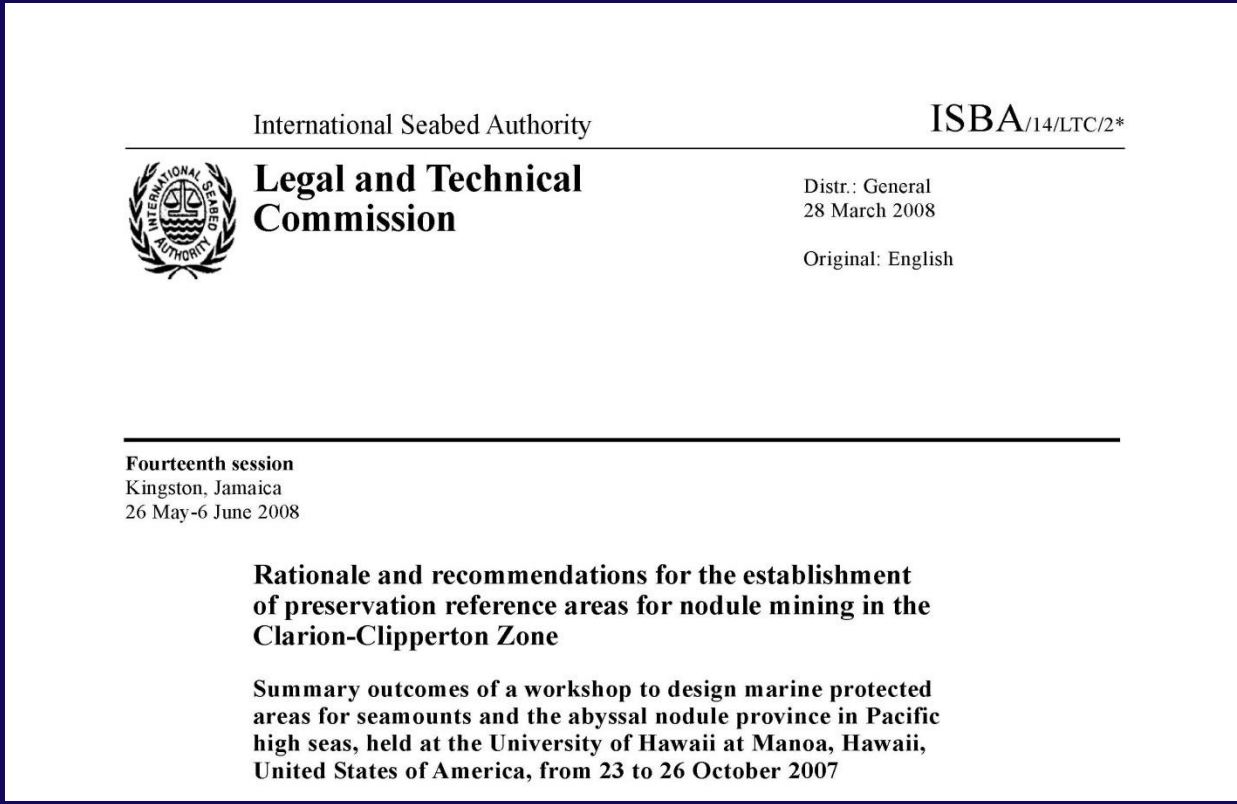
Setup of Marine Protected Areas in Deep-sea Ecosystems: The APEI Process in the CCZ

Presented by Craig R. Smith, University of Hawaii at Mano'a



International Seabed Authority ISBA/14/LTC/2*

Legal and Technical Commission

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Rationale and recommendations for the establishment of preservation reference areas for nodule mining in the Clarion-Clipperton Zone

Summary outcomes of a workshop to design marine protected areas for seamounts and the abyssal nodule province in Pacific high seas, held at the University of Hawaii at Manoa, Hawaii, United States of America, from 23 to 26 October 2007

Craig R. Smith, Steven Gaines, Les Watling, Alan Friedlander, Charles Morgan, Andreas Thurnherr, Sarah Mincks, Alex Rogers , Malcolm Clark, Amy Baco-Taylor, Angelo Bernardino, Fabio De Leo, Pierre Dutrieux, Alison Rieser, Jack Kittinger, Jacqueline Padilla-Gamino, Rebecca Prescott and Pavica Srsen

Outline:

A) The Pew APEI workshop(s) – goals and outcome

B) Key design elements of APEIs in the CCZ of general relevance to the deep sea

C) Lessons learned from the APEI process

Please note that for this talk:

Area of Particular Environmental Interest (APEI) =

Marine Protected Area (MPA) =

Preservation Reference Area (PRA) in our original recommendations

= An area where seafloor mining activities (and, ideally, other environmentally deleterious activities) are not allowed.

A) APEI recommendations based on workshop(s) similar to this:

Design Marine Protected Areas for Seamounts and the Abyssal Nodule Province in Pacific High Seas, Oct 23-27, 2007, University of Hawaii at Mano'a

22 Expert participants from 11 institutions and 8 countries

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* Mining Engineer

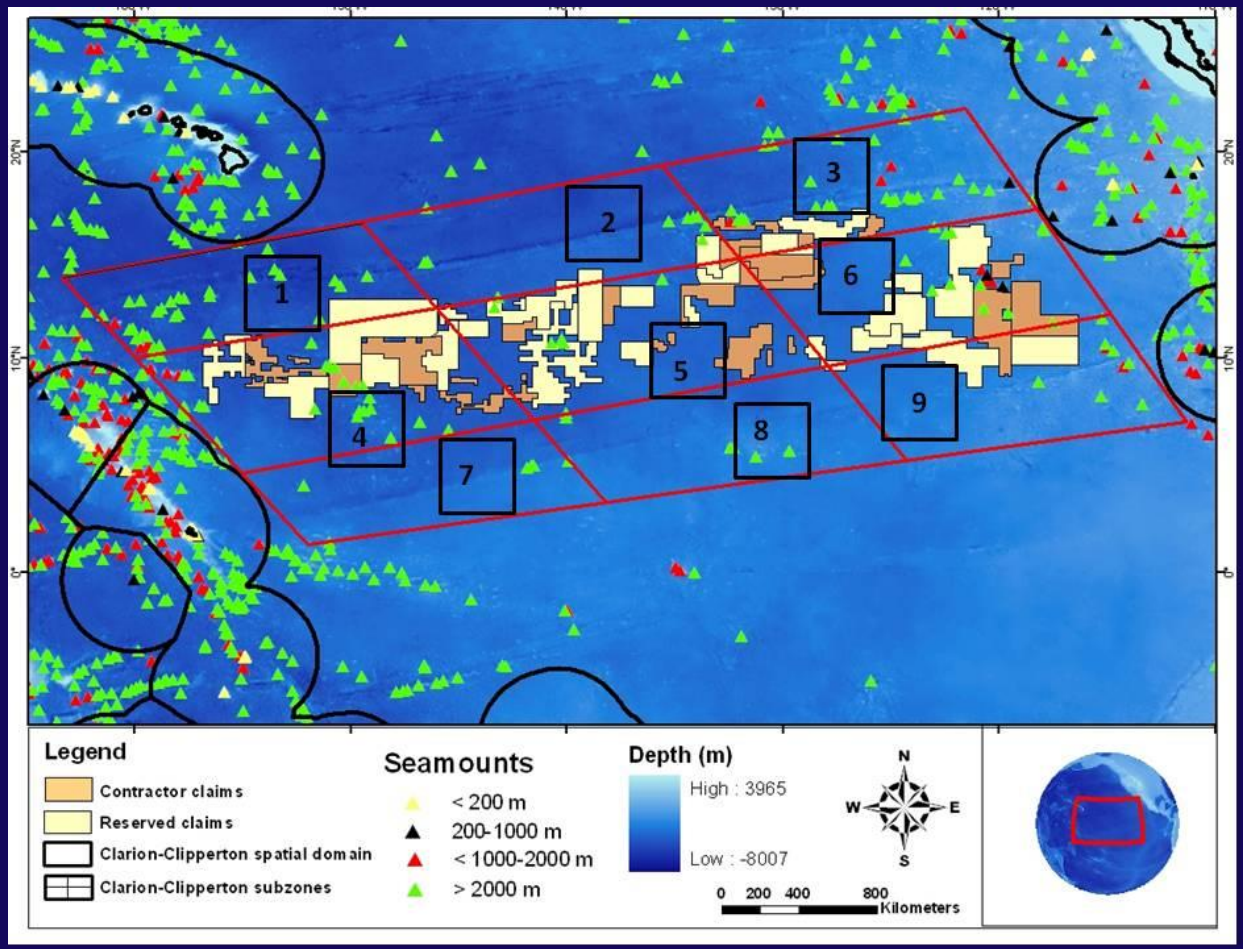
Sponsors: Pew Fellowship for Marine Conservation, Kaplan Fund, Sloan Foundation (CoML), International Seabed Authority, CeDAMar, University of Hawaii

Workshop outcome:

- Recommended dividing Clarion-Clippteron Zone into 9 ecological subregions

- **Each with one 400 km x 400 km Marine Protected Area (=APEI)**
- **APEIs integrated into current framework of mining claims (each 75,000 km^2)**
- **~30% of management area protected (1.44 x 10^6 km^2 (optimizes conservation benefits)**

Locations of APEIs within subregions initially flexible to allow adaptive management



Wedding et al., PRSB 2013

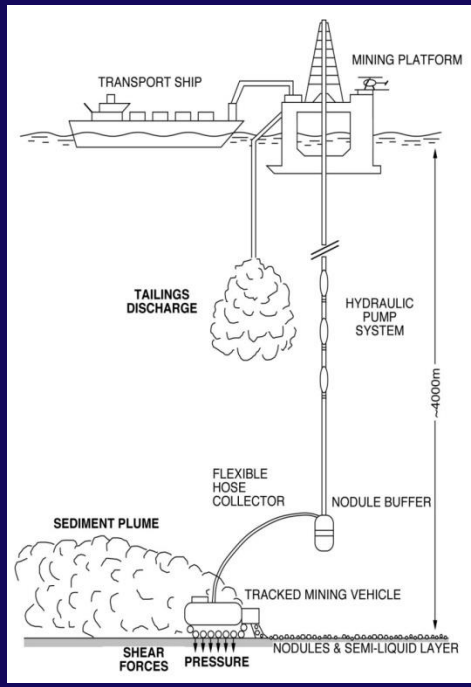
How did we arrive at these recommendations?

