

# Pumice rafting:

A hitchhiker's guide to marine biodiversity



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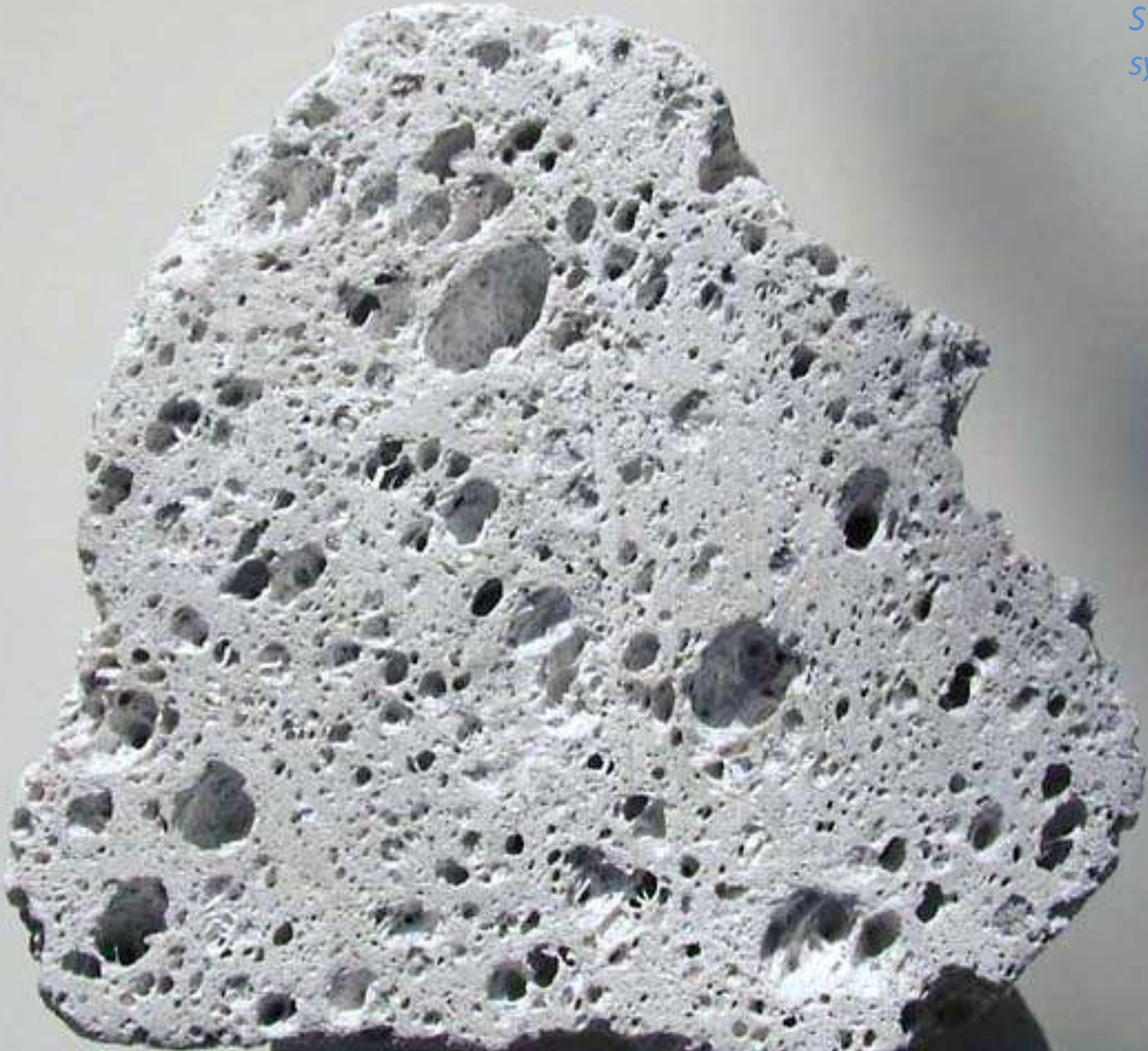
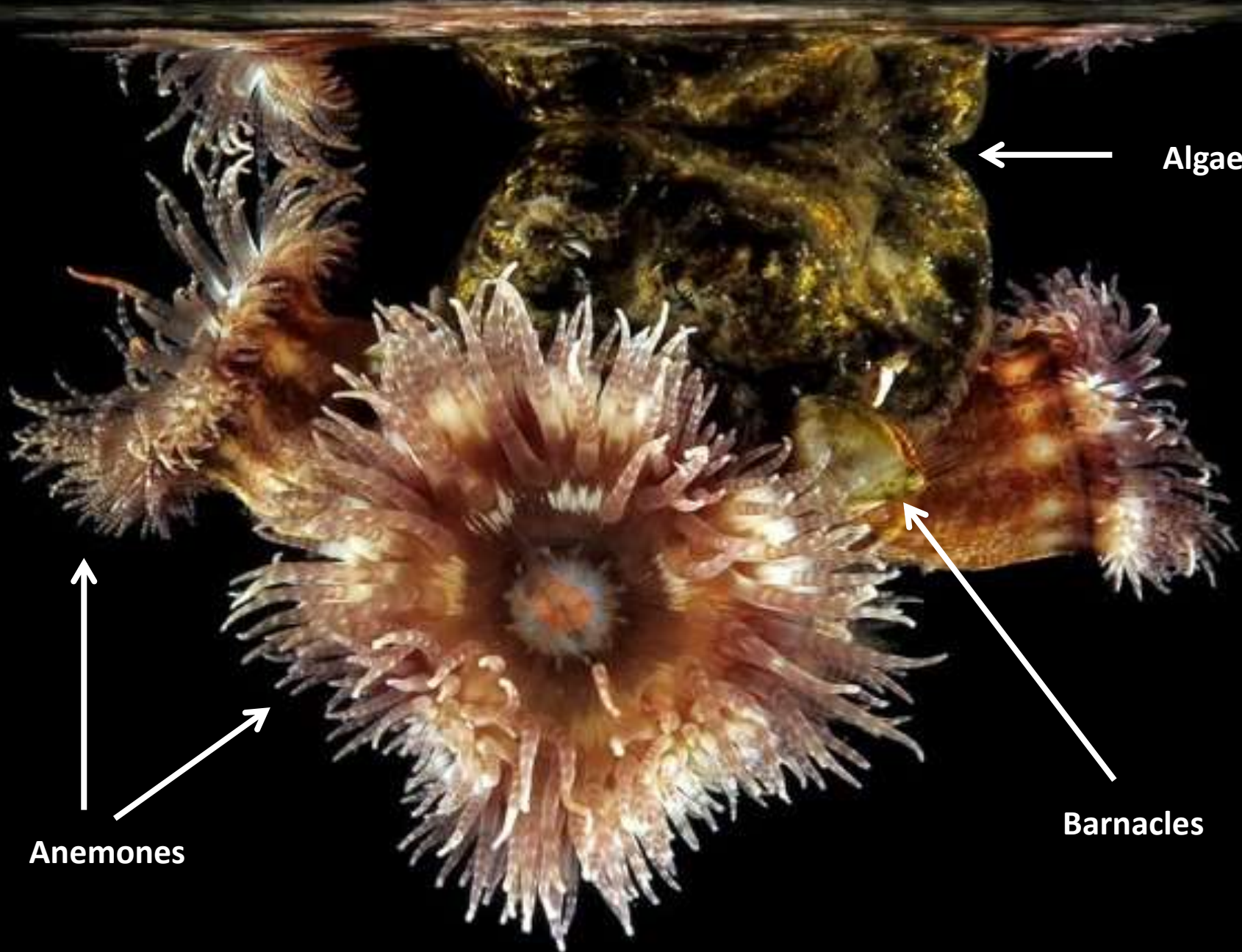




