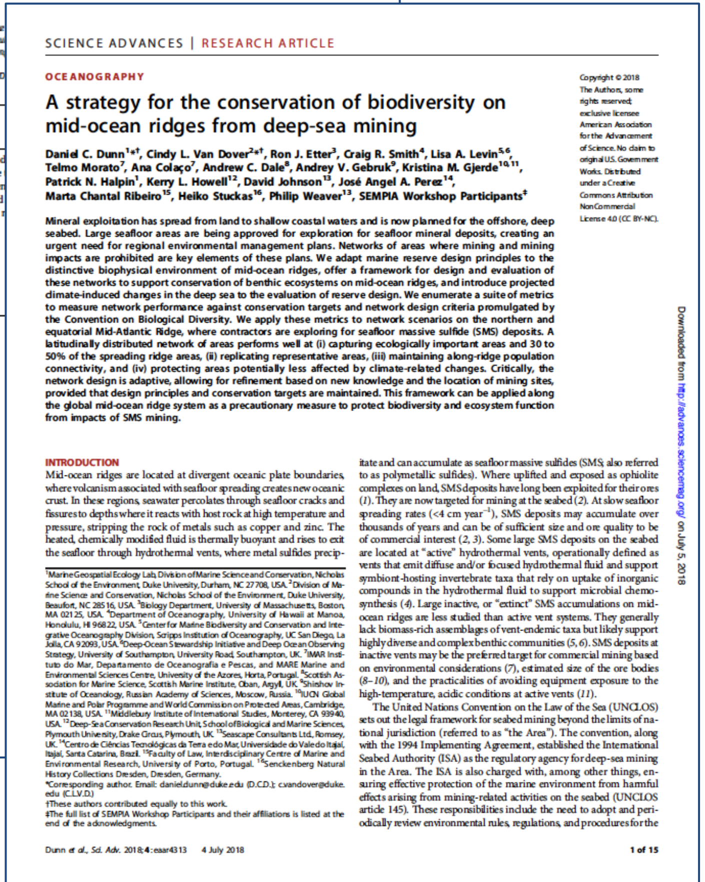
Criteria references:





Dinard

SEMPIA



Criteria based approaches

- The selection of areas for protection in spatial planning are often based on criteria that must be interpreted through ***<u>quantitative regional analysis</u>*** and / or ***<u>qualitative scientific expert judgment</u>*** or a combination of these approaches.
- These criteria may be based on attributes or properties of ***<u>individual species</u>***, ***<u>ecological communities</u>***, ***<u>habitats</u>*** or broader ***<u>ecosystems</u>***.
- These criteria may focus on the ***<u>inherent attributes</u>*** of the species or habitat or may focus on the ***<u>vulnerability</u>*** of the species or habitat to disruption or damage.

Criteria based approaches

There is significant agreement and overlap of the general criteria used in marine spatial analysis

Organization	CBD	FAO	IMO	UNESCO	RAMSAR	**Birdlife**	**IUCN**
Site criteria	**EBSA**	**VME**	**PSSA**	**WHS**	**RAMSAR**	**IBA**	**KBA**[a]
Uniqueness or rarity	✓	✓	✓	✓	✓	✓	✓
Special importance for life history stages of species	✓	✓	✓	✓	✓	✓	✓
Importance to threatened or endangered species	✓	✓	✓	✓	✓	✓	✓
Vulnerability, fragility, sensitivity or slow recovery	✓	✓	✓	X	?	X	?
Productivity	✓	X	✓	✓	X	X	?
Biodiversity	✓	X	✓	✓	✓	X	?
Naturalness	✓	X	✓	✓	✓	X	?
Structure	X	✓	✓	X	X	X	?
Historical geomorphological importance	X	X	X	✓	X	X	X

[a] The KBA criteria are currently under review and is likely to be expanded to be more inclusive.

These criteria are targeted to identify ***individual sites***

Dunn et al. 2014

Criteria based approaches

Site criteria
Uniqueness or rarity
Special importance for life history stages of species
Importance to threatened or endangered species
Vulnerability, fragility, sensitivity or slow recovery
Productivity
Biodiversity
Naturalness
Structure
Historical geomorphological importance

While these criteria guide the identification of **individual sites** they generally require **regional analyses** to assess the importance of a site in the regional context

Site value / Regional value

(numerator / denominator)

Example: for a **site** to be selected for **high biodiversity** you would need to have reference information on the expected range of **regional diversity**.

Two levels of criteria: site criteria and network criteria

Site criteria

- Uniqueness or rarity
- Special importance for life history
- Importance for threatened, endangered or declining species or habitats
- Vulnerability, fragility or slow recovery
- Biological productivity
- Biological diversity
- Naturalness

Annex I of CBD Decision IX/20.

Network criteria

- representativity
- connectivity
- replication
- adequacy

These criteria often require gap analysis and network analysis...

Annex II of CBD Decision IX/20.

Two levels of criteria: site criteria and network criteria

Site criteria

Network criteria

Box 1. Network criteria and conservation objectives for APEIs on a mid-ocean ridge based on CBD Marine Protected Area network criteria. Viability under climate change is newly integrated into the adequacy/viability criterion.

(1) Important areas

(a) Placement of APEIs within the network should capture areas considered to be ecologically and/or evolutionarily important based on best available science. APEIs should conserve 100% of identified important areas.

(2) Representativity

(a) APEI should conserve 30 to 50% of each habitat type (for example, the spreading ridge, seamounts, and transform faults) within each management unit.

(b) APEIs should be representative of the biophysical seascape (for example, depth, slope, and POC flux to the seafloor) within each management unit.

(3) Connectivity

(a) The APEI network should minimize the average and maximum distances between core areas to the greatest extent possible to conserve all dispersal scales and to ensure exchange across the entire network.

(4) Replication

(a) APEIs should be replicated within biogeographic provinces (where the size of the management unit permits) to capture along-axis variation in faunal composition and protect against localized catastrophes.

(5) Adequacy/viability

(a) The APEI network should protect 30 to 50% of the total management unit.

(b) Each APEI unit within the network should include a core area of sufficient length and width to maintain viable populations and ecosystem function.

(c) Each APEI unit within the network should include an appropriately sized buffer zone to protect core areas from indirect mining effects.

(d) Viability under climate change

(i) Projected biophysical conditions (temperature, pH, dissolved O_2 concentrations, and POC flux to the seafloor) in APEIs should include the range of current conditions across the study area.

(ii) APEIs should include at least 30% of the area projected to be least affected by reasonable climate change scenarios (based on predicted changes in temperature, pH, dissolved O_2 concentrations, and POC flux to the seafloor).