1) Considered threats to the managed ecosystem (deep seafloor habitats in CCZ) from mining and other impacts.

2) Reviewed data on patterns of abundance, biomass, biodiversity, species ranges, and gene flow across the region, and their relationships to environmental (i.e., habitat) variables in the CCZ.

3) Developed general goals for Marine Protected Areas in region targeted for nodule mining in the Pacific (the CCZ).

4) Used MPA design principles to develop specific APEI recommendations for this seafloor region.



Oebius et al. (2001)

http://www.soest.hawaii.edu/oceanography/faculty/csmith/MPA_webpage/MPAindex.html

General goals for Marine Protected Areas to conserve biodiversity and ecosystem function in the region targeted for nodule mining (Clarion-Clipperton Fracture Zone):

1. Protect 30-50% of management area (CCZ).

2. Each MPA captures full range of habitat variability within its region.

3. Each MPA contains sustainable populations for most components of the benthic fauna.

4. MPAs are replicated across the region to capture N-S and E-W turnover of biota (driven by gradients in primary productivity and seafloor food flux).

5. Each MPA is large enough that the core region is buffered from impacts of mining sediment plumes.

6. *MPAs are integrated into existing ISA legal framework, without compromising scientific principles of MPA design.*

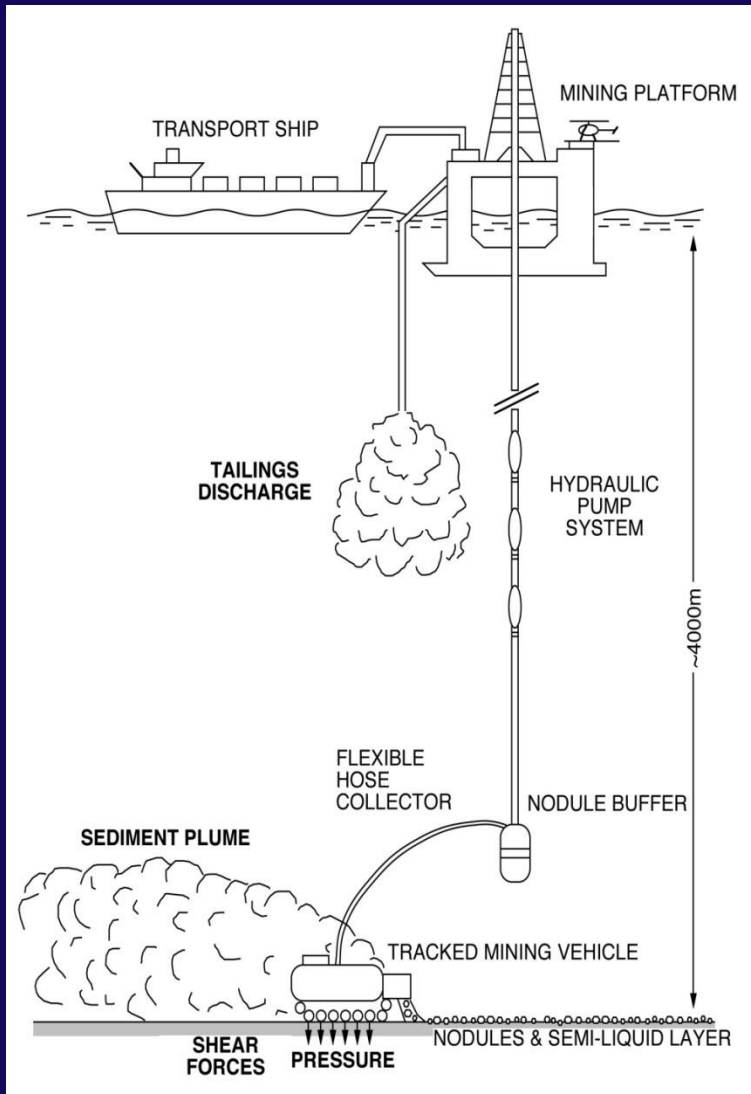
B) APEI design elements of general relevance to deep-sea MPAs

1) The APEIs should be managed across the CCZ region as a whole (i.e., in a *SEMP*) because -

Mining will be intense and affect large areas (>75,000 km^2 per claim) via direct and indirect impacts –

- direct disturbance of seafloor (300-600 km^2 y^{-1})

- sediment plumes (spread 10's of km from site)

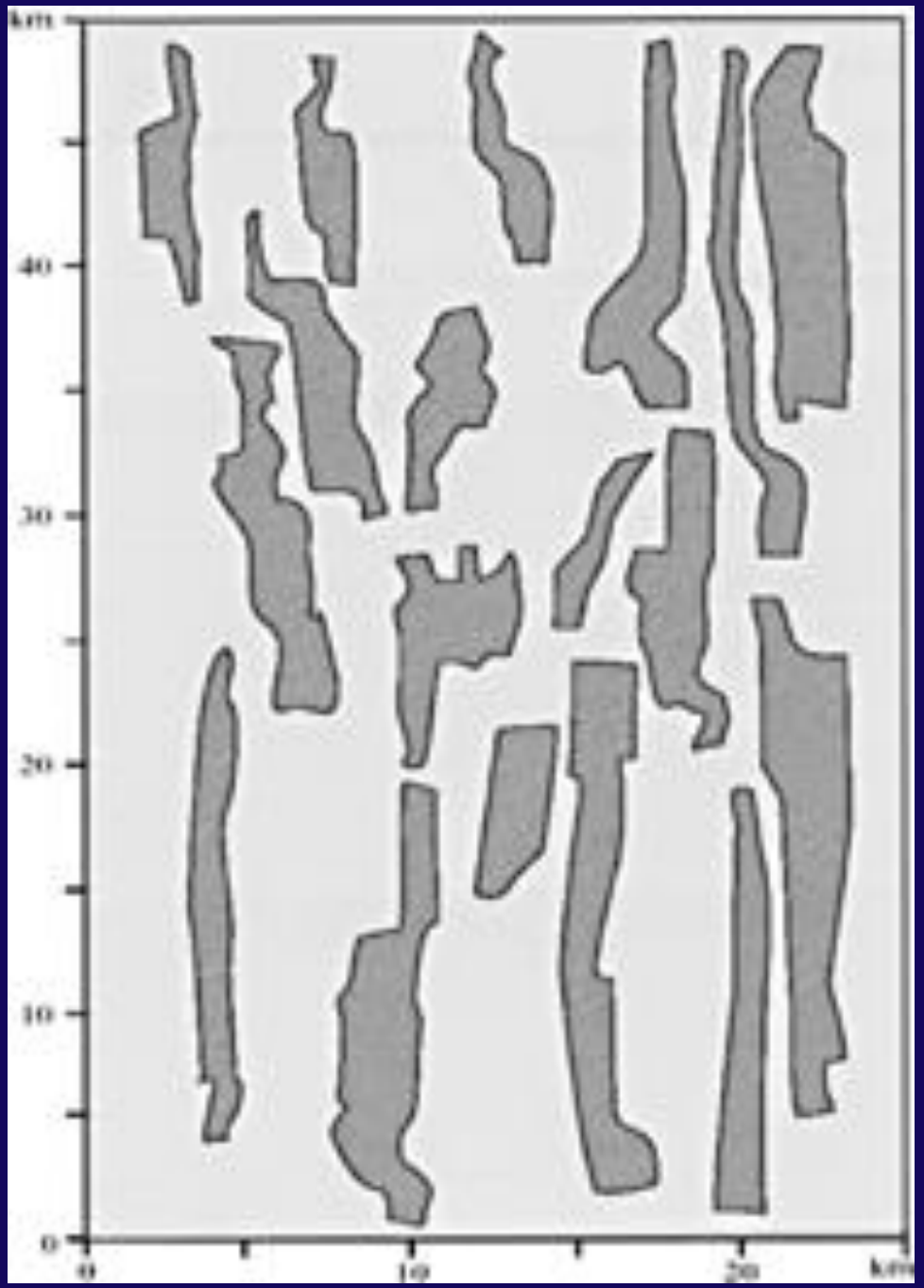


Oebius et al. (2001)

Heterogeneous distribution of nodules will be reflected in mining patterns –

Over 15 yr mining operation, anywhere in a claim area can mined and/or impacted –

