

Globally replicated experiments offer a new perspective for the empirical testing of concepts in ecology

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Benthic Ecology Meeting 2006 ·Quebec City, Canada·March 8th -12th



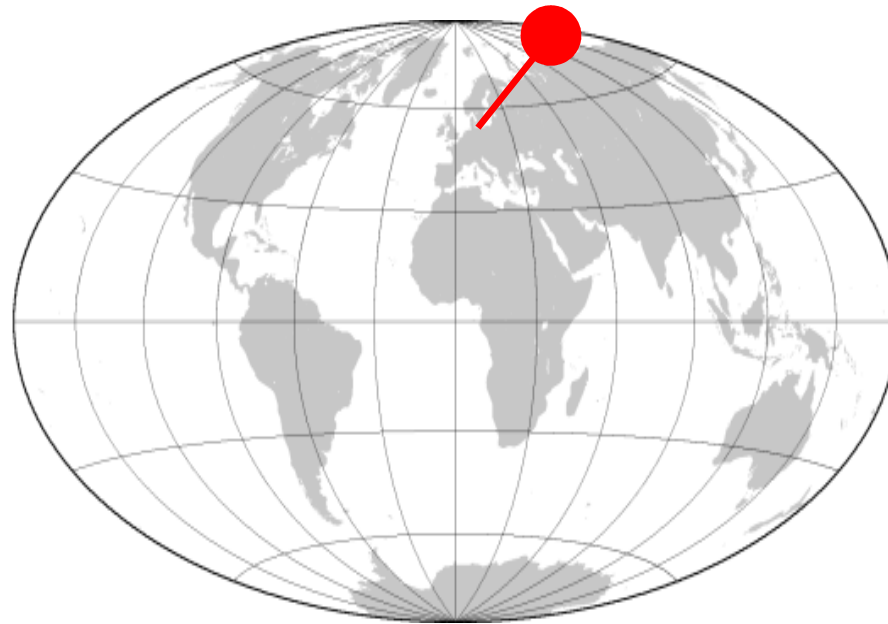
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GAME: Global Approach by Modular Experiments

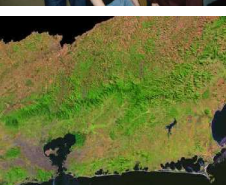
in Marine Benthic Ecology

is an International Research and Student Training Program.



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Aims



- studying relevant and controversially discussed ecological topics
- making robust conclusion and predictions based on the meta-analyses of globally replicated experiments
- training students in an international network of marine research institutions
- consolidating scientific contacts and preparing future collaborations

