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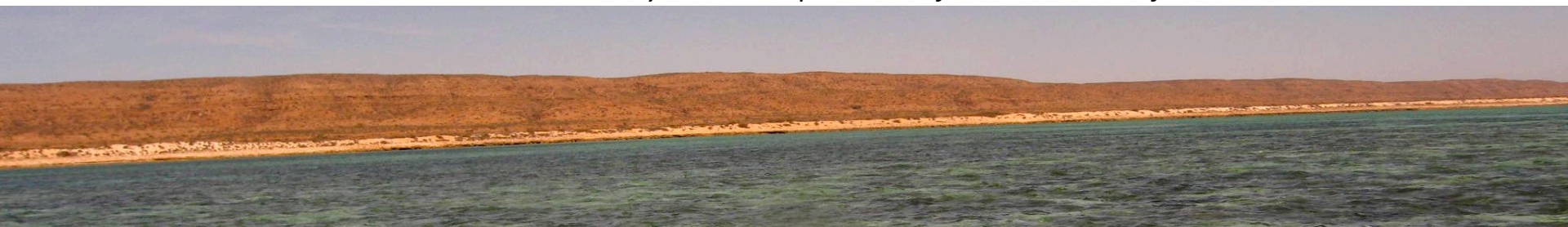


Connectivity and resilience modelling for Pilbara reefs

Potential for application to net
conservation benefit

Fabio Boschetti, Ming Feng, Dirk Slawinski, Frank Colberg, Olly
Berry, Russ Babcock

*This project is funded by the Gorgon Barrow Island Net Conservation Benefits Fund,
which is administered by the WA Department of Parks and Wildlife.*



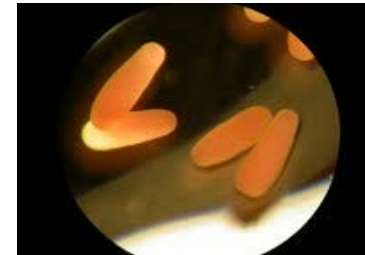
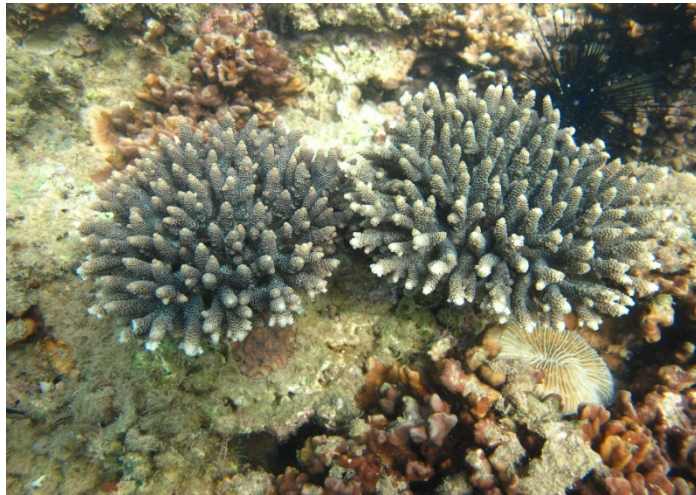


Why larval connectivity?

- Promote resilience of populations/reefs/regions – ability to bounce back from disturbance or disruption