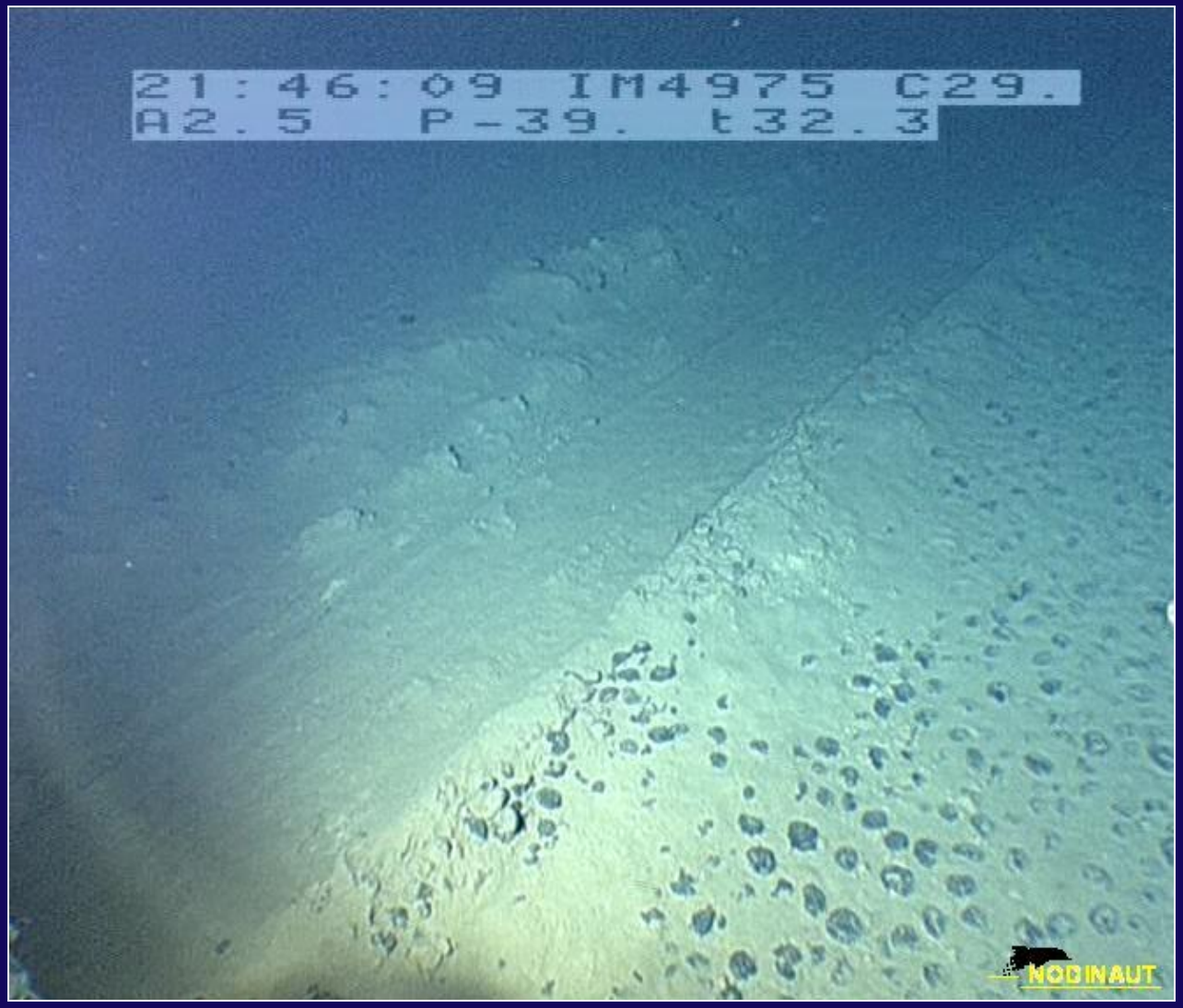
Thus – the entire area of each 75,000 km^2 claim must be considered to be potentially impacted.



Size and relative position of potential mining blocks in the French pioneer area, N. Pacific Ocean (modified from Lenoble 1999).

In addition, benthic ecosystem recovery will be slow – requiring

- Decades for soft-sediment ecosystem structure and function



Test Mining Track in CCZ

~1.5 m wide

~10 cm deep

Appears very fresh.

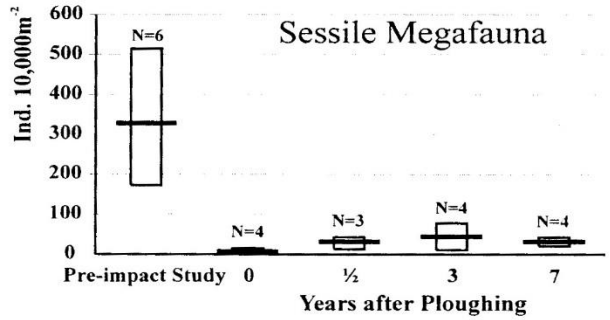
How old is it?

26 y

Meiofaunal diversity low, sed. geochem. still very different in tracks

Results of plowing in DISCOL & others: few mm of deposition

→ Dramatic declines in abundance & diversity of macrofauna and megafauna within 11 km^2 after 7 years



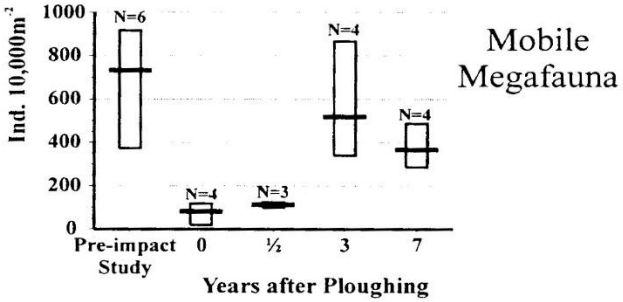
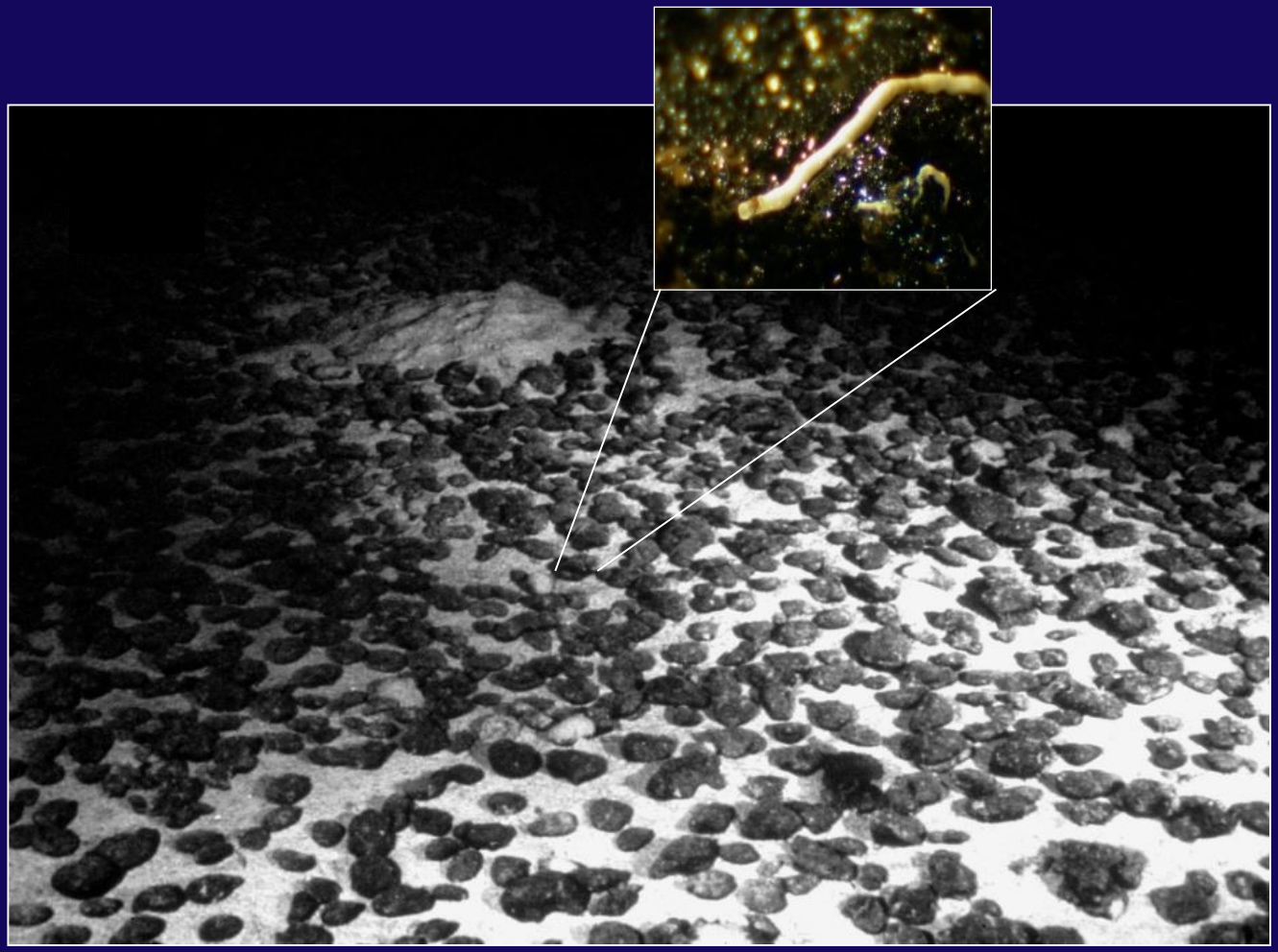


Fig. 2. Disturbed area. Densities (Ind. 10,000 m^{-2}): arithmetic mean, minimum–maximum range and *N*, the number of records used.