Image courtesy of: Denis Reik



Algae

Barnacles

Anemones

# Pumice rafting frequency

- Every 5 – 10 years in South-western Pacific
- >200 years
- Anecdotal recordings
- 1883 - Sailors able to walk on open ocean due to enormity of pumice raft formed - Krakatau

(Adelaide Observer (Australia)  
newspaper of December  
29, 1883)



# Pumice rafting frequency

*Study  
system*



Image courtesy of: [australiangeographic.com.au](http://australiangeographic.com.au) & [acfonline.org.au](http://acfonline.org.au)

# But don't plankton achieve this?

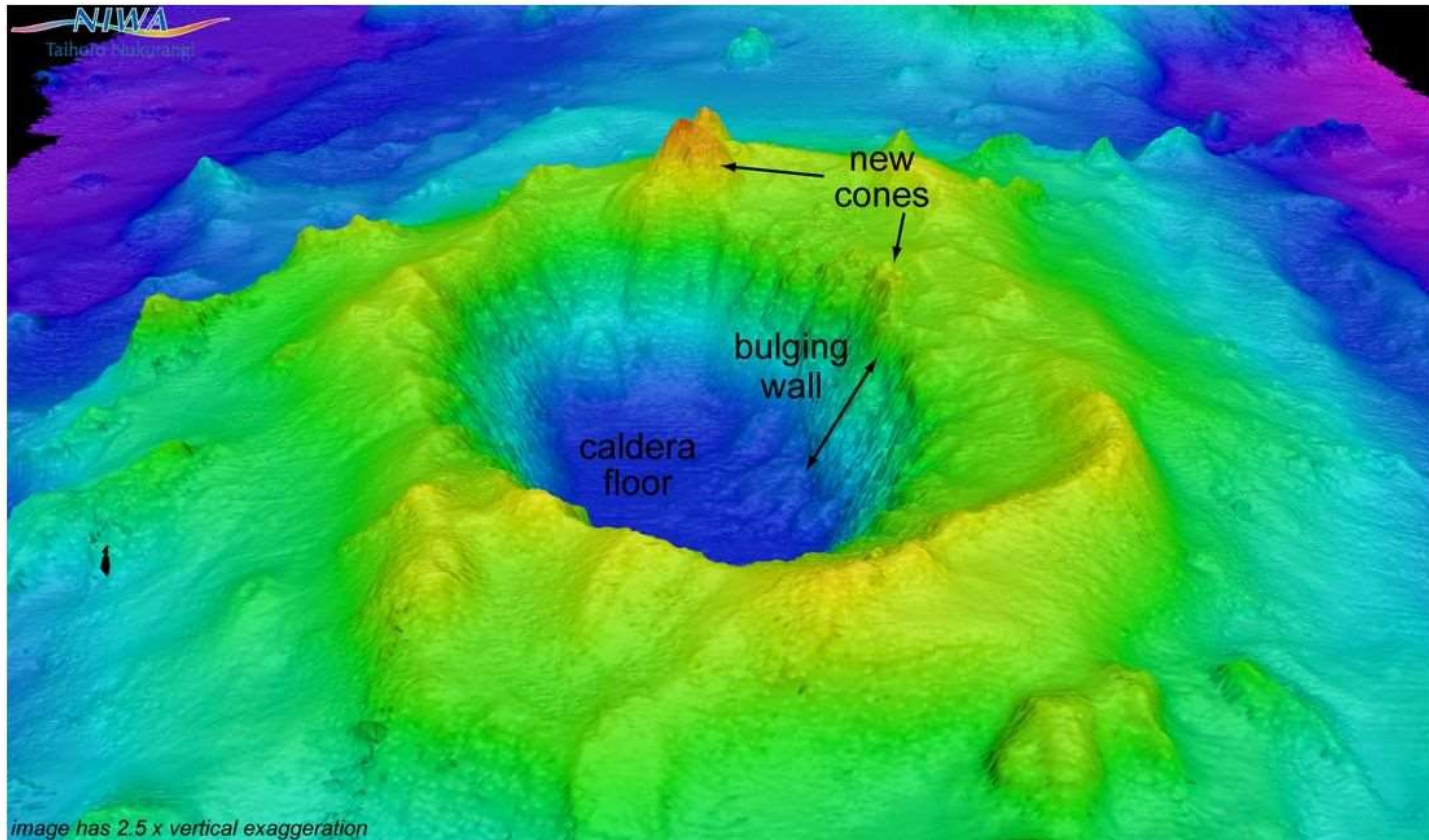
- Not necessarily!
- Most sessile planktonic species have low dispersion & survival rates
- Corals = <600m; <3 days
- Bryozoans = <100m; <36 hours
- Compared to molluscs which can travel 4400km; 293 days