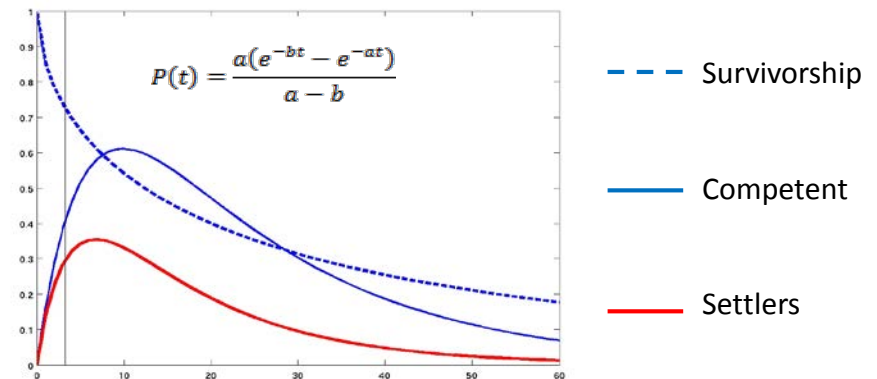


Model species *Acropora millepora*



Acropora millepora
Common mass spawning
species

Larval survivorship dynamics

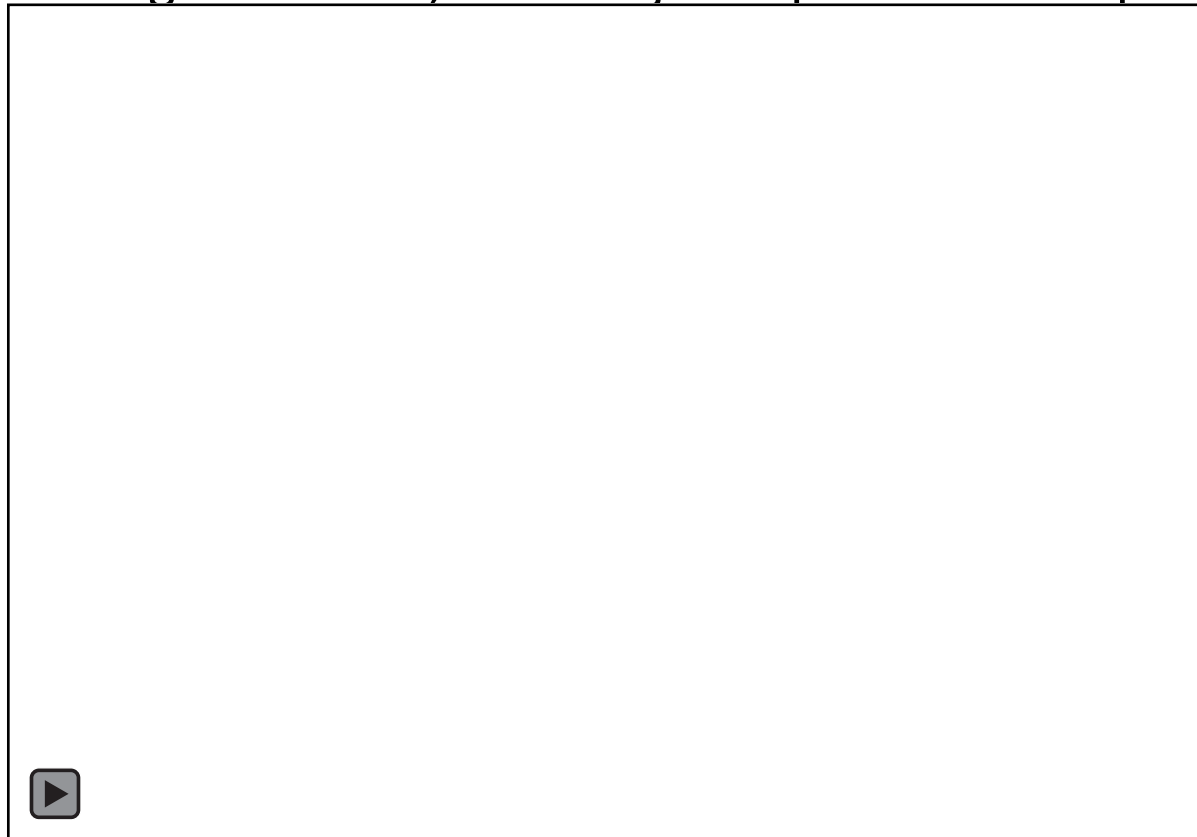


Connolly and Baird 2010



Connectivity

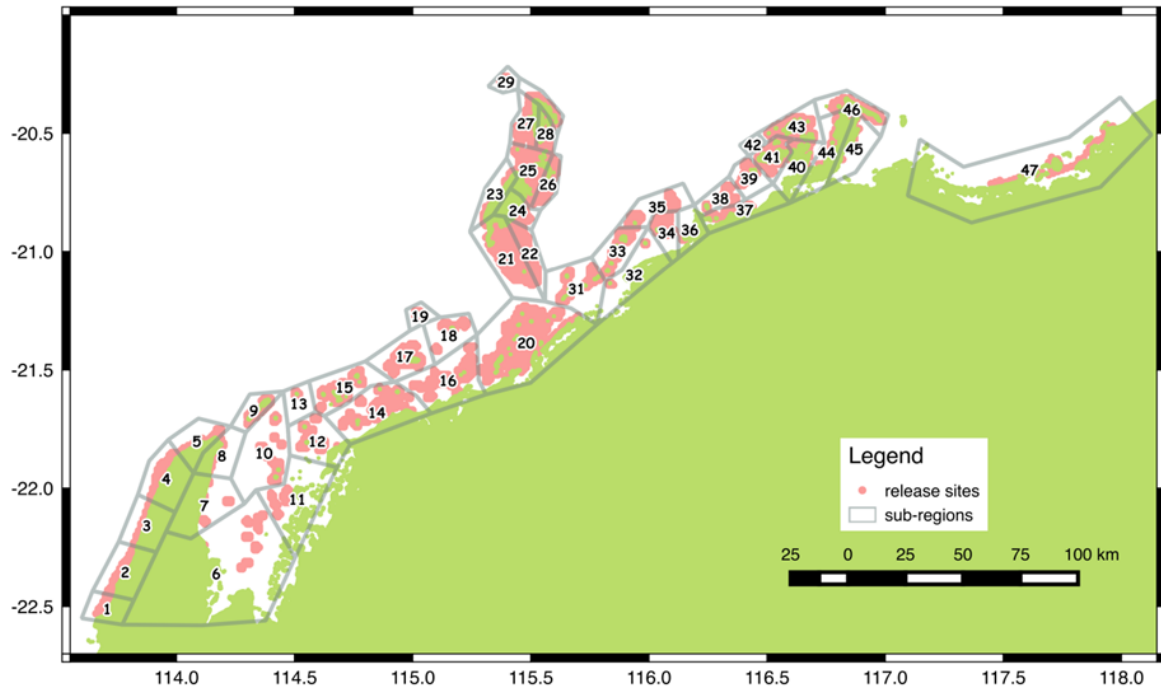
Larvae of marine animals and plants can travel hundreds of kilometres between generations, with major implications of spatial management



ROMS
hydrodynamics
with particle
dispersion
model.

Spatial subdivisions

