

The issue of scarcity in the design and monitoring of IRZ+PRZ

L. Menot



1. The need to quantify an impact with some level of confidence
2. The level of confidence achievable in the deep sea



Type II error and the power of statistical tests

Hypothesis: H_0 $\bar{x}_1 = \bar{x}_2$

H_1 $\bar{x}_1 \neq \bar{x}_2$

Hypothesis	H_0 is true	H_1 is true
H_0 accepted	Good	Oups,there is an impact
H_0 rejected	Oups,there is no impact	Good

The power of the analysis $1-\beta$ is a function of variance, effect size and sample size

Variance is a function of the mean

Taylor's law (also known as *Taylor's power law*) is an empirical law in ecology that **relates the variance** of the number of individuals of a species per unit area of habitat **to the corresponding mean** by a power law relationship

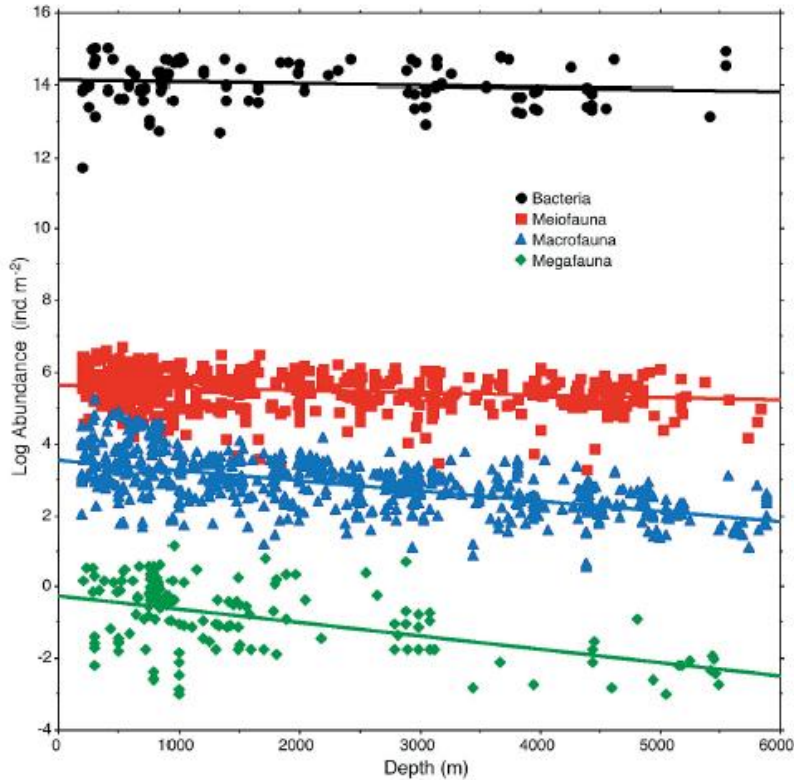
$$\sigma^2 = a\mu^b$$

Assuming that individuals are randomly distributed

$$\sigma^2 = \mu$$

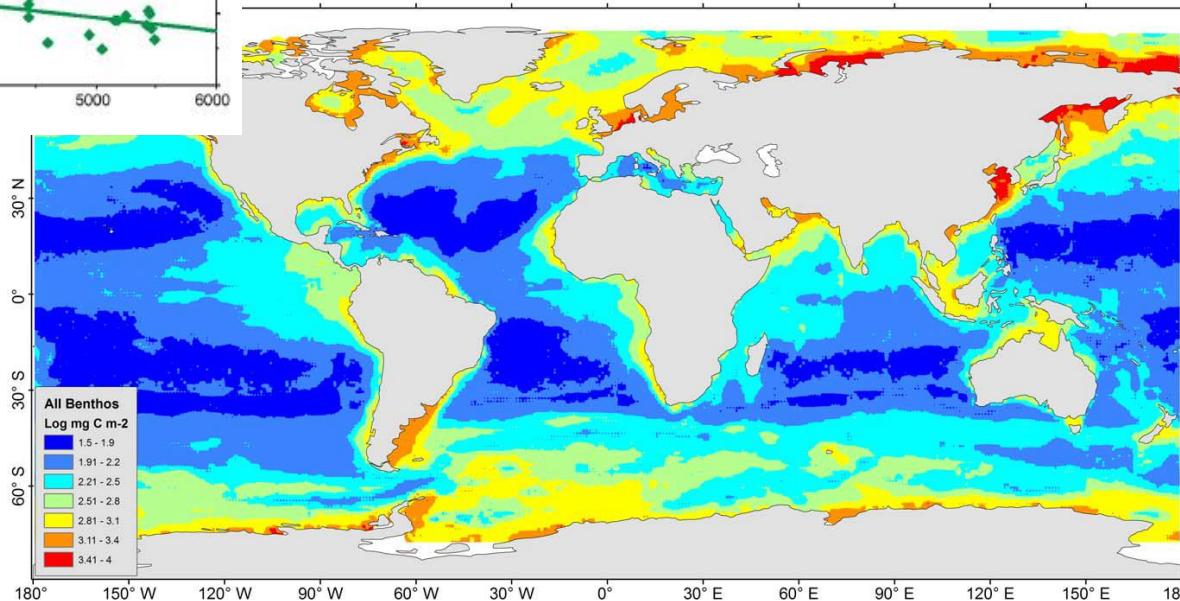
Variance equals the mean

Why is it an issue in the deep sea?



**Shallow – 3000 ind./m²,
0.1 m² = 300 individuals**

**Deep – 300 ind./m²,
0.25 m² = 75 individuals**



Macrofaunal density patterns

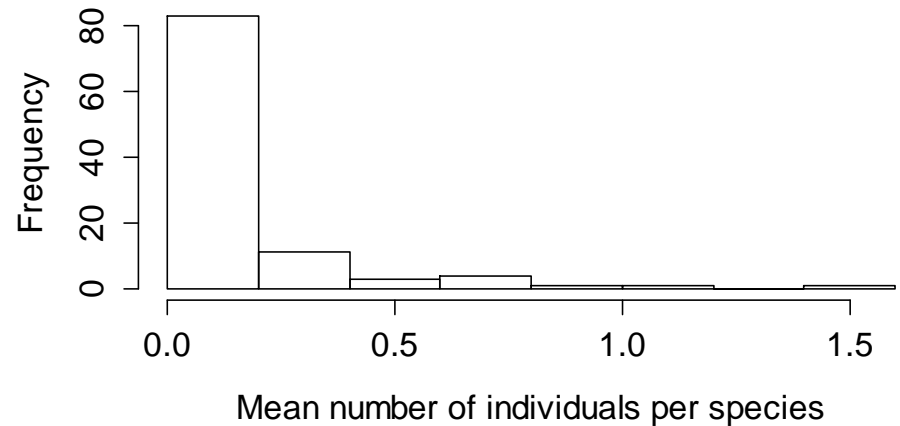
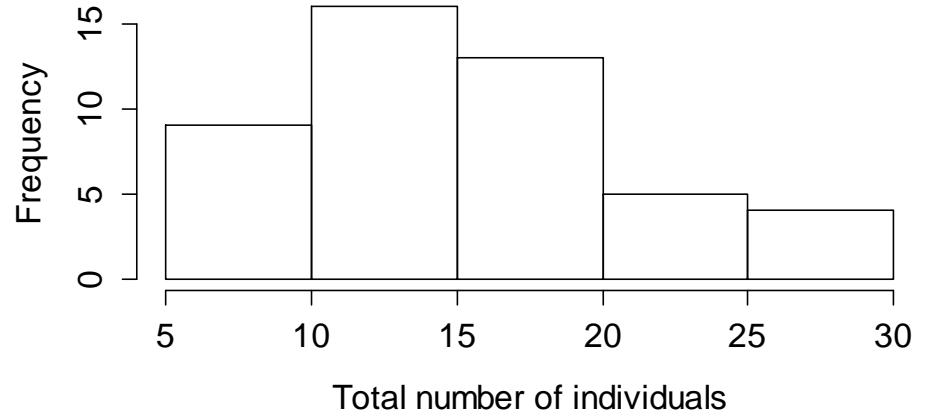
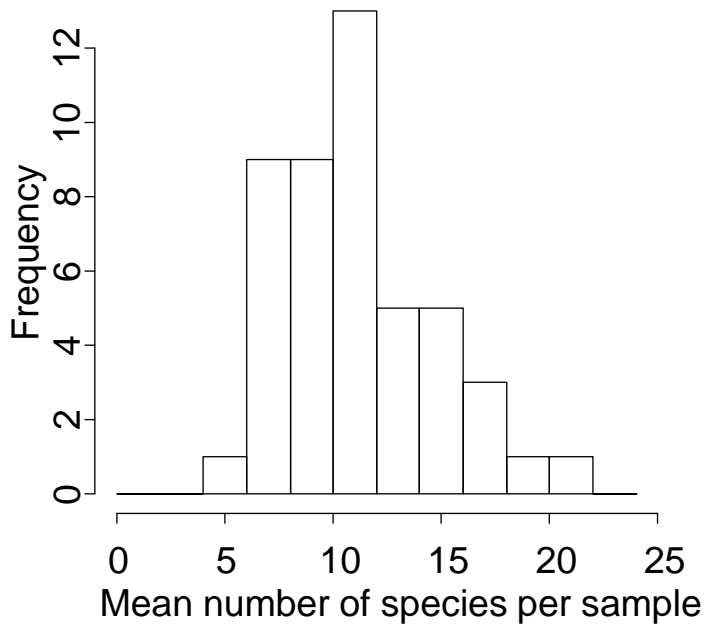