Misery of Experimental Ecology



Complexity

Interactions

NOISE

Feedback
Mechanisms

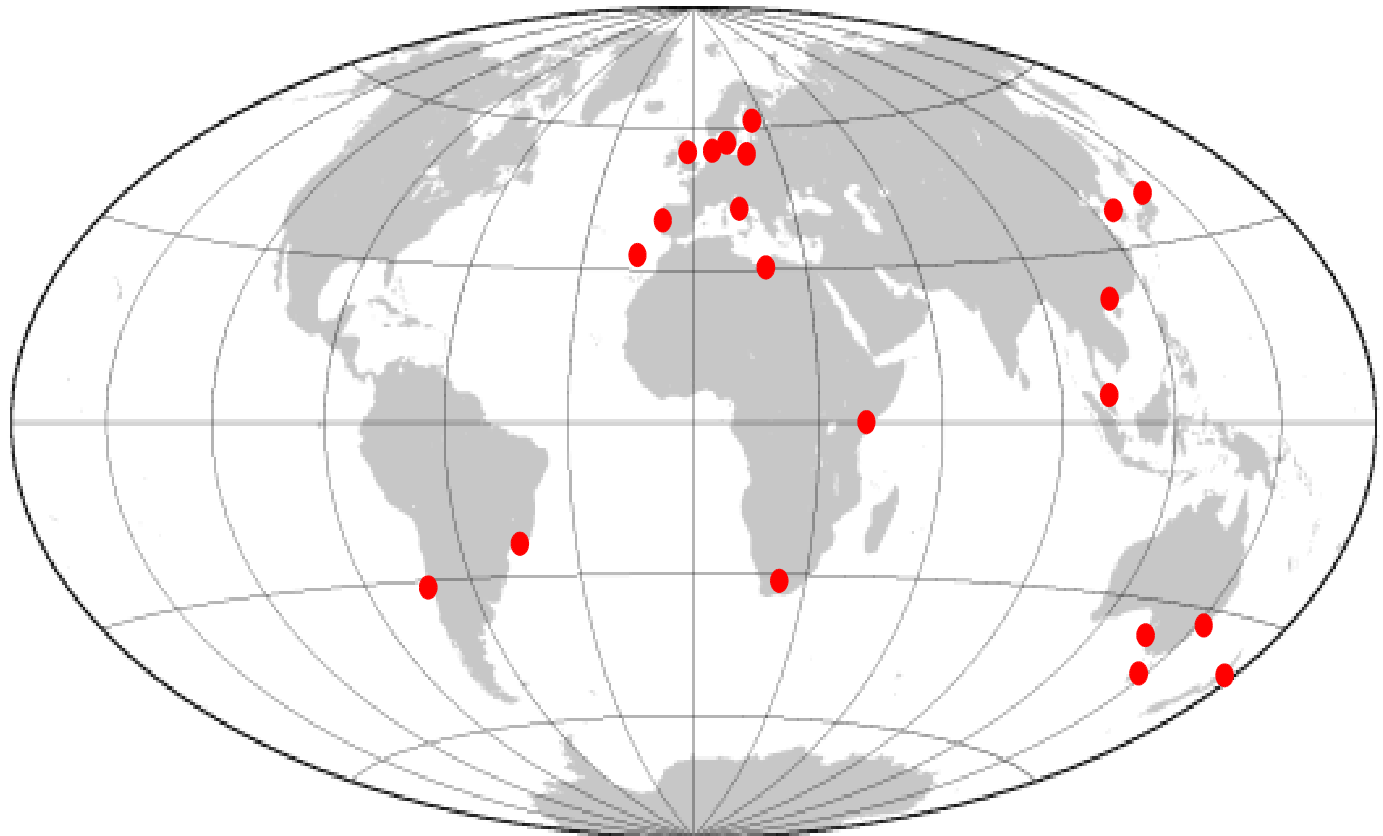
Variable
System
Parameters

Answer: Replication of Experiments in Space...



Global by Modular Experiments

...the Global Approach

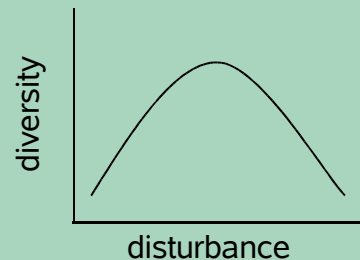


Currently, 21 Stations in 17 Countries.

Tool: Modular Experiments



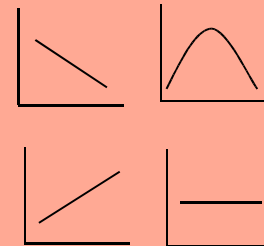
1. One question: e.g. is the disturbance-diversity relationship generally unimodal?



2. One experiment: e.g. applying physical disturbance regimes to fouling communities.

3. Different ecosystems: e.g. in Australia, Brazil, Chile, Japan, Italy, Sweden....

4. One Answer?



Structure

18 experiments per question (i.e. one project).....

...in 9 different countries worldwide.

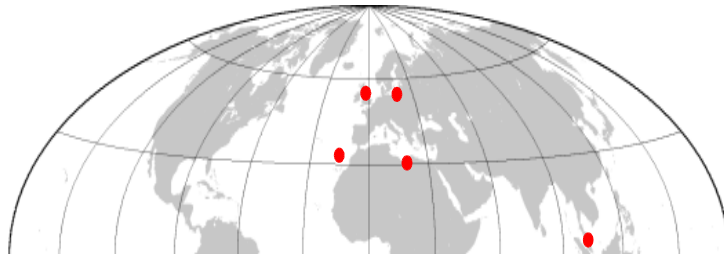


18 students per project...

...working together in teams of two.