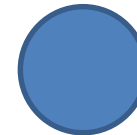
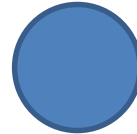
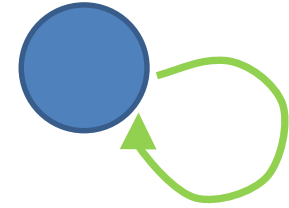
- Over 1000 islands and exposed reefs in the region
- 3430 coral reef locations, which are used as larval release sites in the particle tracking model
- 47 sub-regions defined in this study
- 100 particles per hour for 3 hrs on 3 days per year, for 6 years (900 particles per year)



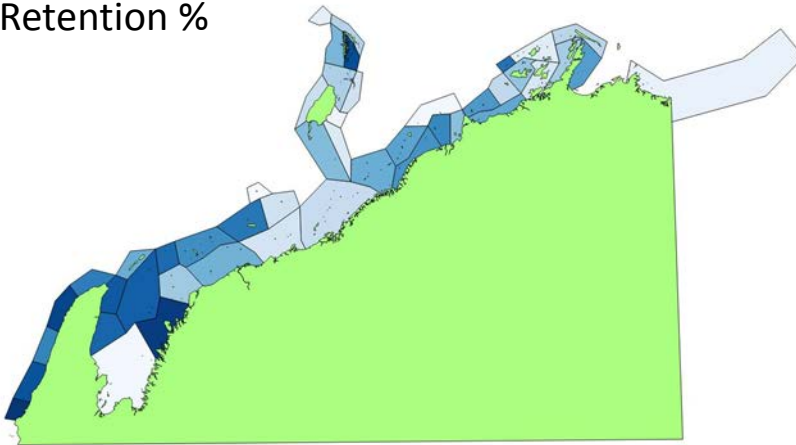


Components of connectivity – which are most important to a reef?