DOMES A

47 Box-cores

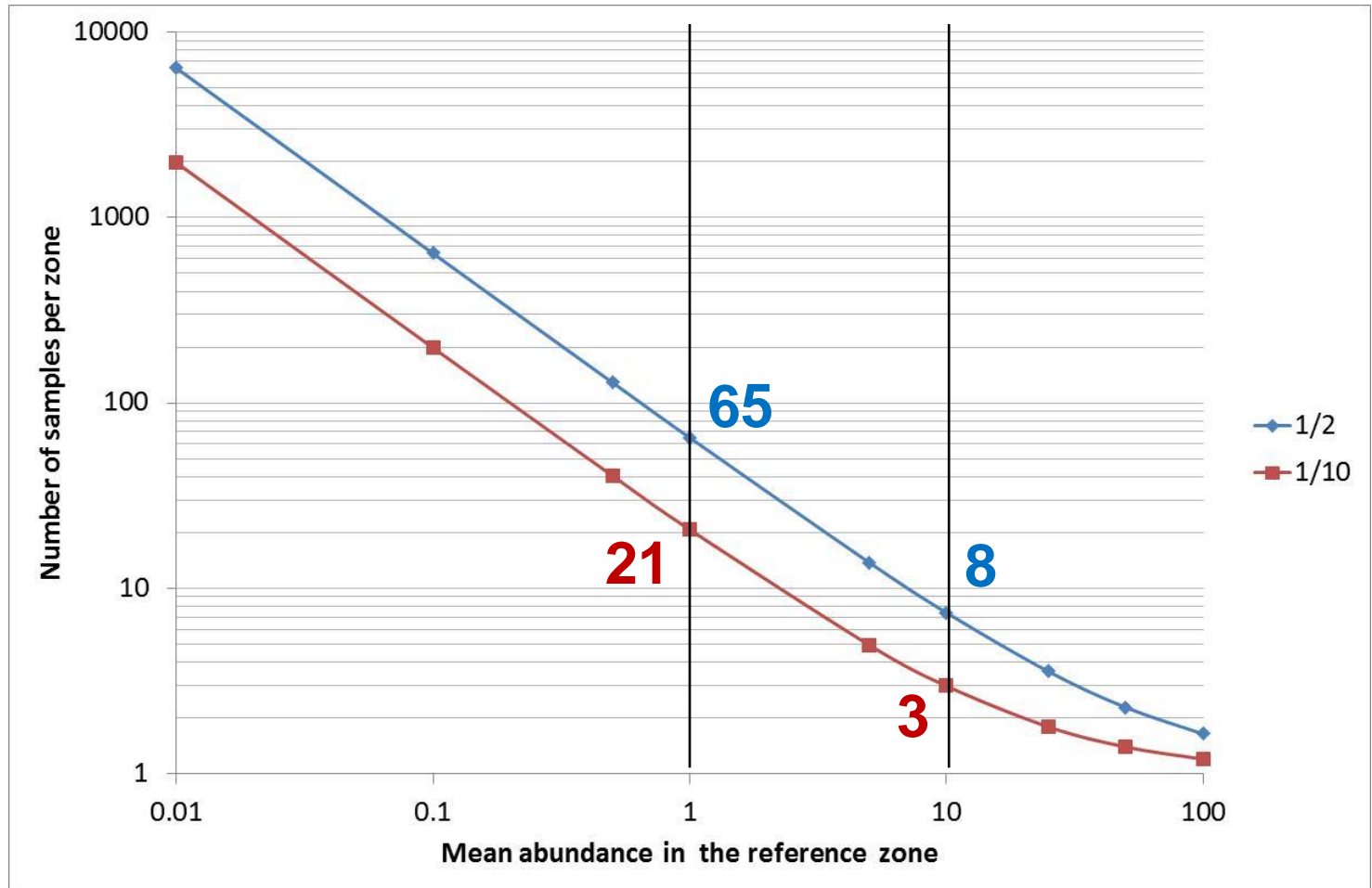
752 individuals of polychaete

104 polychaete species



How many samples are needed to be 80% ($1-\beta = 0.8$, $\alpha = 0.05$) sure to get a statically significant difference in the abundance of a species when:

- The abundance is divided by 2 in the impact area
- The abundance is divided by 10 in the impact area



Basing conservation policies for the deep-sea floor on current-diversity concepts: a consideration of rarity

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The rare component at depth is largely comprised of species more common at other locations near and far. The rare component on the shelf is comprised mostly of species which are consistently rare and restricted in distribution. These observations suggest a shallow–deep difference that is more one of degree than fundamental in nature; the deep having larger regions and regional species pools.