- Redeposited layer low in food quality (Fukushima & Kuboki, 2000)

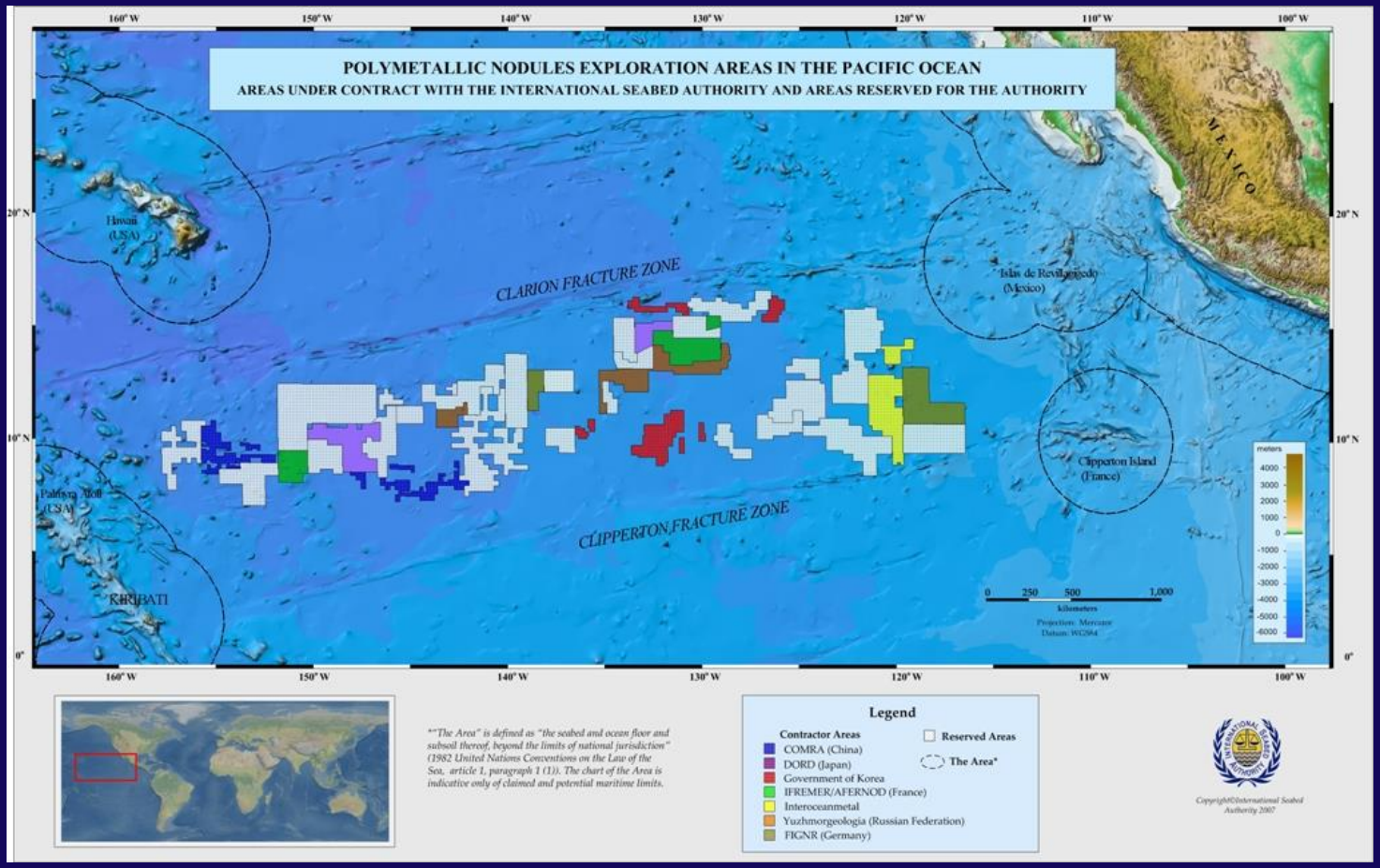
-Recovery times of millennia for specialized nodule fauna -

-because nodules grow back at a few mm per million years



Thus,

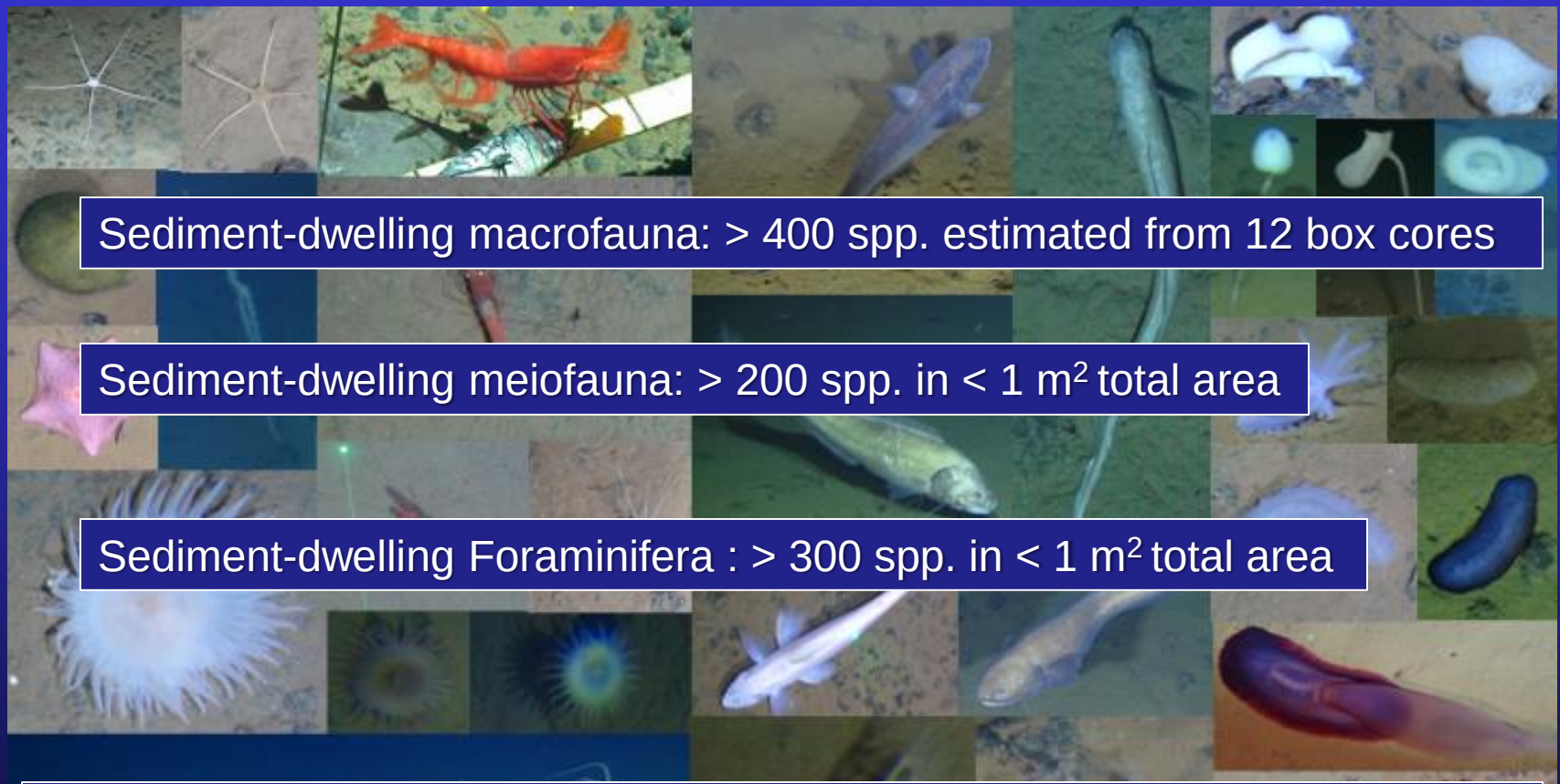
Over time scales of benthic ecosystem recovery (decades - millennia) – en*vironmental impacts of mining may be simultaneous and widespread across the CCZ* *(all mining claims may be mined before any claim fully recovers).*



→ MPAs must be managed across the CCZ region as a whole (true for all deep sea?)

Also important to note: CCZ fauna not only fragile but remarkably diverse and poorly known - e.g., "charismatic" megafauna:

5 ROV surveys in UK-1 Claim area in 2013 , ≥ 181 spp. in 30 x 30 km



Sediment-dwelling macrofauna: > 400 spp. estimated from 12 box cores

Sediment-dwelling meiofauna: > 200 spp. in < 1 m^2 total area

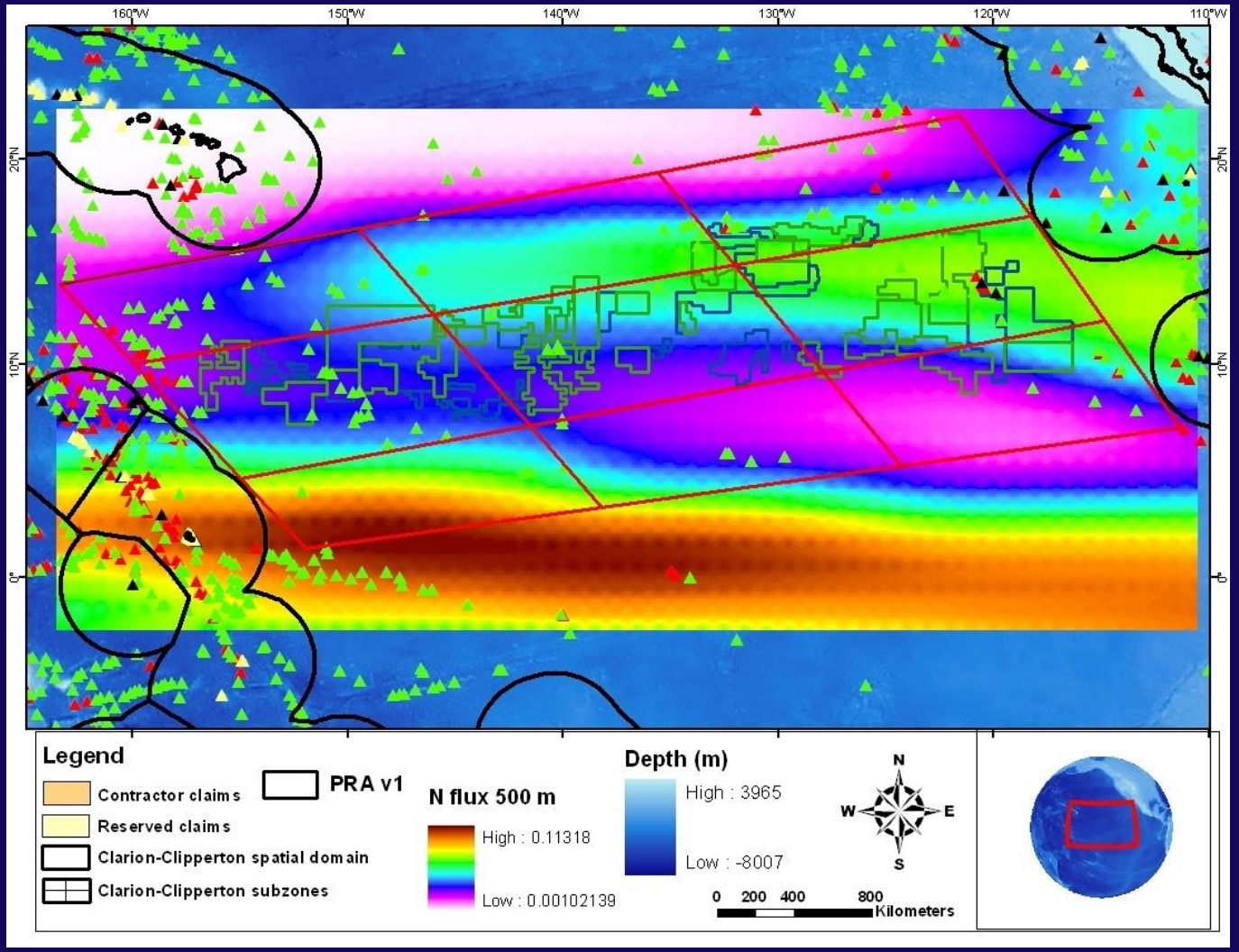
Sediment-dwelling Foraminifera : > 300 spp. in < 1 m^2 total area

Conclusion: >>1000 faunal species, (>90% new to science) in a single, structurally complex, very slowly recovering CCZ locality.

Everywhere in the CCZ potentially qualifies as a VME!

Design element 2:

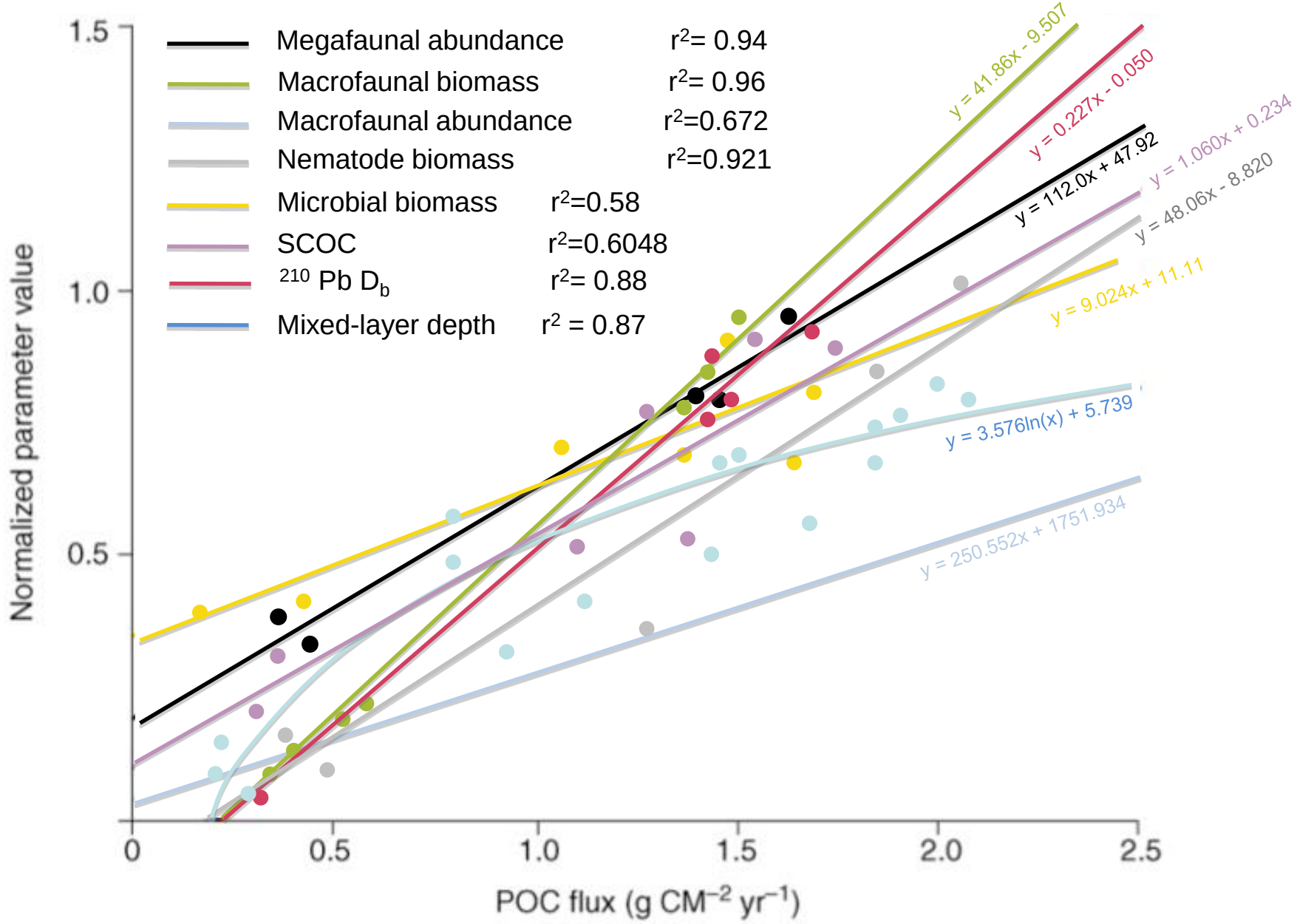
The CCZ region can be divided into three east-west and three north-south habitat strata because of strong productivity driven gradients in ecosystem structure from east to west and south to north. This yields nine distinct sub-regions within the CCZ, each requiring an APEI.



Export flux (mmol N m^2 d^{-1}) at 500 m for CCZ estimated from Yool et al. (2007) model. Note N-S and E-W gradients and that each of 9 subregions has different export flux regime.

Why is this important to abyssal CCZ?

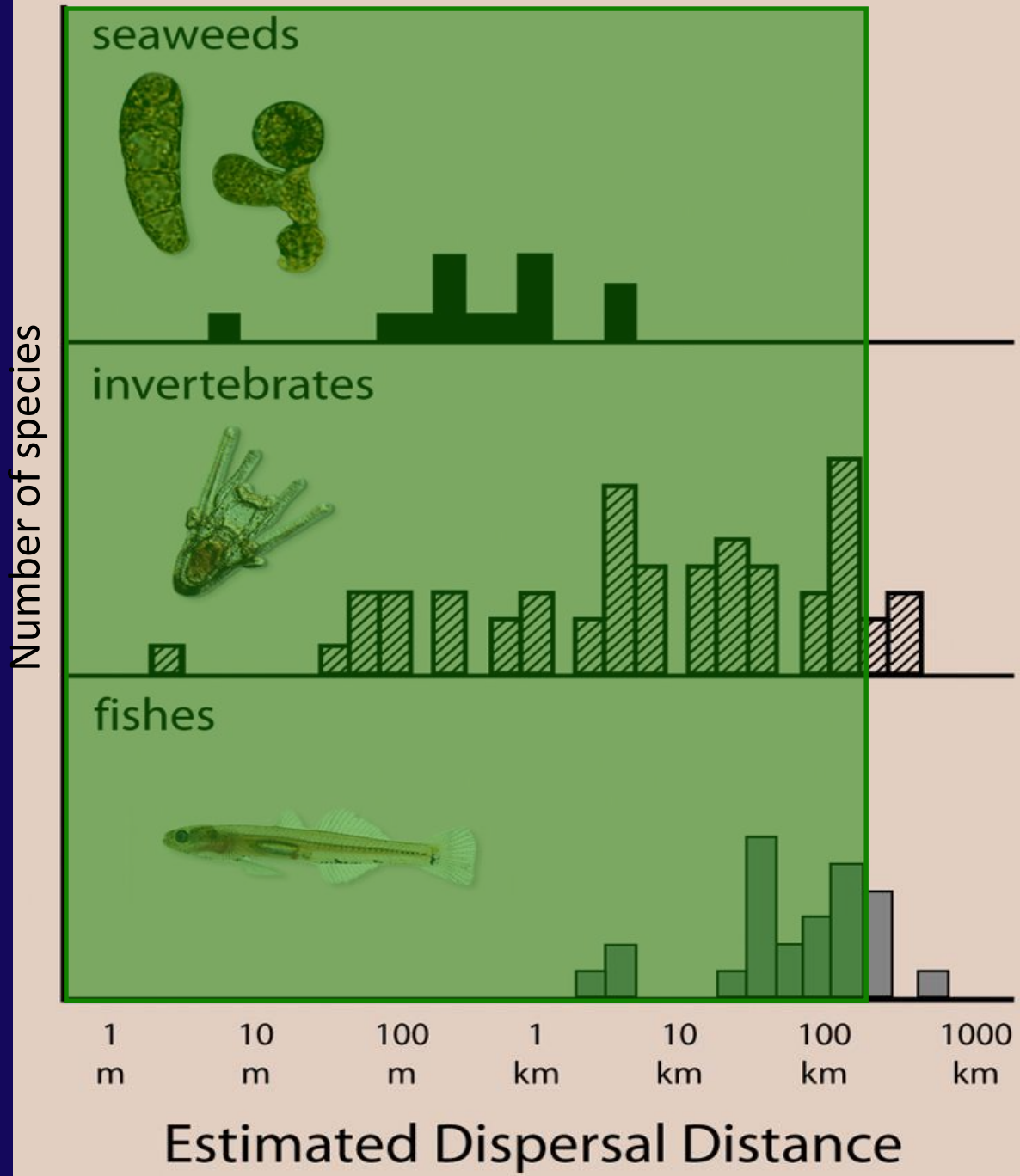
Biotic abundance, ecosystem functions, & biodiversity can vary strongly with the flux of organic matter (or “food”) to the abyssal deep sea.