Dunn et al. 2018

Dinard Guidelines:

Example of a process to address a specific feature

Spatial Design of Chemosynthetic Ecological Reserves (CERs)

- **Identify chemosynthetic sites** that meet the Convention on Biodiversity criteria for Ecologically and Biologically Significant Areas (EBSAs) or are otherwise of particular scientific, historical, or cultural importance for priority consideration for protection.
- Define the **regional framework** for protection of biodiversity. Natural management units (biogeographic provinces and bioregions within these) form the ecological framework within which CERs should be established for the protection of chemosynthetic ecosystems.
- Establish the **expected distribution patterns** of chemosynthetic habitats to provide a spatial framework for capturing representativity.
- Establish CERs and **design replicated networks of CERs** within bioregions, using guidelines for size and spacing that ensure connectivity and that take into account the pattern of distribution of chemosynthetic habitats, which may vary from semi-continuous to widely dispersed.
- **Define human uses and the levels of protection** for each CER to achieve the conservation goal.

C.L. Van Dover et al. / Marine Policy 36 (2012) 378–381

Approaches

- Criteria based approaches
  - Site criteria
  - Network criteria
- Scales of ABMT tools (APEIs, Sensitive Sites...)
- REMP ABMT implementation:
  - Expert knowledge elicitation / mapping
  - Implementing criteria
  - Evaluating ABMT configurations

Two scales of analysis: coarse filter & fine filter

Coarse filter approach: targeting the representation of broad ecosystem features and gradients

Fine filter approach: targeting unique sites that may be of particularly high values or at particularly high risk

The expectation is that the majority of protection value can be captured by the designation of large, coarse filter areas and then supplemented by specific fine filter targets to capture regionally unique and / or vulnerable sites that may otherwise be missed in the process.

Note: These terms or similar terms have been used in the spatial planning literature since the early 1980s (TNC 1982)

Areas of Particular Environmental Interest (APEI)

APEIs are generally described as: "**Large areas** with **self-sustaining populations** and a **broad range of habitat variability**. Those should not be affected directly by physical activity or indirectly by mining effects such as plumes, although the degree of impacts raised by potential deep-sea mining is still unknown." (ISBA/17/LTC/7)

APEIs are an archetypical example of a "course filter" approach.

Areas of Particular Environmental Interest (APEI)

APEI Criteria	Assessment Approach
large areas	spatial analysis of ecosystem extent vs. relative areas
self-sustaining populations	metapopulation & dispersal distance connectivity analysis
broad range of habitat variability	Habitat models & representativity analysis
no direct mining effects	disturbance & recovery models
no indirect mining effects	physical models (plumes)
unknown impacts	precautionary approach

The need to investigate a fine scale protection tool for the ISA deep sea mining context

Experience and lessons learned from CCZ-EMP as well as the long-term experience from CBD and FAO may enable ISA with the spatial planning tools to scientifically **describe and identify sites, at a finer scale, in need for protection** to preserve ecological balance of the marine environment, as stipulated in article 145 of the Convention

- ✓ **<u>Areas</u> of Particular Environmental Interest** (APEIs)
- ✓ **<u>Sites</u> in need for protection** to maintain ecological balance of the marine environment

Site level example: FAO Vulnerable Marine Ecosystems (VME)

FAO VMEs have been used, within the context of managing deep sea fisheries, as identifier for specific habitats and ecosystems that are particularly valuable due to their uniqueness or rarity, their structure forming characteristics and/or also for potential fragility or slow recovery from disturbance, being defined as areas that meet one or more of the following criteria:

- ✓ Uniqueness or rarity
- ✓ Functional significance of the habitat
- ✓ Fragility
- ✓ Life-history traits of component species that make recovery difficult
- ✓ Structural complexity

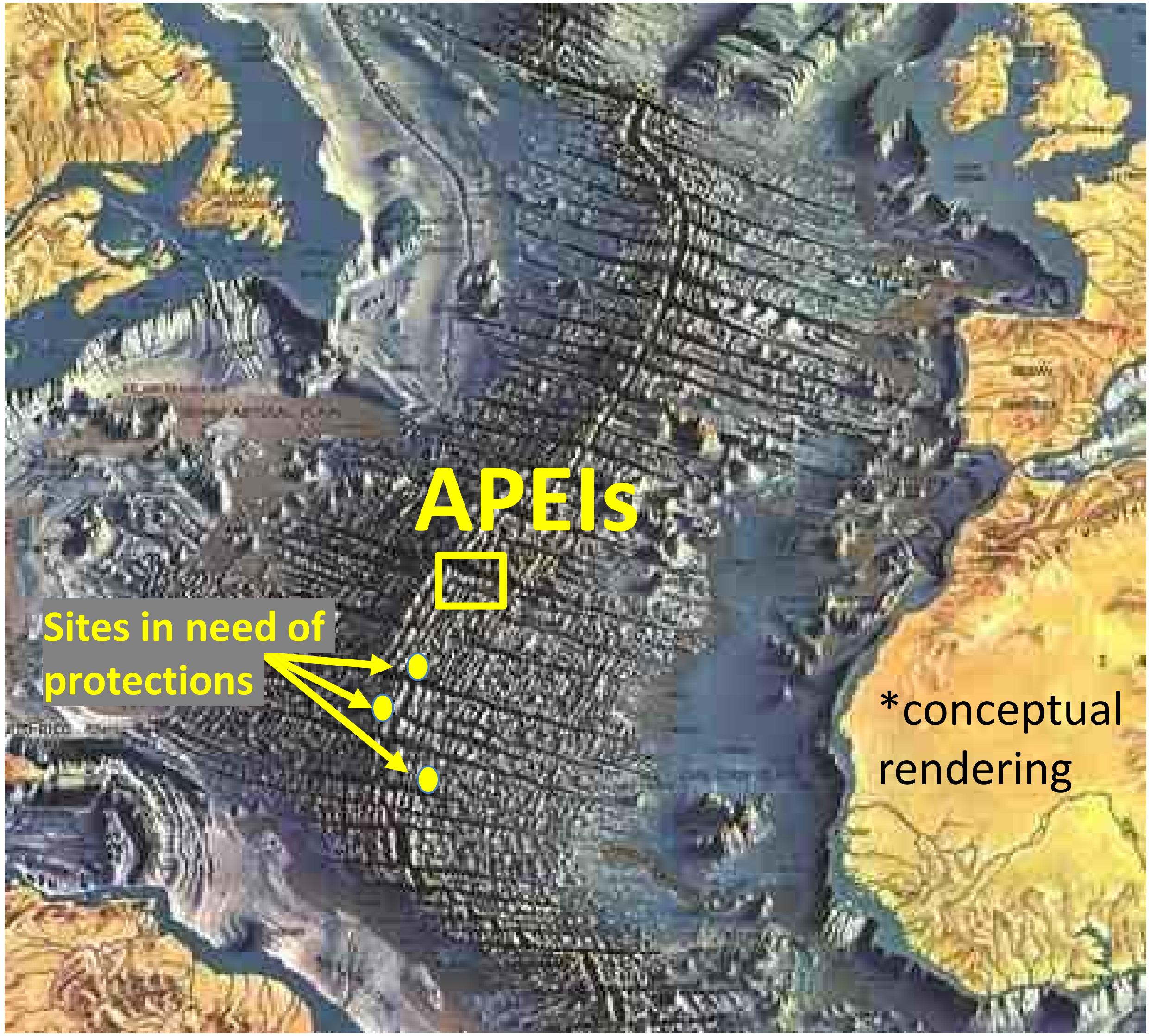
http://www.fao.org/in-action/vulnerable-marine-ecosystems/en/