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A Source-Sink Hypothesis for Abyssal Biodiversity

Michael A. Rex,^{1,*} Craig R. McClain,^{2,†} Nicholas A. Johnson,^{3,‡} Ron J. Etter,^{1,§} John A. Allen,^{4,||} Philippe Bouchet,^{5,#} and Anders Warén^{6,**}



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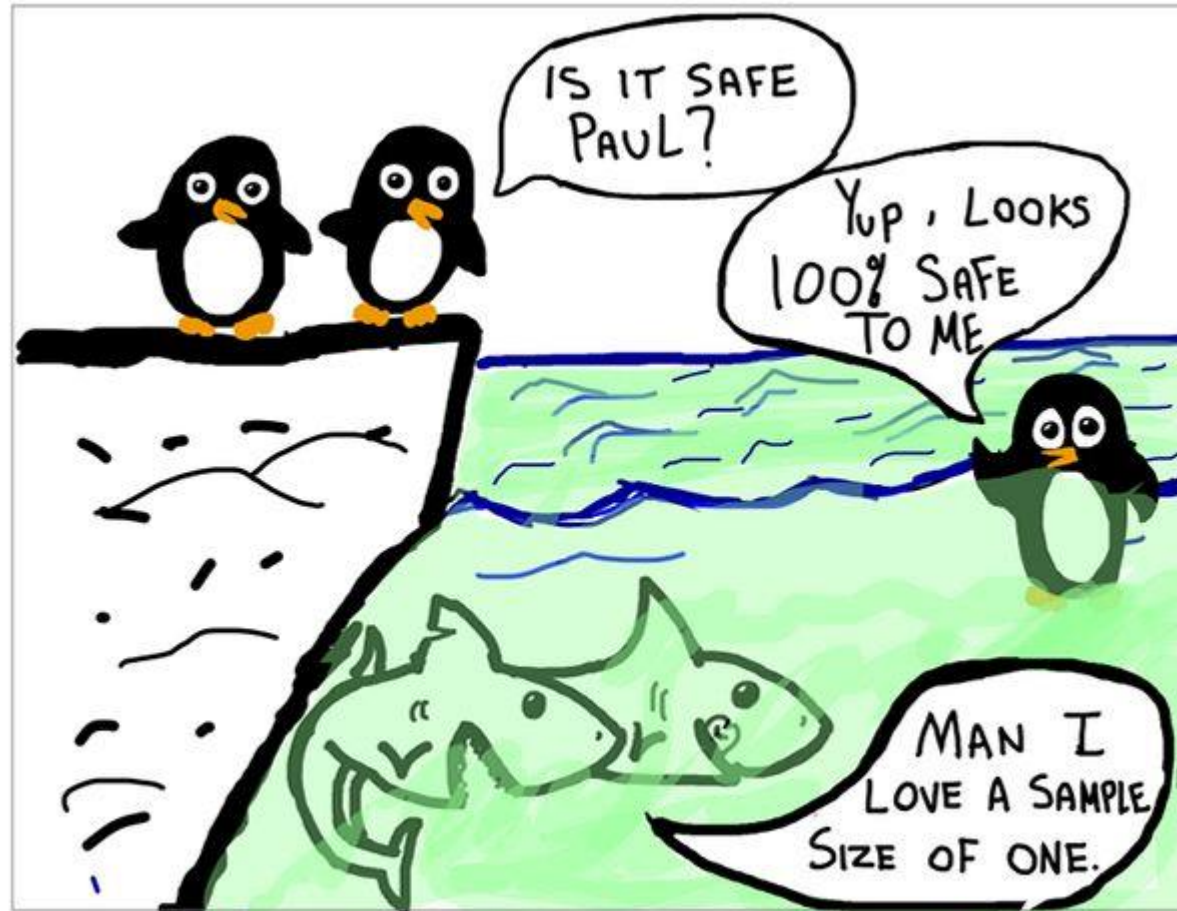
Diversity in deep-sea benthic macrofauna: the importance of local ecology, the larger scale, history and the Antarctic

John D. Gage*

Conclusions and assumptions

- Even the most abundant species are scarce in the CCZ
 - Low densities mean unrealistic sampling size to achieve reasonable statistical power.
 - Assumptions:
 - > same number of species = same functions at community level
 - > same abundance in dominant species = same environmental conditions
- => Monitoring species richness & the abundance of the top 2 – 5 most abundant species within each functional / size group**

Thank you...



#DataDoodle by @WholeWhale