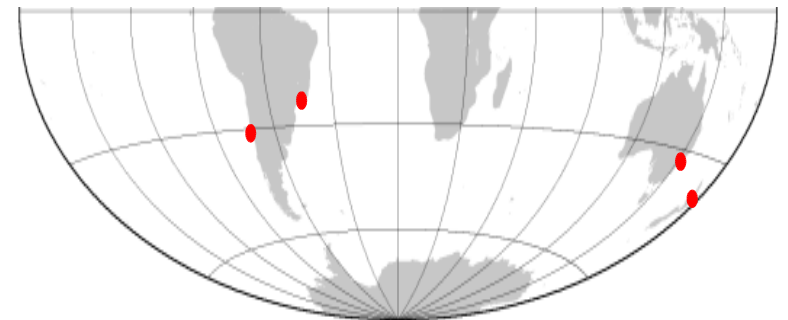


Structure



Northern Hemisphere
Experiments: May to October
5 Countries

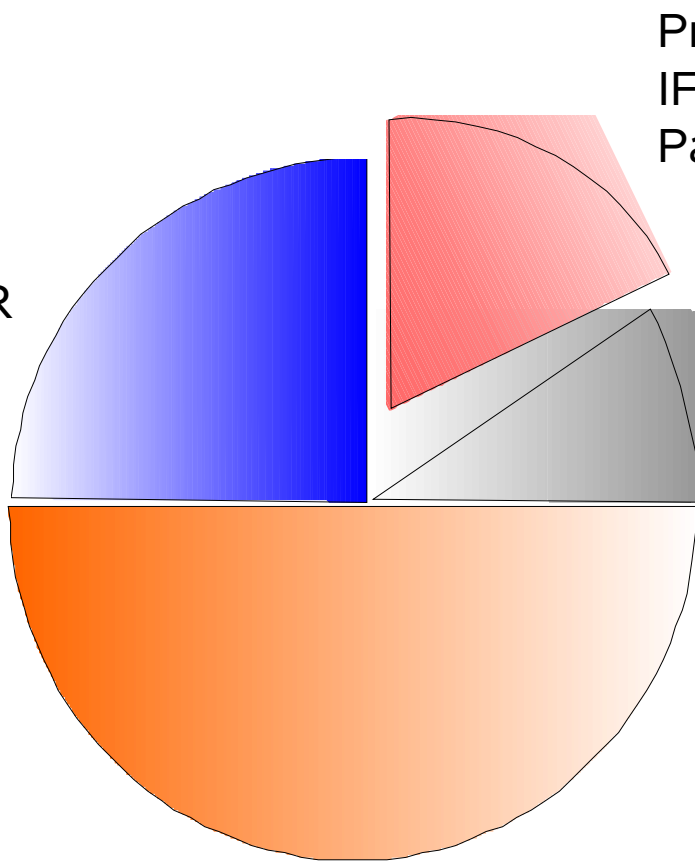
Southern Hemisphere
Experiments: November to April
4 Countries



Structure



Analysis,
Interpretation,
Publication,
3 Months,
IFM-GEOMAR



Preparation, **2 Months**,
IFM-GEOMAR and
Partner Institutes

Introductory Course,
1 Month, IFM-GEOMAR

Experiments, **6 Months**,
Partner Institutes

Small Scale: Study sites



Chile



Madeira Island, Portugal



Tasmania, Australia



England



New Zealand

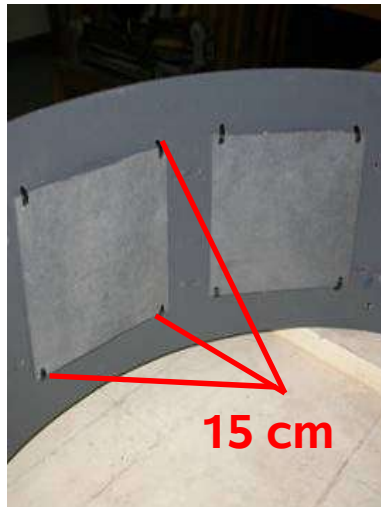


Malaysia

Small Scale: Model System



Fouling communities grown on artificial hardsubstrata



Topics



Pilot study: Effects of UV radiation on shallow water hardbottom communities (2000 - 2002).



#1: Inducible chemical defense in macroalgae (2002 - 2004).



#2: Interactive effects of disturbance and nutrient availability on hardbottom communities (2003 - 2005).



#3: Effects of temporal variability in a disturbance regime on hardbottom communities (2004 - 2006).