Combined coarse filter **area** and fine filter **site** approaches

APEI areas: provide broad area protection of habitats, gradients and connectivity

Sites in need of protection: provide protection for unique and vulnerable sites

Potentially supplemented with
Environmental Management Measures:

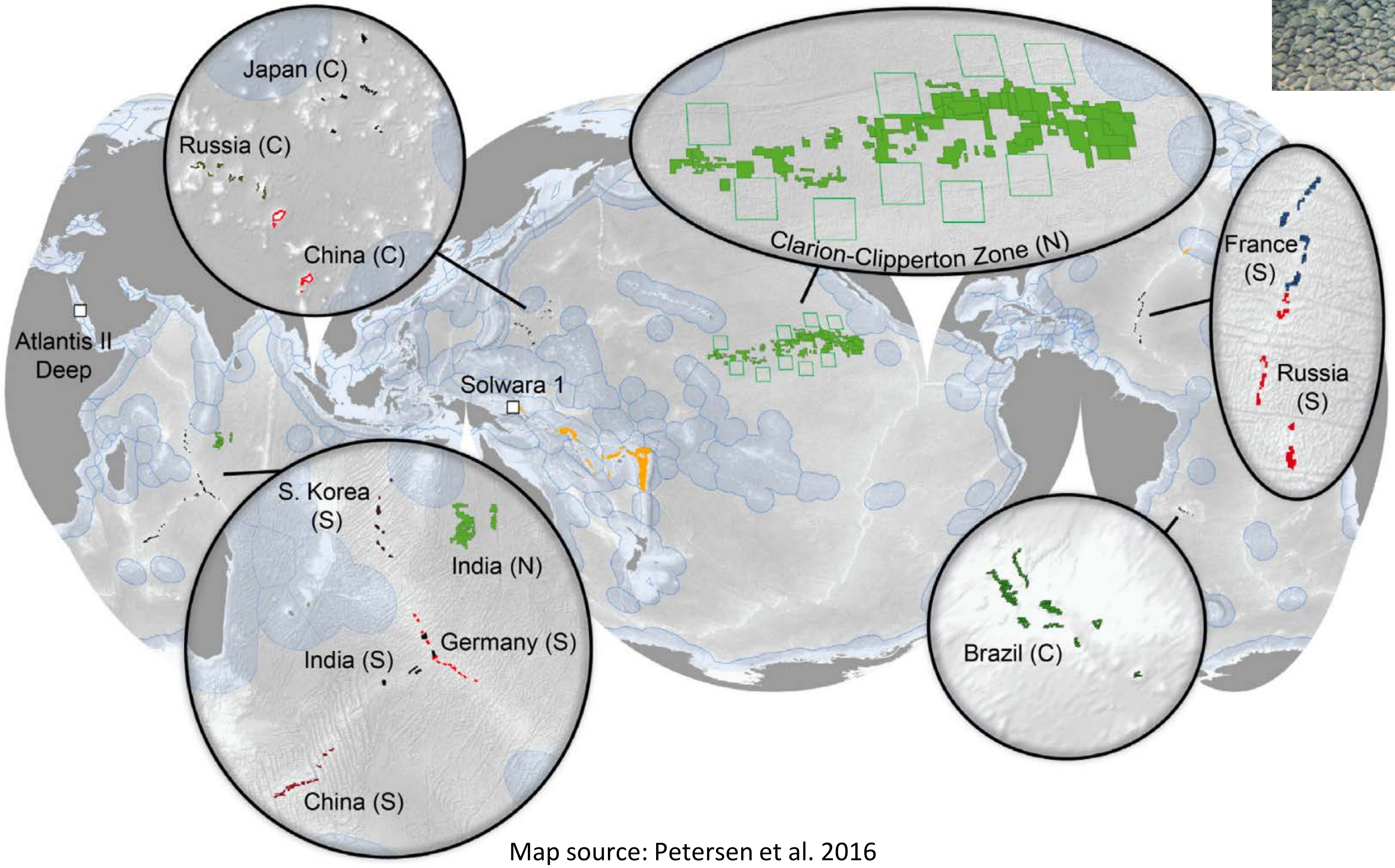


https://sites.google.com/site/waldorfwatch/_/rsrc/1347828608553/atlantis-and-aryans/atlantic%20floor.jpg

The Area Based Management Tools (**ABMT**s) considered for REMPs will vary between regions and mineral types and may require different approaches and thresholds to ensure effective management.

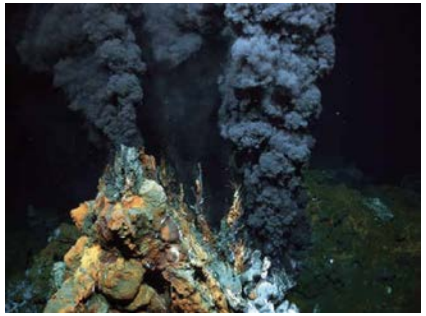
Polymetalic crusts
800-3000 m
seamounts,
guyots,
ridges, plateaus