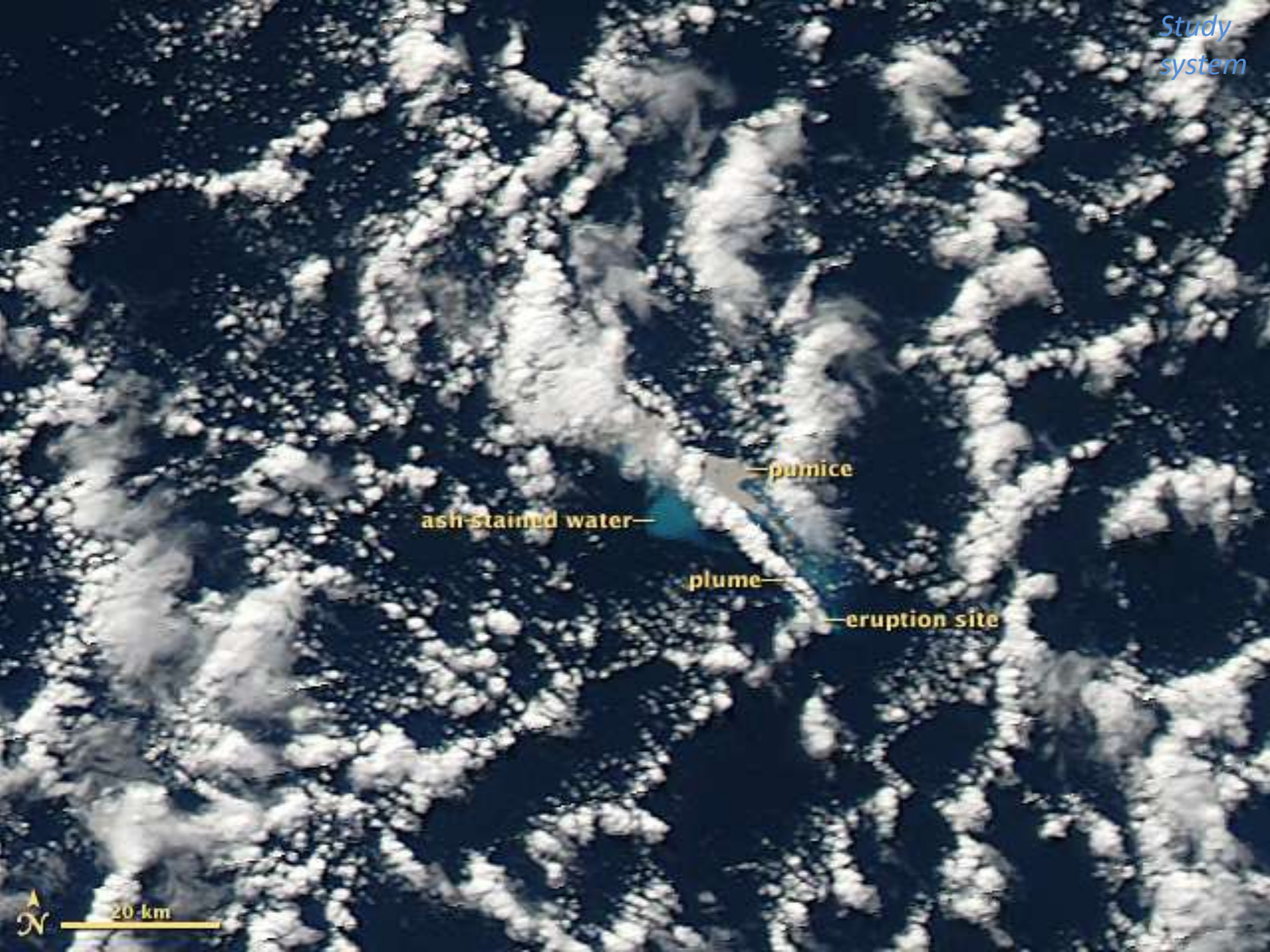




# The Havre Seamount

- Erupted July 2012
- Forming an enormous pumice raft
- 4 trillion pumice clasts
- Affected  $>550,000\text{km}^2$  = area of France





