Pilbara Marine Conservation Partnership

Managing the conservation values of coral reef ecosystems in the Pilbara/Ningaloo region, Western Australia
Setting priorities for conservation at the interface between ocean circulation, larval connectivity, and population dynamics

- Ecological connectivity
- Population dynamics
- (unknown) natural variability
- Purpose of management intervention:
  - system maintenance and system recovery
Method

• Extensive fieldwork & habitat mapping
• Hydrodynamic model
• Particle tracking model
• Ecological model
• Network analysis

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Method

Extensive fieldwork & habitat mapping
(1200+ transects in 47 zones)
Method

Regional Ocean Modelling System, years 2004-2009
Method

Particle tracking (3430 reefs in 47 zones)
Method

Particle tracking
Method

**Betweenness centrality**

the number of shortest paths between any two zones that go through a specific zone
\[ b_{i}^{t+1} = b_{i}^{t} - d b_{i}^{t} + r b_{i}^{t} \left( 1 - \frac{b_{i}^{t}}{K_{i}^{t}} \right) + \sum_{j} C_{j,i} b_{j}^{t} f + e_{i}^{t} \]

growth \quad density \ dependence \quad connectivity \quad recruitment \quad noise
Method

\[ b_{i}^{t+1} = b_{i}^{t} + r b_{i}^{t} \left( 1 - \frac{b_{i}^{t}}{K_{i}^{t}} \right) - d b_{i}^{t} + \sum_{j} C_{j,i} b_{j}^{t} f + e_{i}^{t} \]
Method

\[ b_{i}^{t+1} = b_{i}^{t} - db_{i}^{t} + rb_{i}^{t} \left( 1 - \frac{b_{i}^{t}}{K_{i}^{t}} \right) + \sum_{j} C_{j,i} b_{j}^{t} f + e_{i}^{t} \]
Results

Purpose of management intervention:

- system maintenance
- system recovery.
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Results

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• **system recovery**
Results

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Purpose of management intervention:

- system maintenance
- system recovery
Core Result n. 1

- zones which offer larger contributions to system maintenance do not necessarily do the same for system recovery
Results

- ocean circulation,
- (unknown) natural variability
- larval connectivity, and
- population dynamics
Results

- ocean circulation, \textit{(unknown) natural variability}
- larval connectivity, and
- population dynamics
Results

• ocean circulation, *(unknown) natural variability*
• larval connectivity, and
• population dynamics
Results

- ocean circulation, *(unknown) natural variability*
- larval connectivity, and
- population dynamics
Core Result n. 2

• mean connectivity values are not a good approximation of yearly variability
Results
Core Result n. 3

- A zone’s contribution to system maintenance and system recovery may vary considerably under different connectivity patterns.
Core Results

1. A zone’s contributions to system maintenance vs system recovery may differ.
2. Mean connectivity is a poor indicator of yearly variability.
3. A zone’s role in the system may vary under different connectivity patterns.
Main Questions

• What are the long term patterns of ocean circulation?
• How will climate change affect ocean circulation and ecosystem processes
• What is the aim of conservation initiatives? (sustainability, resilience, others?)

Future work

• Update runs with more recent data of ocean circulation
• Use connectivity to group reefs into more ecologically meaningful zones