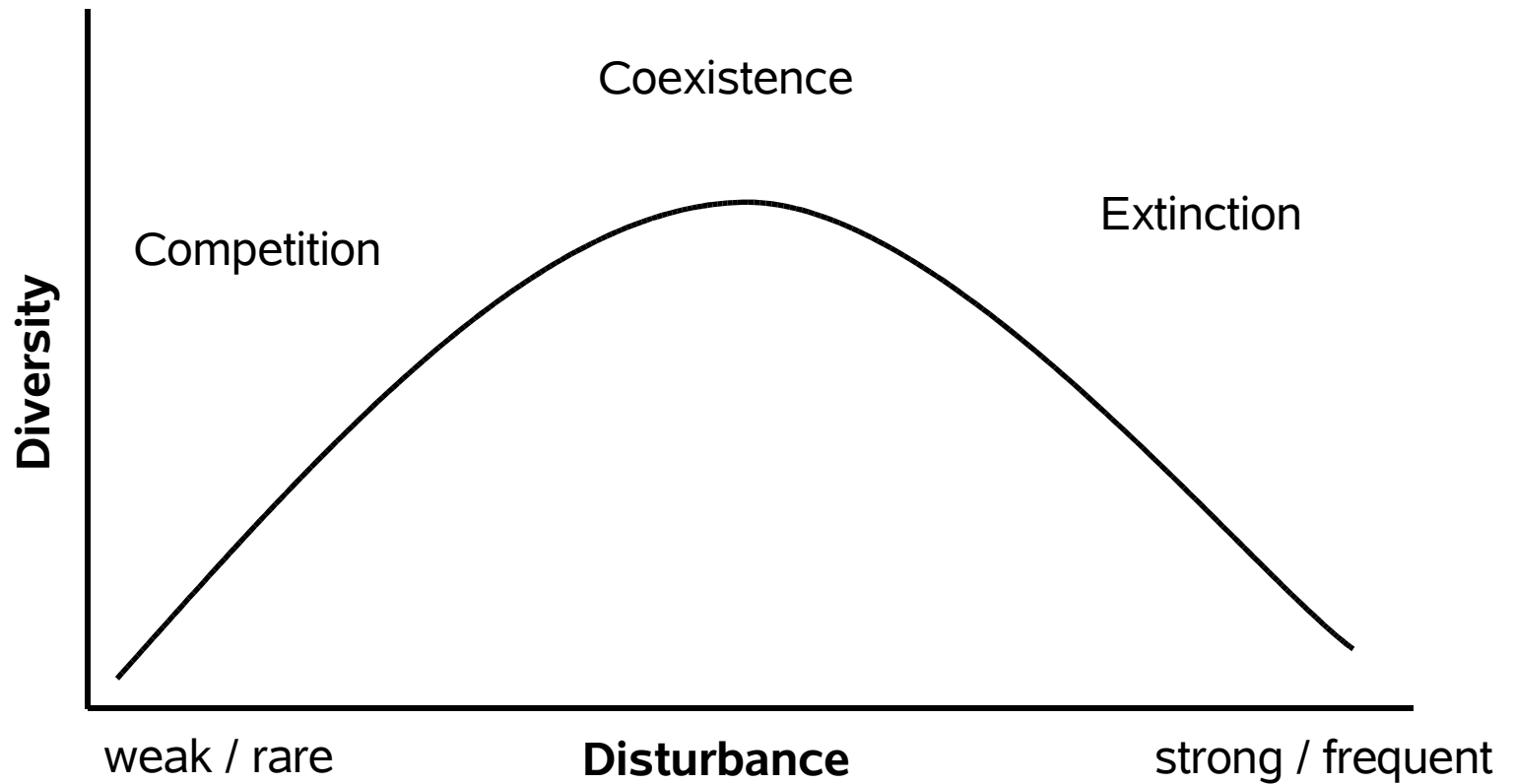


#4: Role of community structure for invasion dynamics (2005-2007).



Disturbance-diversity relationships

Intermediate Disturbance Hypothesis (IDH)
sensu Grime (1973) & Connell (1978)



Disturbance-diversity relationships

Disturbance regime

Intensity : complete removal of 20% of total abundance per disturbance event.

Frequency: number of disturbance events in 168 days.

Levels of Frequency: 0, 2, 3, 4, 6, 12 events in 168 d.