Polymetalic nodules
5000-6000 m
abyssal plain



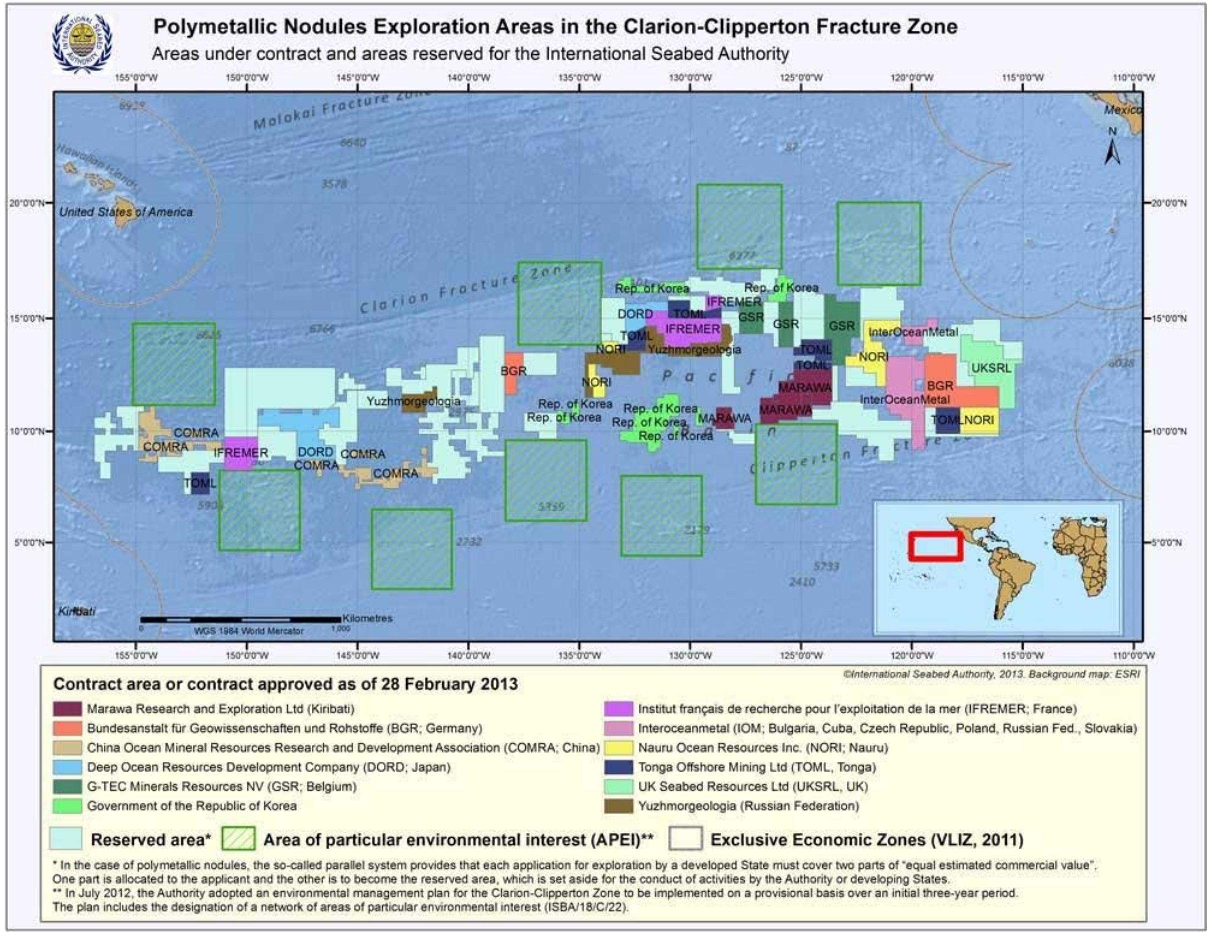
Map source: Petersen et al. 2016

Polymetalic sulphides
1500-3500 m
mid-ocean ridges
back-arc spreading centers
island arcs



The Clarion-Clipperton CCZ-EMP example

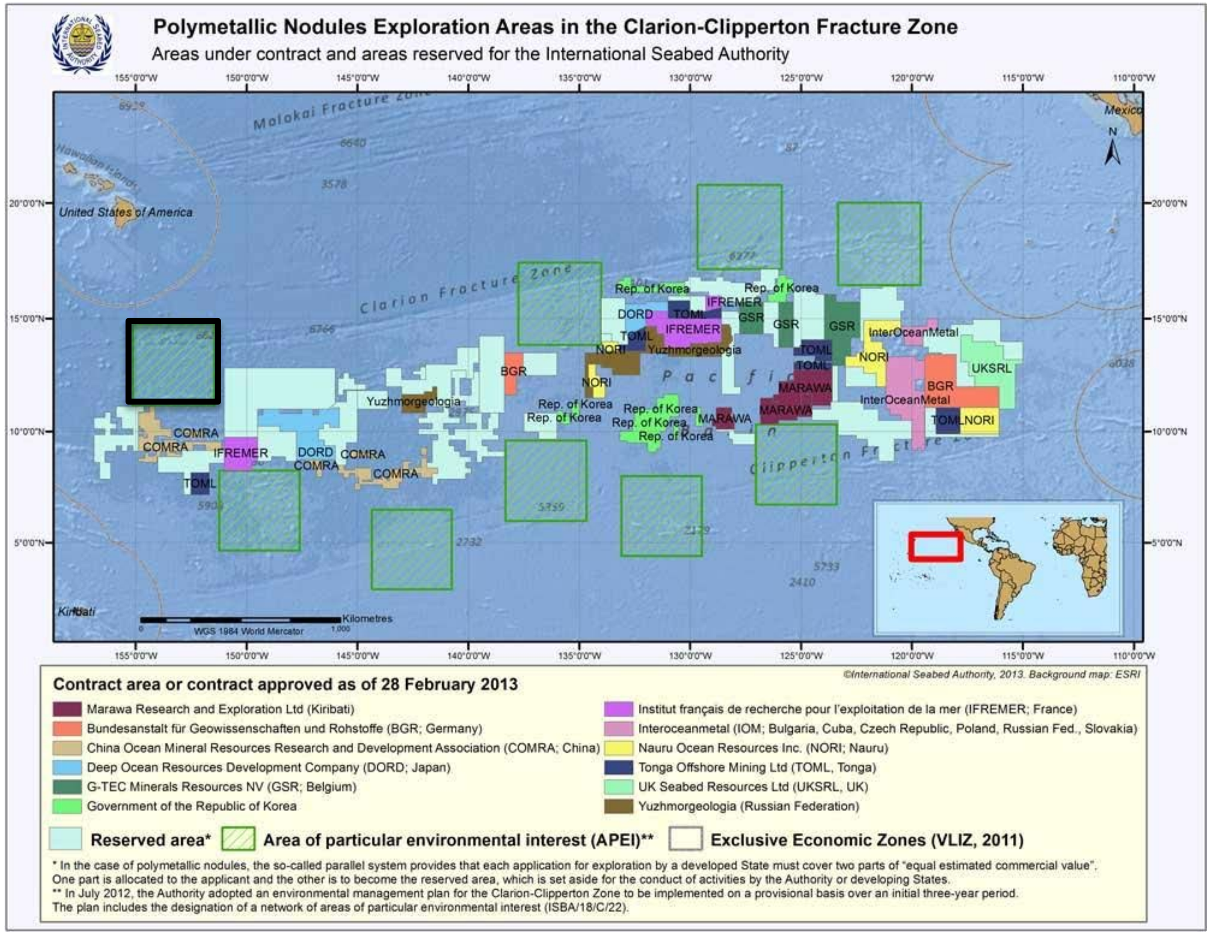
- ✓ should take into account ***biophysical gradients*** which affect the biogeography of marine biodiversity in the planning region;
- ✓ should protect a ***full range of habitat types*** found within each subregion;
- ✓ should be ***large enough*** to maintain minimum viable population sizes for species potentially restricted to a subregion;
- ✓ should be surrounded by a ***buffer zone*** to ensure that biota and habitats in the protected area are not affected by anthropogenic threats occurring outside the APEIs; and
- ✓ The boundaries should be ***straight lines*** to facilitate rapid recognition and compliance.