Smith et al., 2008, TREE, 23:518-528

Design element 3:

6)The core area of each MPA should be at least 200 km in length and width, i.e., large enough to sustain populations for species potentially restricted to a subregion of the CCZ.



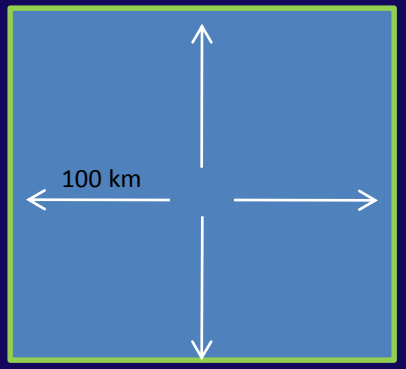
Kinlan and Gaines, 2001

For sustainable populations, MPA size should be 2X mean dispersal distance of larvae

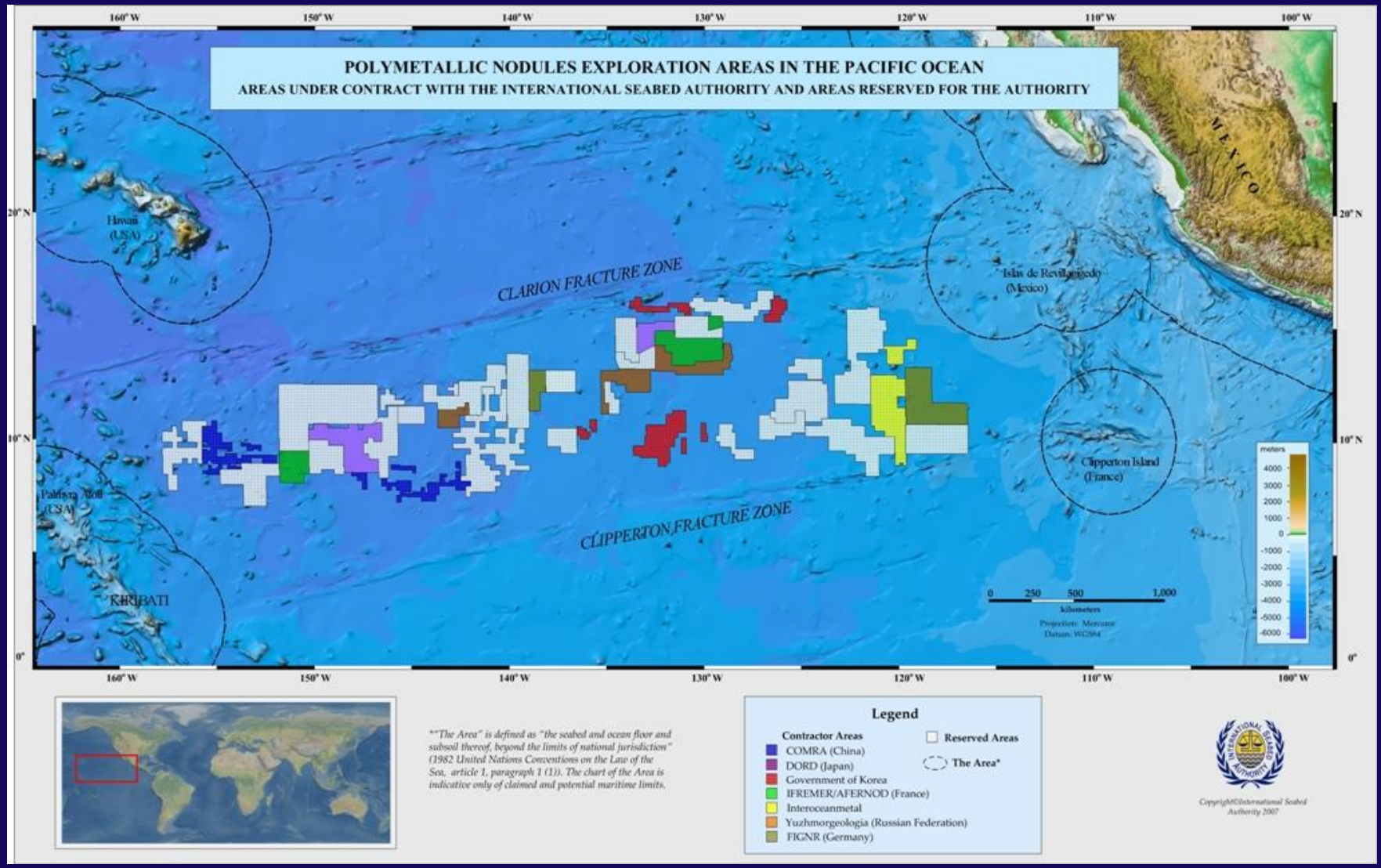
Most marine benthos have mean larval dispersal distances < ~100 km

Recommended MPA core size -

200 x 200 km



NB. Large individual reserve size, rather than a closely spaced network of small reserves, was recommended because the size of existing claim areas (> 200 km) exceeds the mean dispersal distance of most benthos.



Design element 4: Representivity

Each MPA should contain the full range of benthic habitat types found within its subregion:

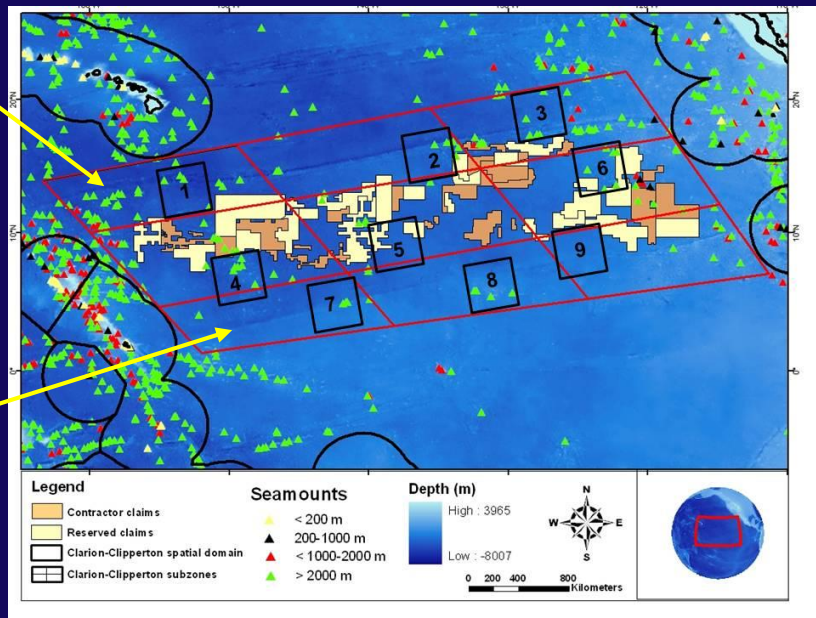
Abyssal plains/abyssal hills

with and without nodules

(200 x 200 km adequate)

Seamounts

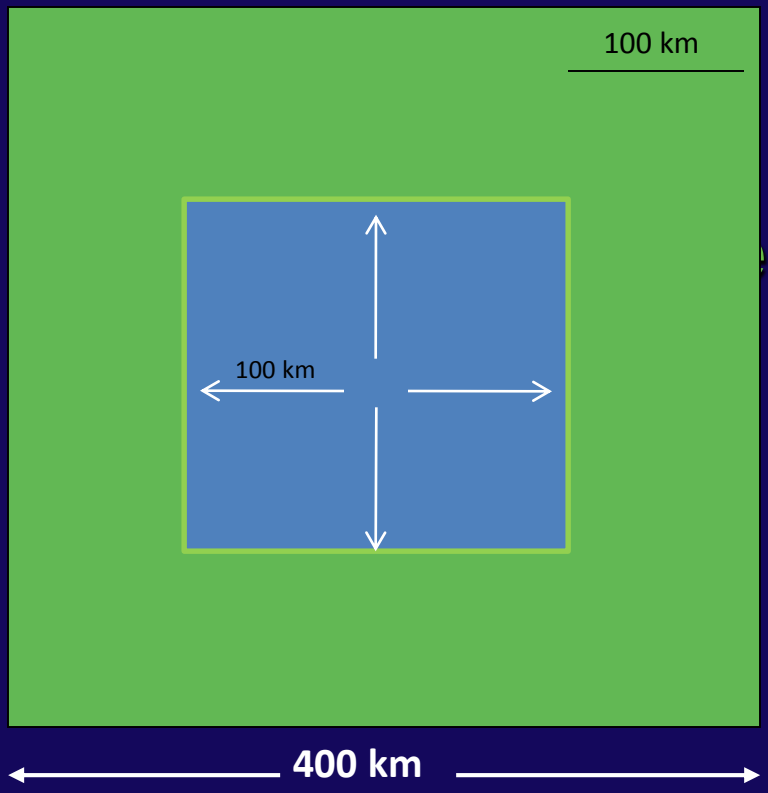
(often harbor unique, vulnerable, diverse communities – protect 30-40% in each subregion)