Disturbance-diversity relationships

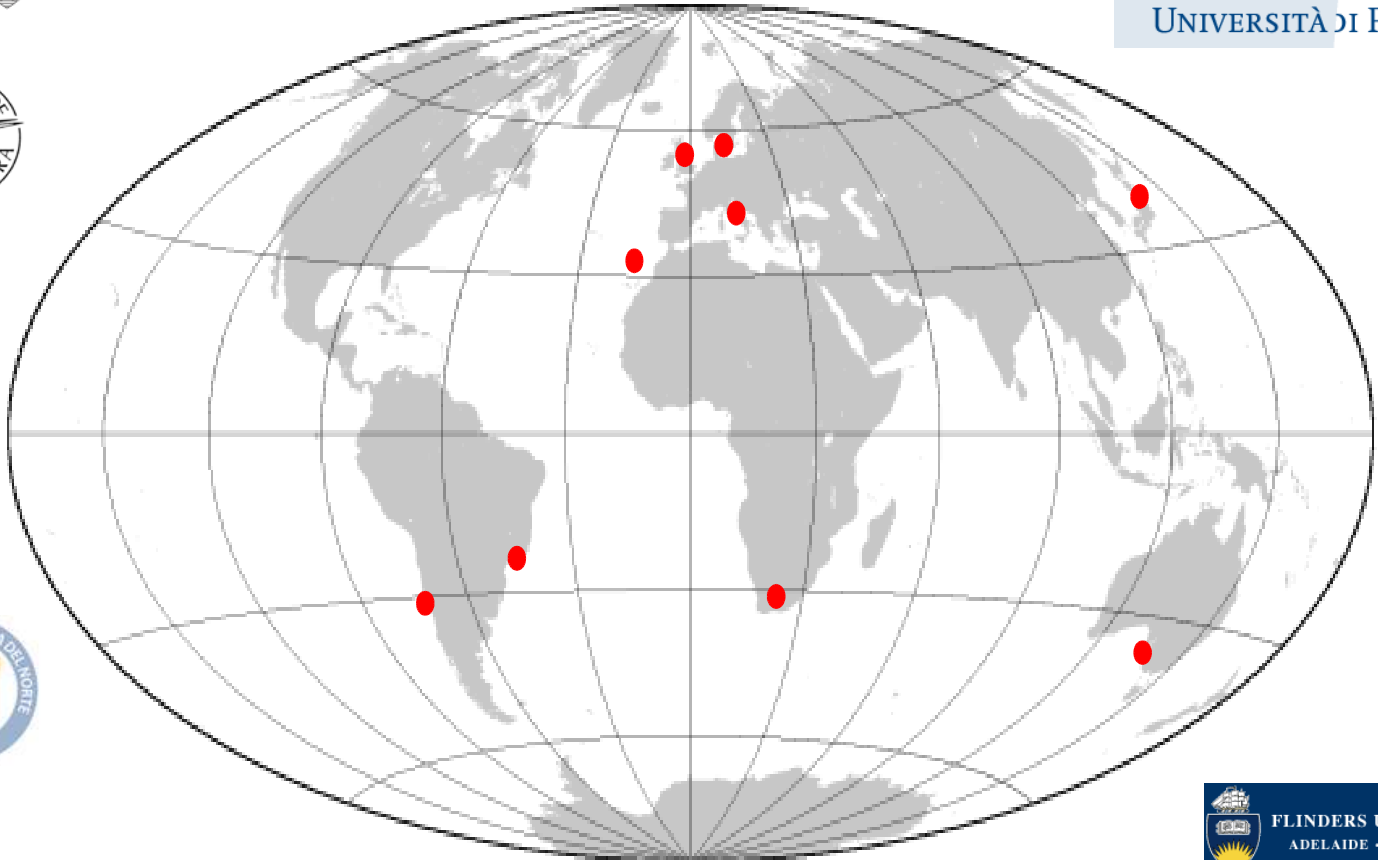


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Disturbance-diversity relationships



| Country | Pattern |
|--------------------|---------|
| Portugal (Madeira) | |
| England | |
| Sweden | |
| Italy | |
| Japan | |

| Country | Pattern |
|--------------|---------|
| Brazil | |
| Chile | |
| South Africa | |
| Australia | |

Disturbance-diversity relationships

Summary:

Unimodal disturbance-diversity relationships were observed in $< 25\%$ of the cases.