ash-stained water

pumice

plume

eruption site

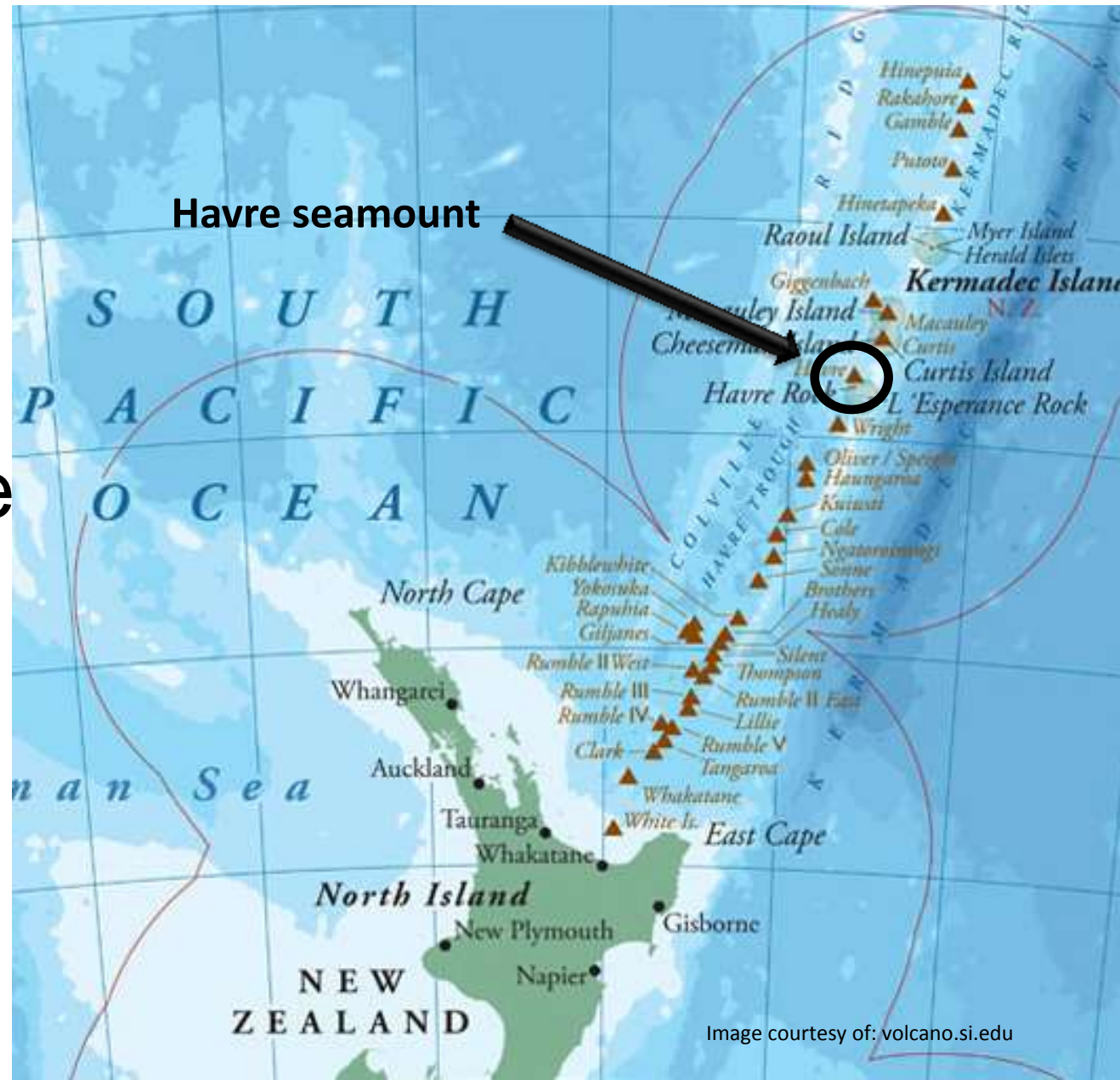


20 km



# Where is the Havre Seamount?

- Located on Kermadec arc
- Sub-tropical marine zone
- North-East of New Zealand



# The Havre pumice raft

- >8 months to arrive on eastern Australia shores
- Assume 1/3 of raft arrived in Australia = 1 trillion pumice clasts (after Bryan et al. 2012)
- Also assume, 1 pumice stone = transport for 1 organism
- Laden with >trillions of marine hitchhikers



# Pumice rafted community provides unique opportunity to test TIB

## How?

- Each clast formed at same time and place
- Similar underlying structure & chemistry
- Acted on by similar initial biotic and abiotic conditions
- Is a huge natural experiment with trillions of replicates

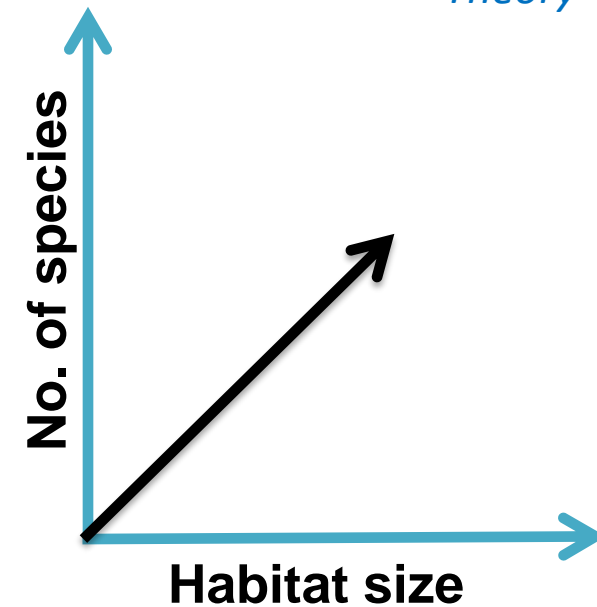
**Each pumice clast can be thought of as a mini-island**