The Clarion-Clipperton CCZ-EMP example

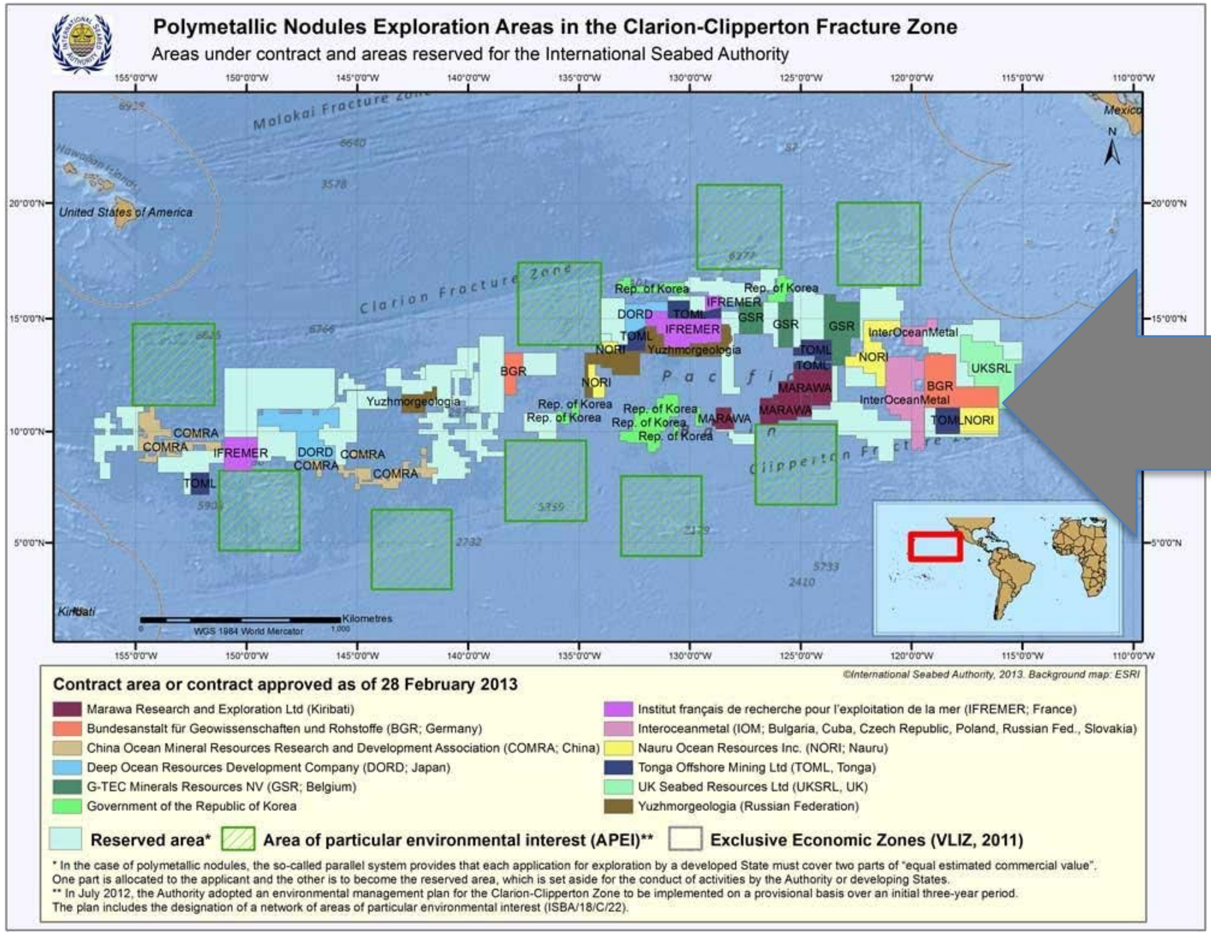
9 rectangular APEIs composed of 200km x 200km core areas with 100km buffer zones providing **400km x 400km** final APEI units.

The simple spatial design of these APEIs reflects both a desire to use parsimonious criteria, but also reflect the matching the limits of spatial precision to the data and knowledge limitations in the region