IDH requires a set of prerequisites which are rarely encountered in the systems investigated.

The explanatory power of the concept for patterns in diversity is restricted.

Valdivia et al.(2005) Mar Ecol Prog Ser 299: 44-54

Contardo Jara et al.(2006) Mar Ecol Prog Ser 308: 37-48



Topics



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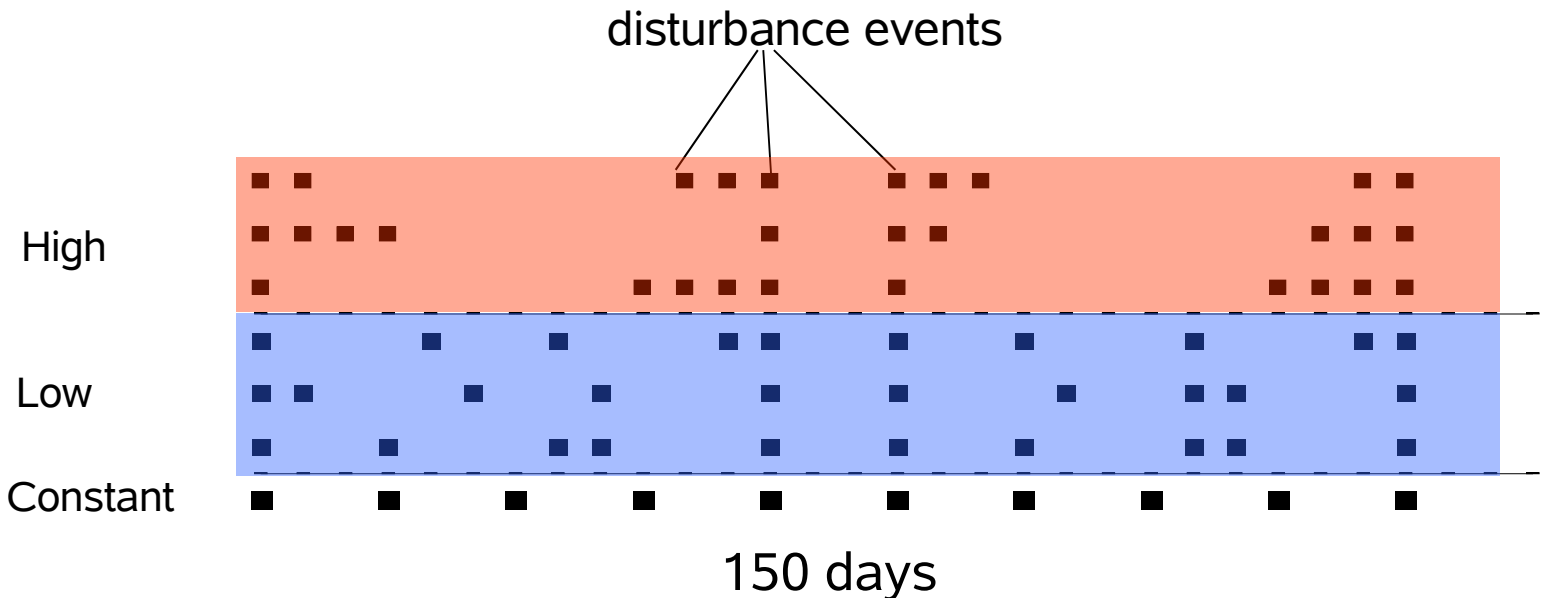
Temporal variability of disturbance