# How am I testing TIB?

## 1) Species-area relationship

**(SAR):** larger habitat = increased species richness (more niche space + target effect)



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ORIGINAL  
ARTICLE

## A general dynamic theory of oceanic island biogeography

Robert J. Whittaker\*, Kostas A. Triantis and Richard J. Ladle

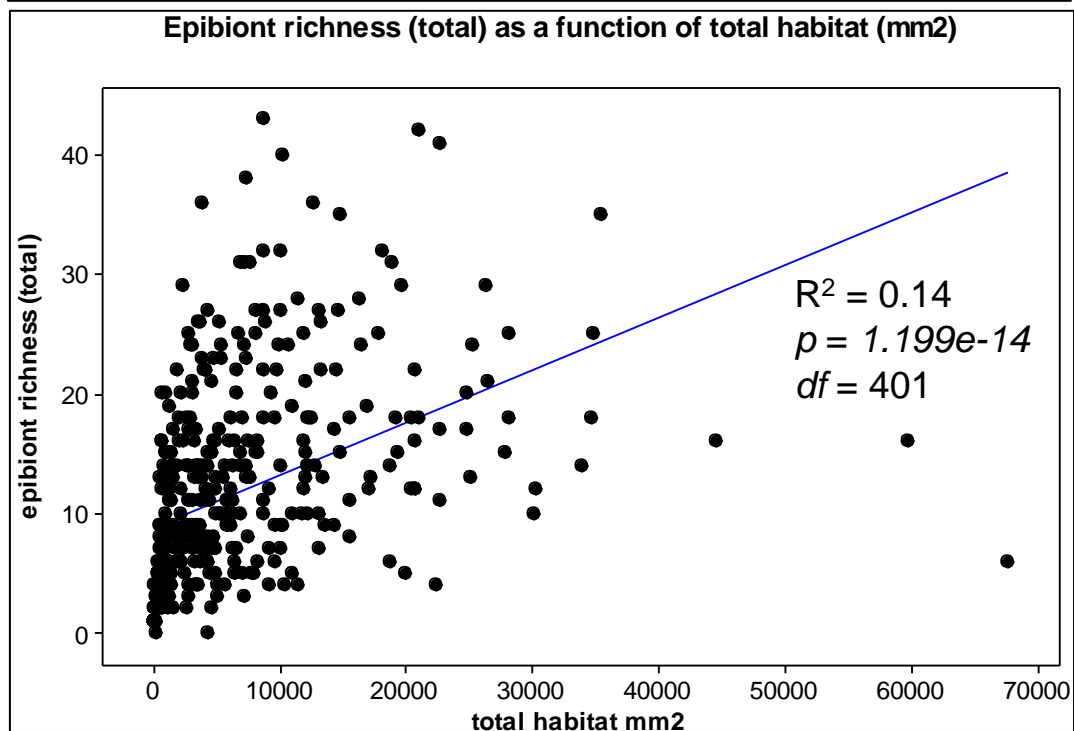
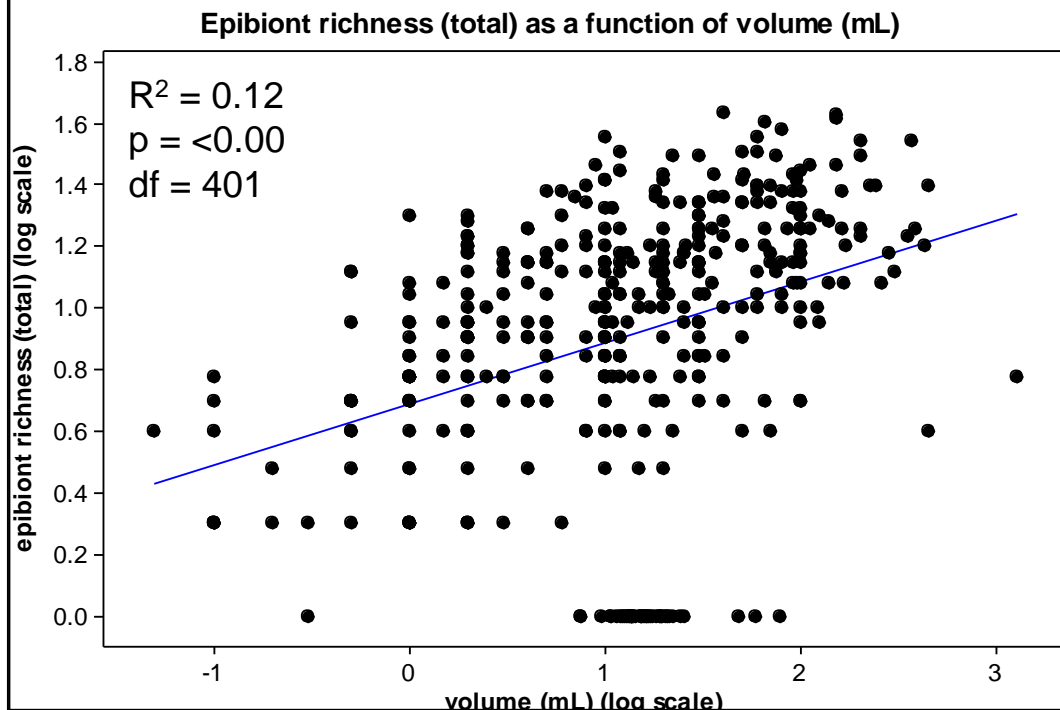
**2) GDM developed by Whittaker in 2008 added two predictive factors:**

- i) age (immigration, speciation etc) &
- ii) isolation (reduced chance of arrival)