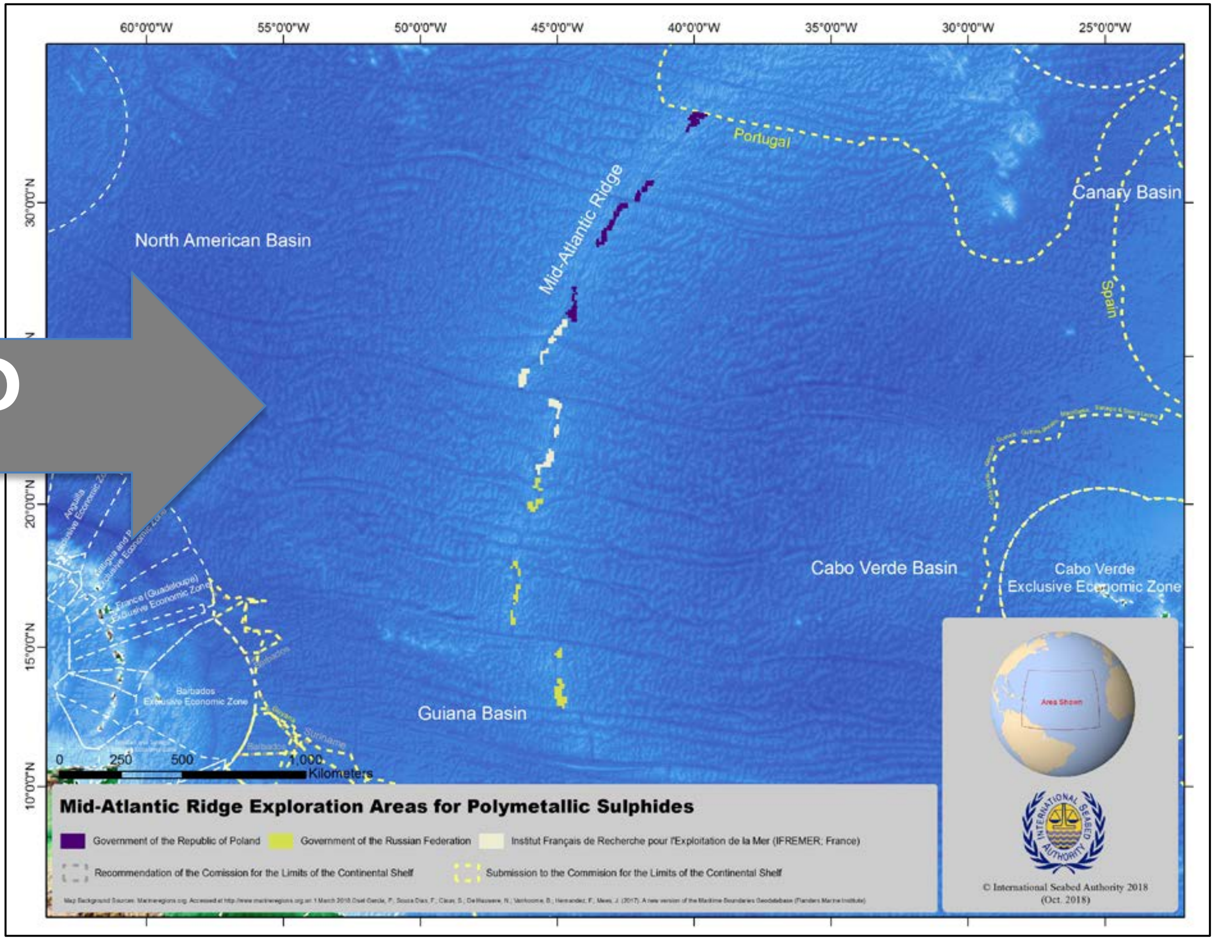


APEIs configurations for different regions

Appropriate size, shape configuration specifications may necessarily differ



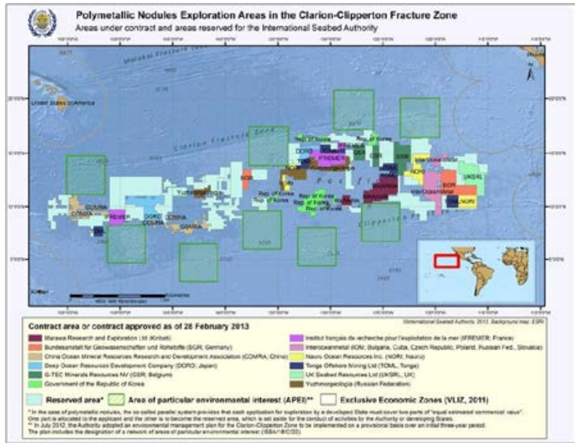
?



Spatially precise versus spatially coarse approaches

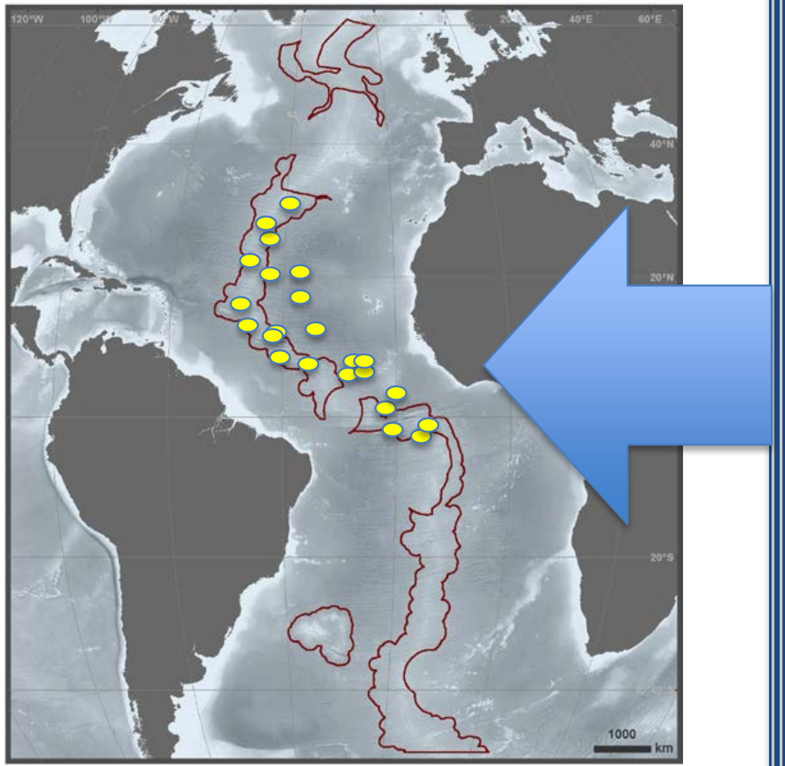
General reasons for proposing large, simple shape areas

- ✓ Need to protect contiguous habitats and gradients
- ✓ Need to preserve biological and genetic connectivity
- ✓ Needs to buffer areas from impacts
- ✓ Lack of precision due to imprecise knowledge
- ✓ Desire to use simple shapes to facilitate navigation & compliance