Disturbance regime

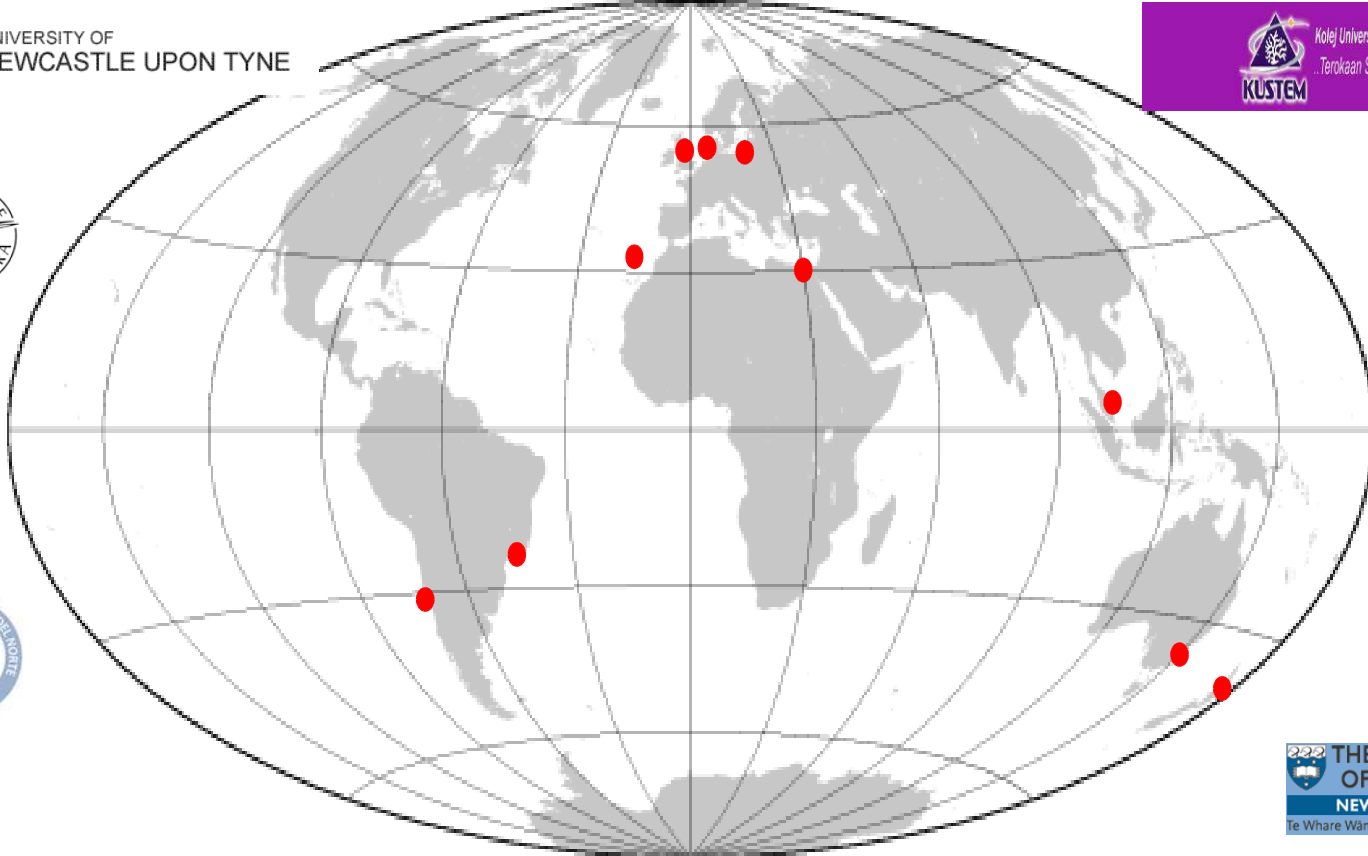
Intensity : complete removal of 20% of total abundance.

Frequency: 10 disturbance events in 150 days.

Variability: Different lengths of inter-disturbance intervals.



Temporal variability of disturbance



Temporal variability of disturbance

Summary:

Effects of disturbance on community structure in all systems.

Significant effects of temporal variability in the disturbance regime in 1 out of 10 systems.

In the systems investigated, temporal variability of disturbance is generally of low relevance.

Required:

- a) Match between temporal patterns of disturbance and patterns in colonization or growth.
- b) Competition for space among solitary and colonial organisms.

Cifuentes et al. submitted

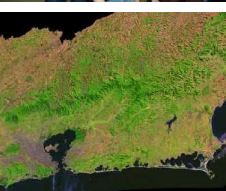
Atalah et al. submitted



Survey

After 3 years of GAME....

- 52 students successfully finished the program
- 8 started their experiments in November 2005
- 10 will start the program in April 2006
- 21 research institutions in 17 countries participated in GAME
- 18 publications are submitted to, accepted by or already published in peer-reviewed journals



Acknowledgements



Global by Modular Experiments

We thank the Mercator foundation for funding the program and all our partners and students for realizing it.

Visit GAME at www.ifm-geomar.de



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