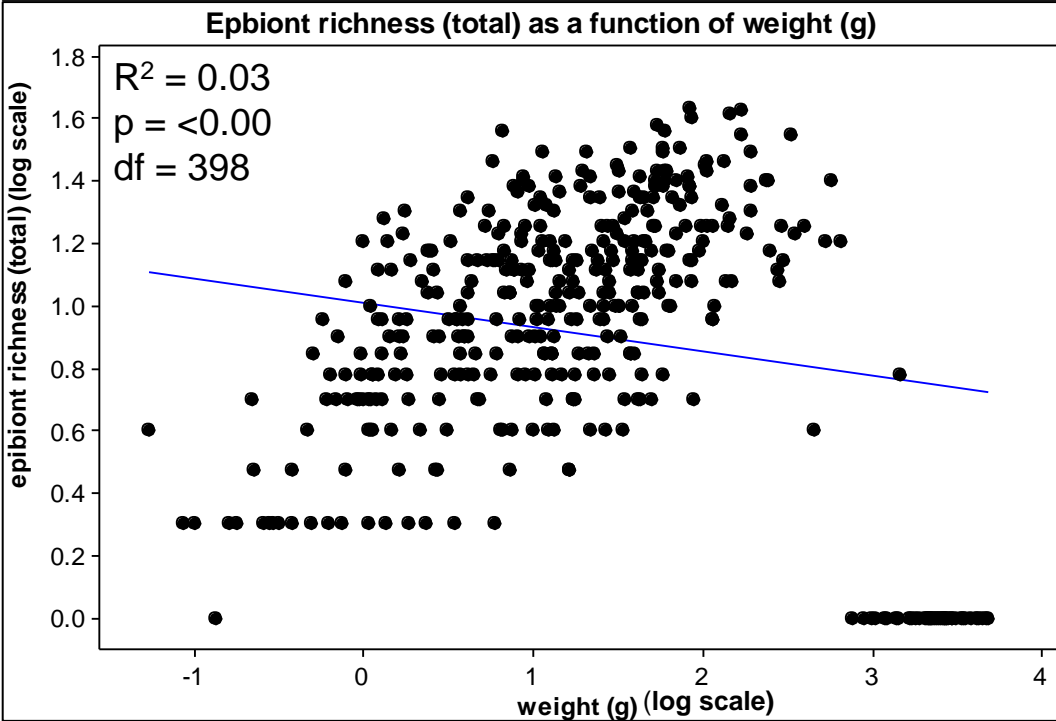
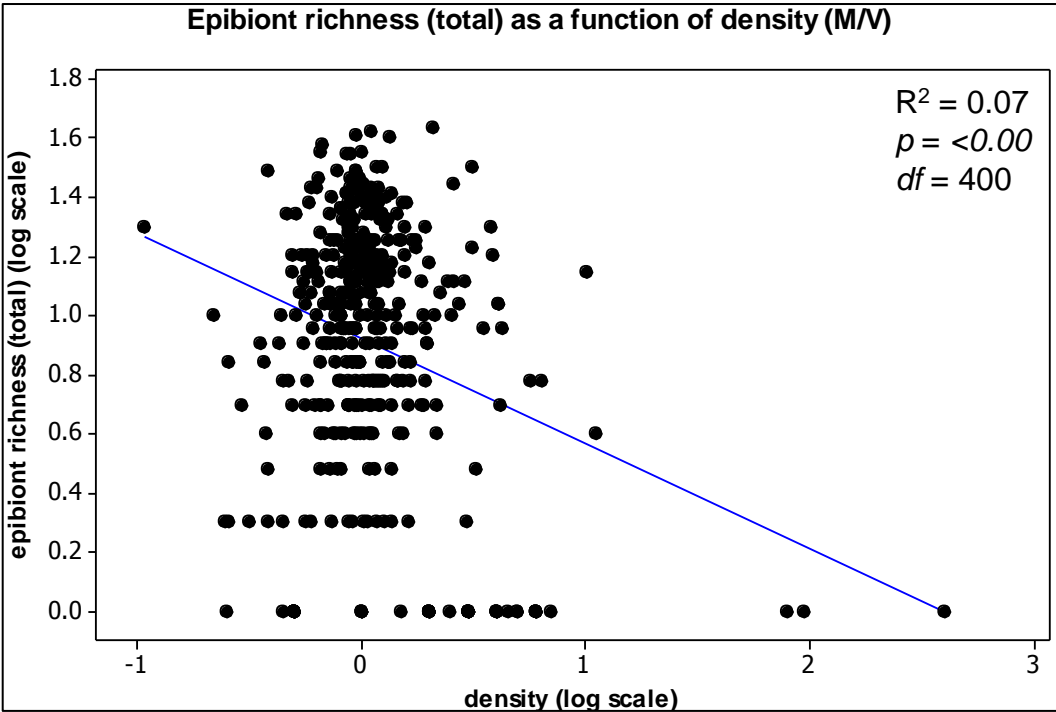
# Preliminary Results

- 403 clasts from 13 locations processed
- >66 epibiont groupings from 10 phyla (most likely more – currently awaiting IDs)