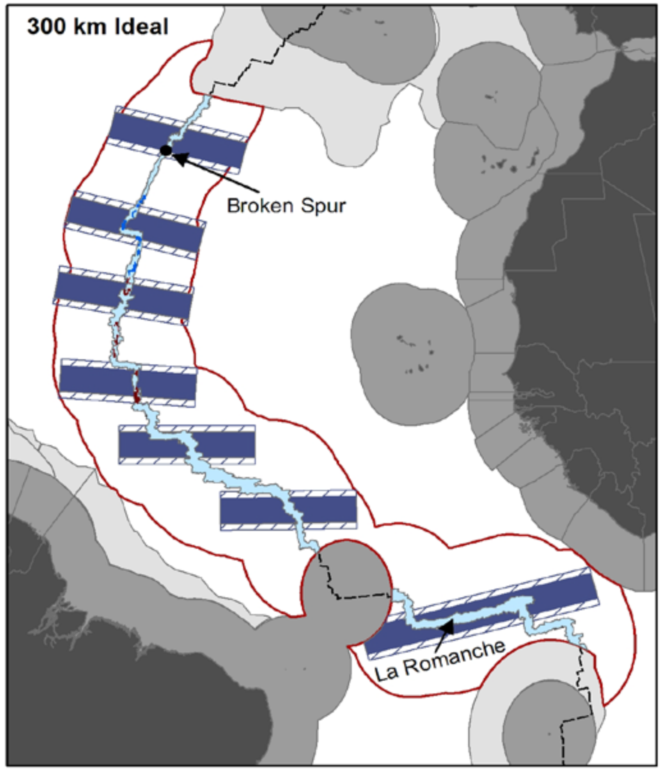


Spatially precise versus spatially coarse approaches

<u>Caveat:</u> Increased spatial precision will require increased quality and coverage of data



Spatially precise, site approach



Spatially coarse, large APEI approach

A suggested portfolio of ABMTs

A purposefully configured **mixed portfolio** combining **large areas** to protect and buffer intact gradients of habitats augmented with **specific sites** in need of protection may provide the most flexibility to satisfy both mining interests and protection needs.

A suggested portfolio of ABMTs

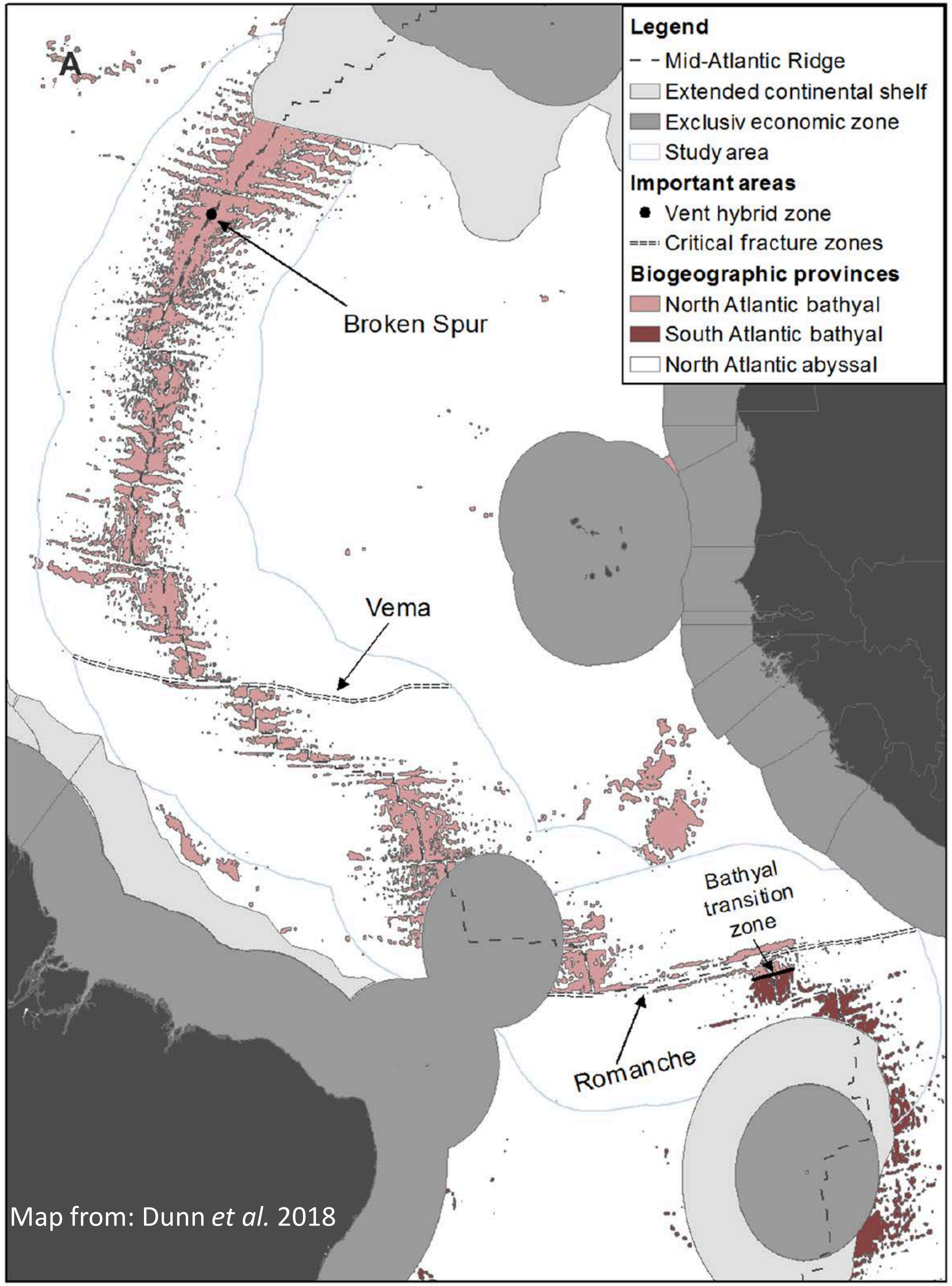
Also: a portfolio of ABMT areas could include **areas of increased precaution**, or other categories of use in addition to closure areas.

The areas could require more intensive pre-use exploration, mapping, monitoring and potential remediation.

REMP APEI spatial planning process

What could a REMP portfolio of coarse scale APEI ***areas*** supplemented with fine scale ***sites*** in need of protection look like?

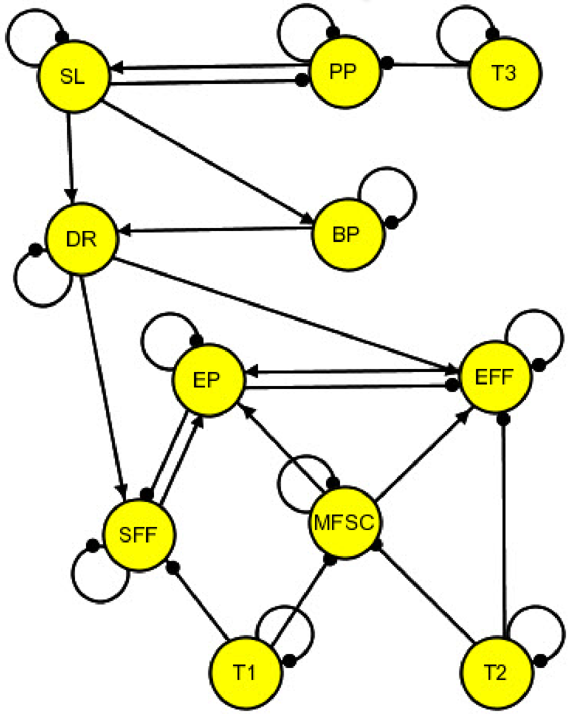
Could a combined strategy satisfy both the need to provide broad ***representative habitat protection*** as well as ***vulnerable site*** protections?