Fracture zones

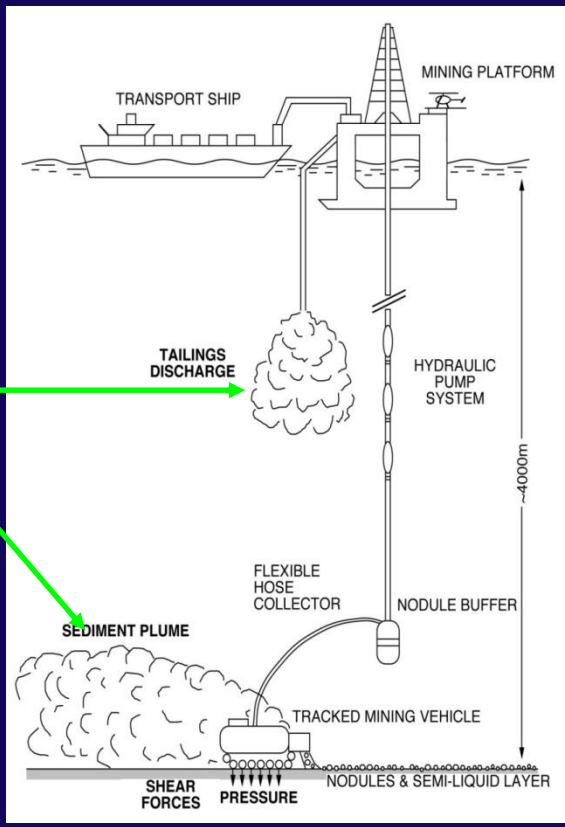
Design element 5:

Each MPA core area should surrounded by a buffer zone 100-km wide to insure that the MPA core is not affected by mining plumes.



Physical oceanographic models and tracer experiments suggest plume transport over scales of ≤100 km

(Oebius, 2001; Rolinski et al. 2001; Ledwell 2000; Thurnherr 2004)

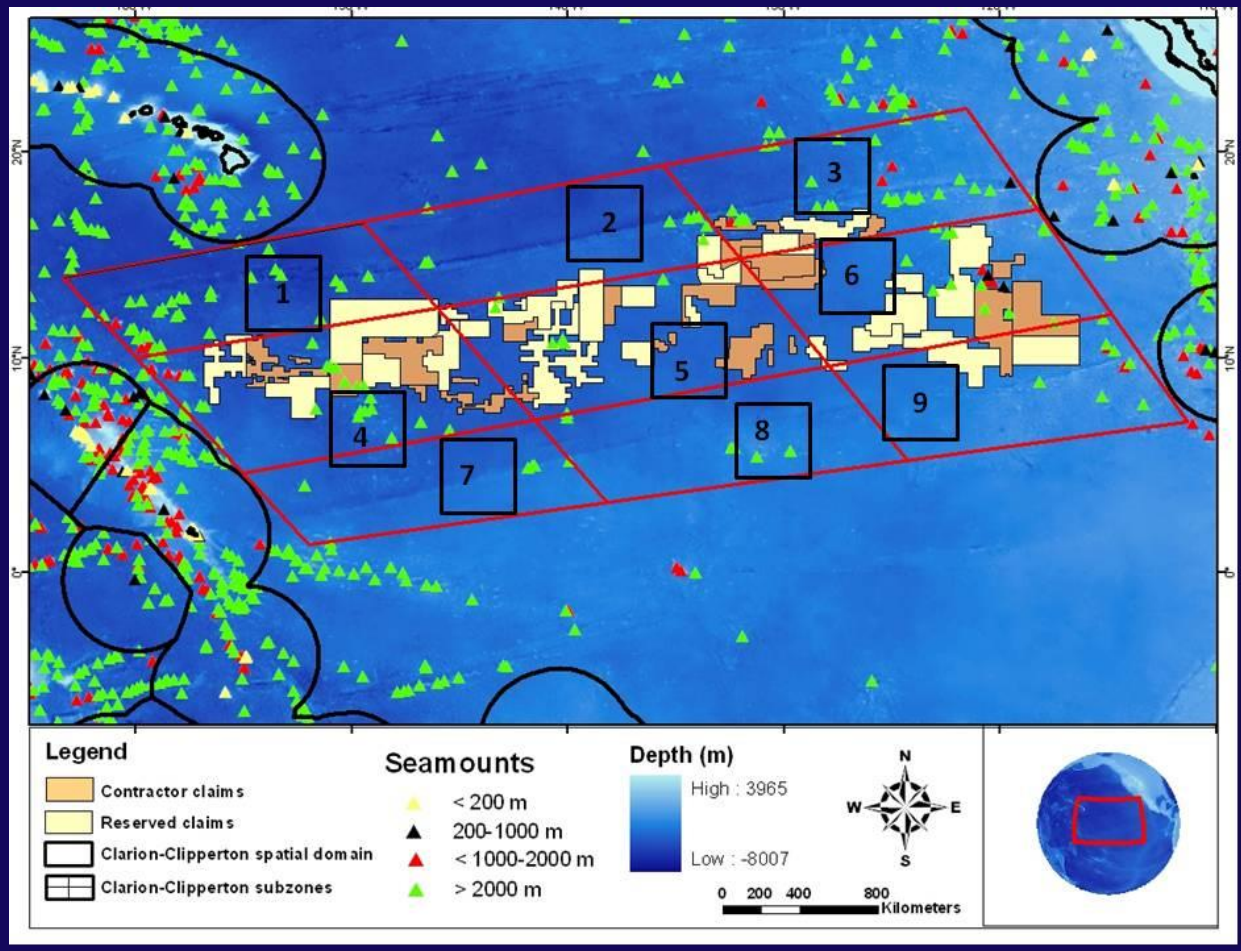


Summary of MPA Recommendations for CCZ –

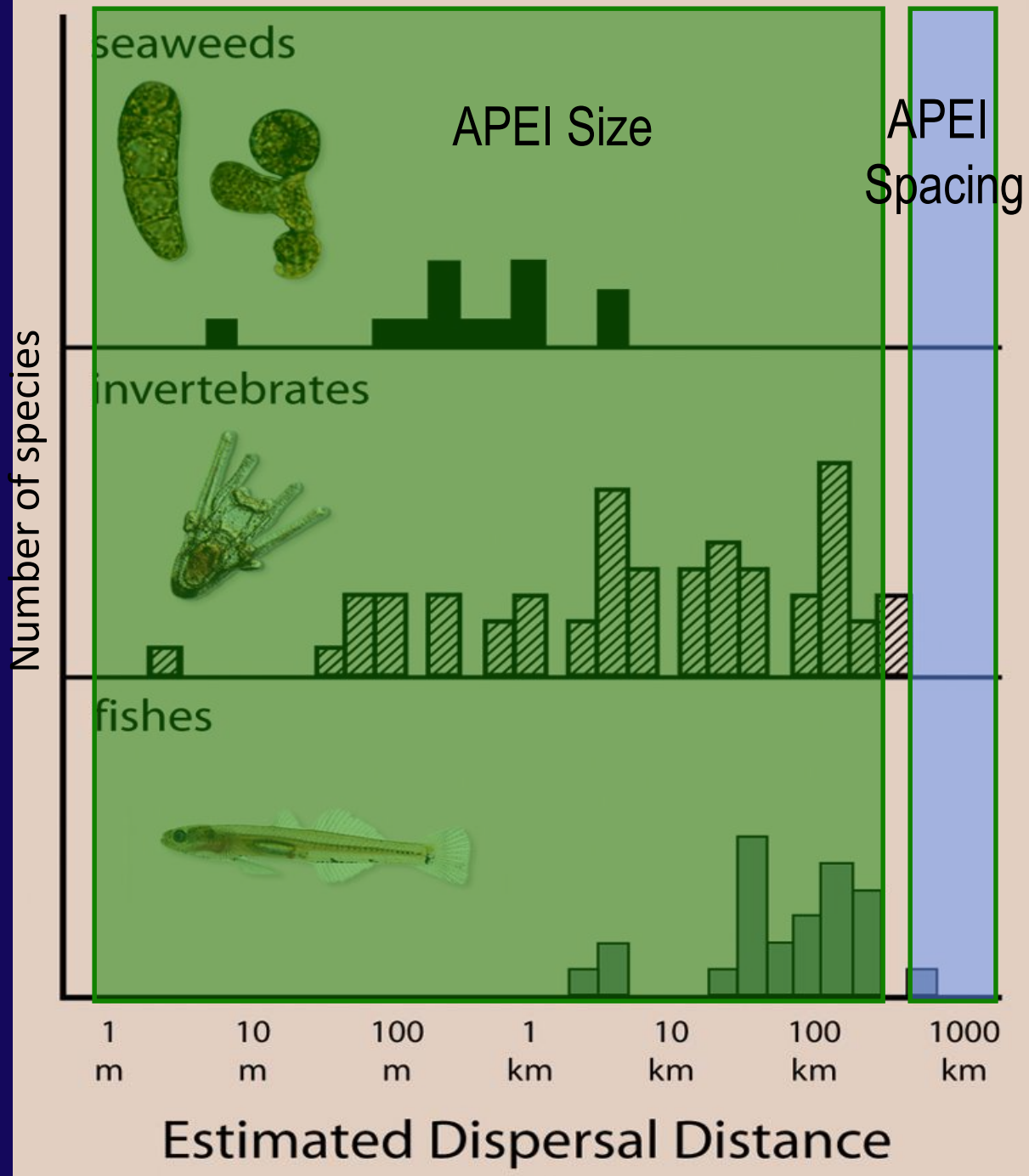
- Nine 400 x 400 km MPAs, one in each of the 9 subregions defined by productivity gradients and faunal turnover. MPAs situated to avoid or minimize overlap with existing mining exploration and reserved claim areas and to protect as many seamounts as possible within a subregion.