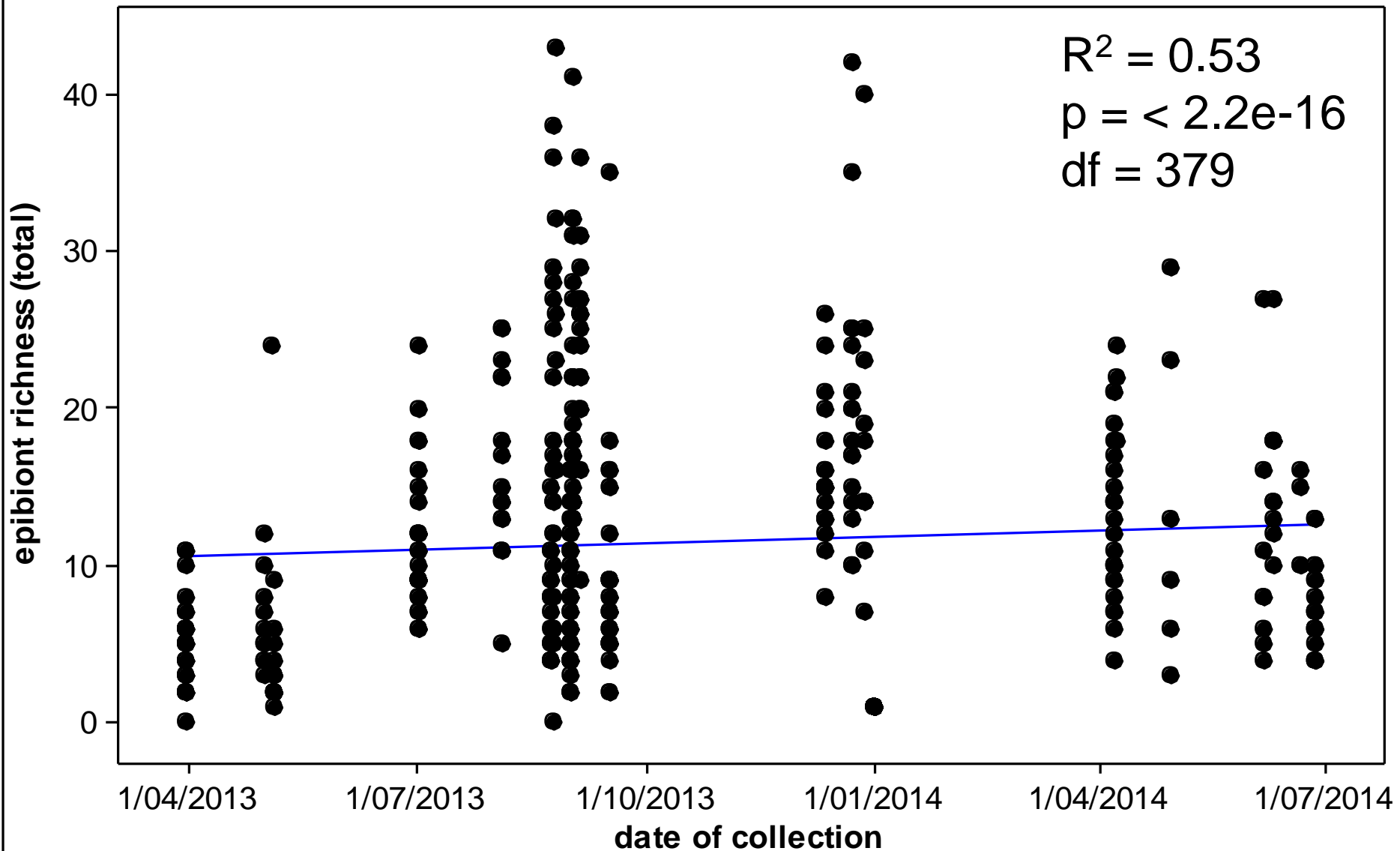
# Why a negative relationship?

- Weight/Density has negative relationship
- Possibly due to increased porosity of **lighter** pumice clasts = increased habitat
- Porosity provides **safe sites** for epibiont colonisation



# Test of GDM using age of clasts

Epibiont richness (total) as a function of date of collection



# MEM Results

*Preliminary  
Results*

Effect	df	logLik	AICc	Delta	Weight
Total habitat mm <sup>2</sup>	3	5 -1295.146	2600.443	0.000000	0.987823959
Days since eruption	13	6 -1298.800	2609.812	9.369178	0.009124065
Distance travelled	23	6 -1299.895	2612.003	11.559430	0.003051976

# Conclusions

- Evidence that TIB is a predictor for Pumice rafting:
  - SAR is maintained over various measures of habitat size
  - Total habitat being strongest predictor
  - GDM tests of “age” also indicate that this predictor works for pumice epibiont richness
- Despite limitations:
  - Pumice islands move in time & space
  - Species disperse during island movement and upon washing up on shorelines
  - Inability to ID all animals

# Acknowledgements

- The Queensland Museum and collaborators
- HDR students in R Block & Research Master Class
- Laboratory assistants @ QUT
- My husband



Coral



Amphipod & hydroids



Polychaete worm

Images courtesy of: Denis Reik

Questions?



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