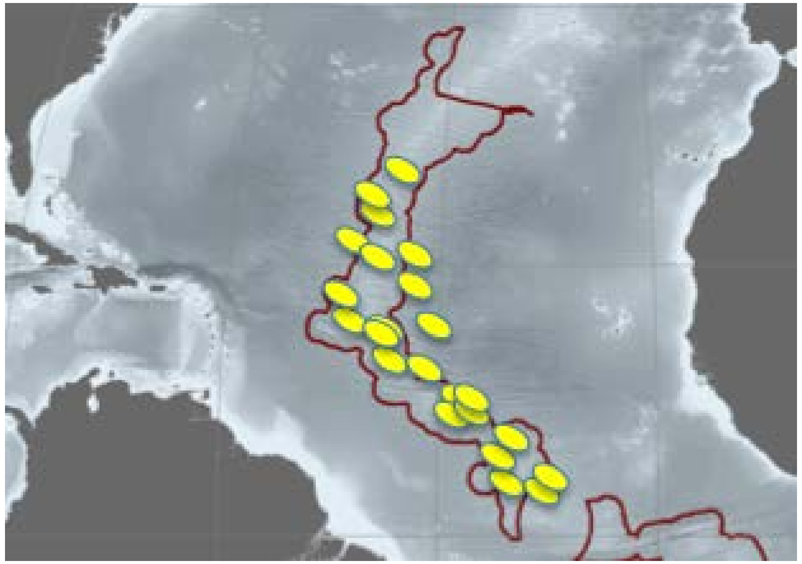


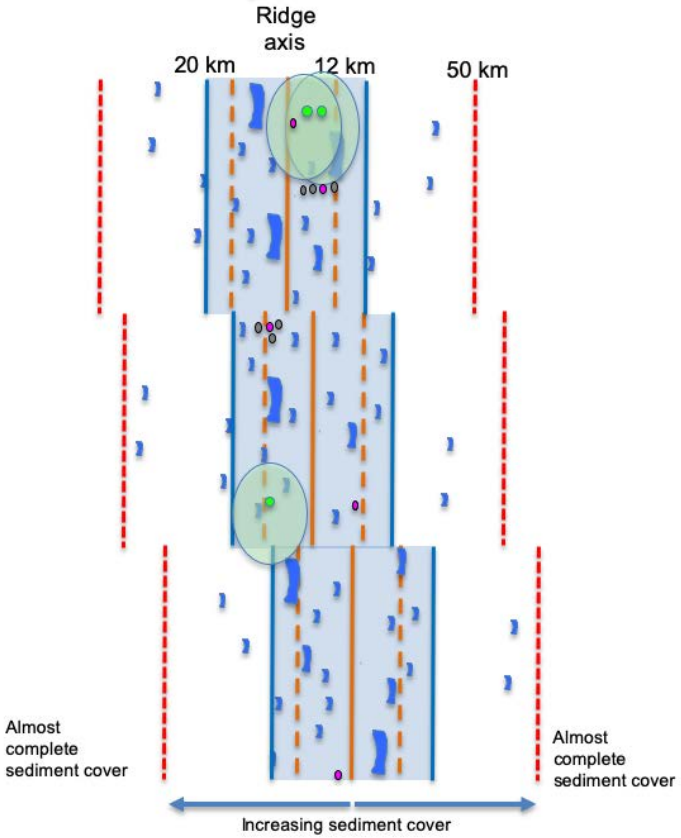
Map from: Dunn *et al.* 2018

Cumulative Impact Assessment **Area Based Management** **Adaptive management**

Complementary Approaches







models of pressures, impacts & risks **identified areas (APEIs, VMEs...)** **measures and procedures**

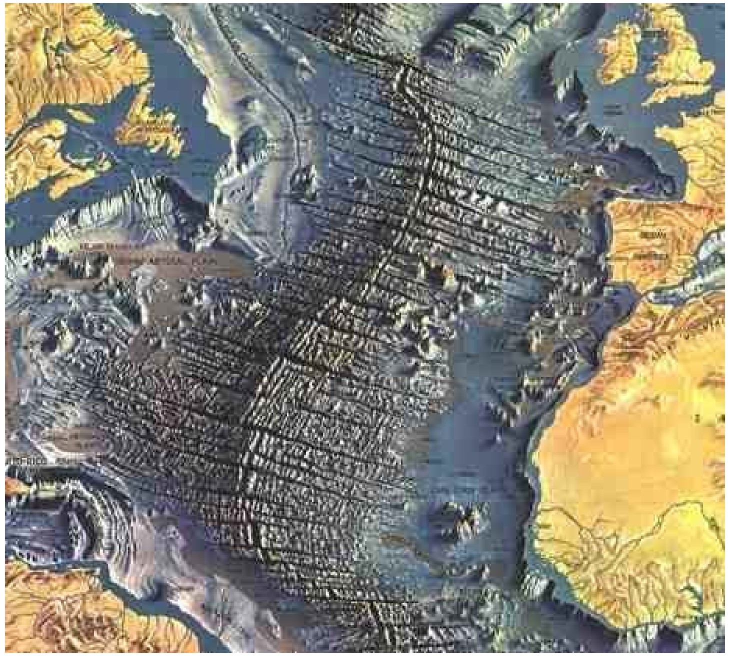
Take Home Messages

- Area Based Management Tools can be **complemented** with non-ABMT tools
- Combined **coarse** and **fine scale** ABMTs can provide increased flexibility and more robust protection of both broad habitat areas and vulnerable sites
- Spatial planning requires both **site criteria** as well as **network criteria**
- **Increased spatial precision** will require **increased data coverage and detail**
- Defining the appropriate biogeographic **spatial extent** of a REMP is a fundamental step in the planning process
- Defining **tractable evaluation criteria** for assessing different network configurations (size, spacing, placement...) will be fundamental to REMP planning
- Planning for an **adaptive management** to anticipate changes in data, knowledge, new technologies, area relinquishment... will likely be required

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

Marine Geospatial Ecology Lab
Duke University

Discussion



Supported by European Commission