Used GIS-based optimization analysis to locate MPAs within subregions (capturing seamounts) – locations initially flexible, i.e., negotiable.

- Still act as network with spacing of 300-600 km (i.e., a small dispersal gap)



Wedding et al., 2013

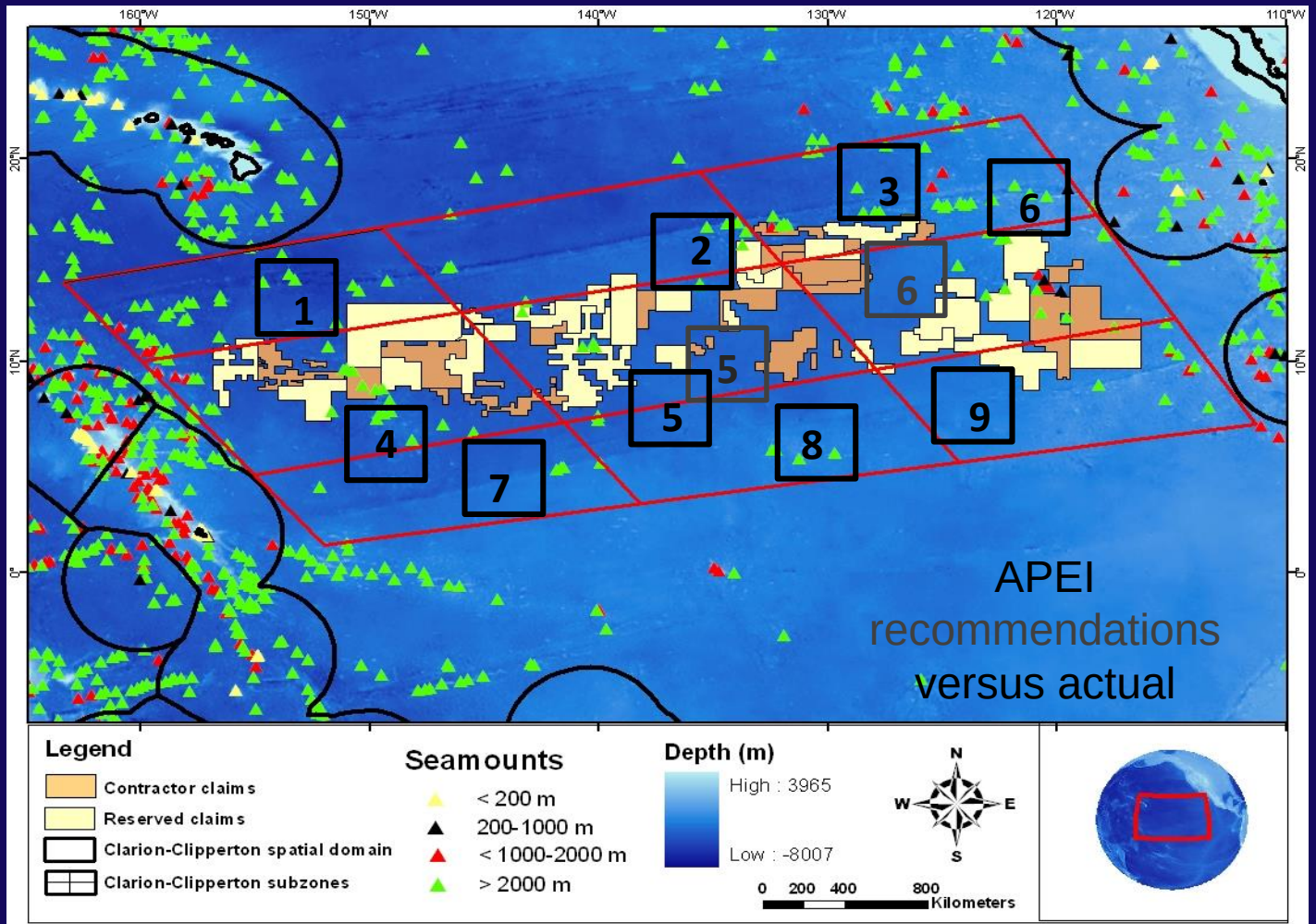


To maintain largest number of sustainable populations, one goal is to minimize gap between MPA size and spacing in MPA network

For the CCZ, our recommendations yielded size of **400 km** with spacing of **300-600 km**.

Status of MPA Recommendations for the CCZ:

- Presented to the ISA Legal and Technical Commission in Mar - May, 2008.
- Strongly endorsed by the ISA LTC *in concept.*
- Provisionally adopted in 2012 for 3 years, with repositioning of two APEIs.
- Up for renewal in summer, 2015.



C) Lessons learned from APEI process for the CCZ:

1) MPA networks should be erected within regional EMP before many exploration claims granted (otherwise ability to design viable networks may be compromised).

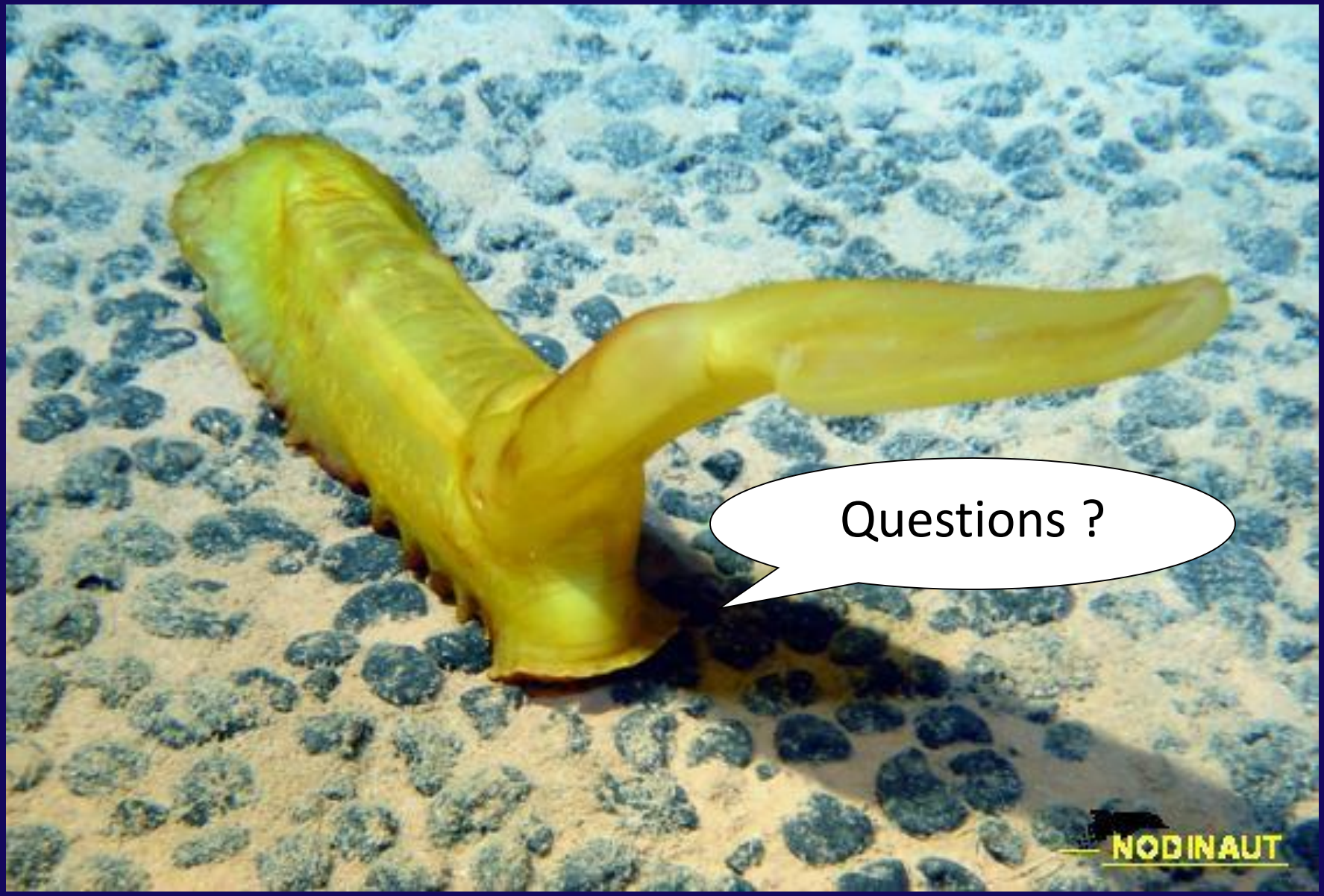
2) Species/community distributions and connectivity patterns (for >>1000 spp.) are not knowable on time scales necessary to develop MPA networks (and SEMPs) for deep-sea mining **-**

- We must use a representative MPA approach to fully protect biodiversity and ecosystem functions in the deep sea.

3) There will substantial pushback from industry to reduce/relocate MPAs, especially from prime-grade mineral deposits:

"We don't know enough to justify an MPA in this area"

However, because mineral grade (geochemistry) and biota are often linked, precautionary approach *requires* protecting high-grade areas in absence of extensive regional data on biodiversity and species ranges.


Questions ?
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