Organisms to Ecosystems

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Do you need a work flow?
Genes to Ecosystems

The “Holy Grail”
BIOLOGY
WP1 + WP2 + WP3
Transcriptomics
Proteomics

WP4 + WP5

WP1
Physiology

Acclimation

Altered
physiology

WP3
Immunology

Mechanism
change

WP2
Reproduction

Life history
change

Ecological
change

Strategy
change

Modelling

Energy budgets and
resource partitioning

WP1 + WP2 + WP3
+ WP4 + WP5
Envisioning a Marine Biodiversity Observation Network
Duffy et al. (2012) Bioscience 63, 350-361
Figure 2. Aquatic biodiversity can be assessed over spatial scales from millimeters to thousands of km using a combination of detection methods (top panel) and observing infrastructures (bottom panel). Some observing infrastructures can accommodate multiple detection methods, indicated here by different colors: e.g. ships can accommodate all four detection methods whereas satellites use only imaging methods. The relevant spatial scales refer to the range of a single unit and single sortie for each instrument type.
APEX

Accurate prediction of how ecosystems will be affected under climate change
FOUNDATION

Biodiversity surveys
Long term monitoring and surveys
Standard protocol: minimum reporting standards

BUILDING BLOCK
Organism
Picture
Type specimen
Barcode

Building Block
Abundance
Food webs

Diet

Genetic Connectivity

Reproductive mode: broadcast/brooder
Age at first reproduction
How long the larvae are in the water column

Life history traits

Life span
Age structure of population
Effects of ageing
Reproductive efficiency

Community interactions

Mobility

Genetic structure
Heterozygosity

Seasonality

Oceanography and water chemistry

Bentho-pelagic coupling

Meio/microfauna

Genetic Connectivity
Reproductive mode: broadcast/brooder
Age at first reproduction
How long the larvae are in the water column
Temperature tolerance and rate of change

**Experimental manipulation**
Simulate environmental stress

**Molecular studies**
Refine thresholds
Trade-offs

**Rate of change**
Upper temperature limit (°C)
0
2
4
6
8
10
12
14
16
18
20
day\(^{-1}\)
week\(^{-1}\)
1 month
3 month

**Long term culture**
<table>
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<tr>
<th>Species</th>
<th>Tractable</th>
<th>Common</th>
<th>Husbandry</th>
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<tr>
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<td>Spirorb R: Paralaeospira levinseni</td>
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Actual data decreases
More reliance on models

But structure will:
• Highlight gaps
• Provide impetus for experiments and data collection

Work flow and modular structure should provide:
• Compatibility
• Scalability
• Reproducibility