- Sources
- Sinks
- Self seeding
- Retention



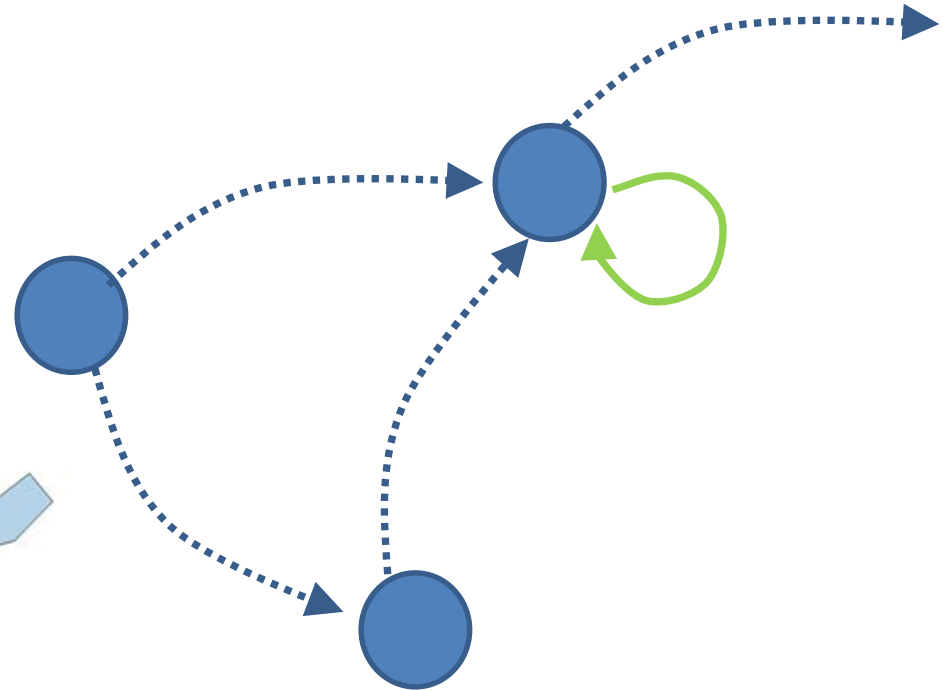
Retention %



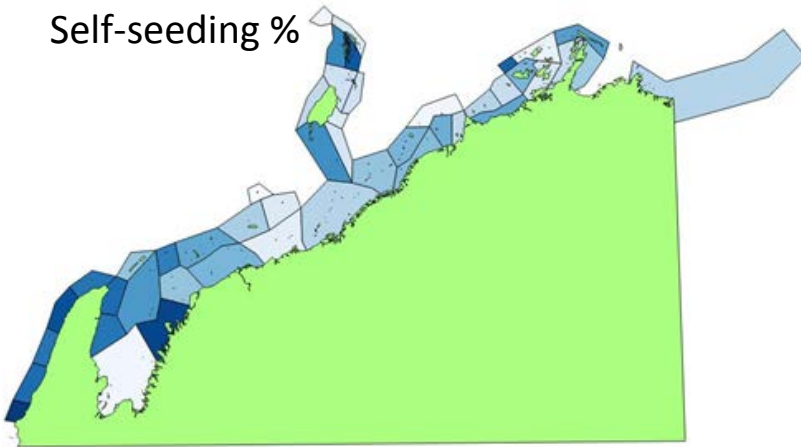


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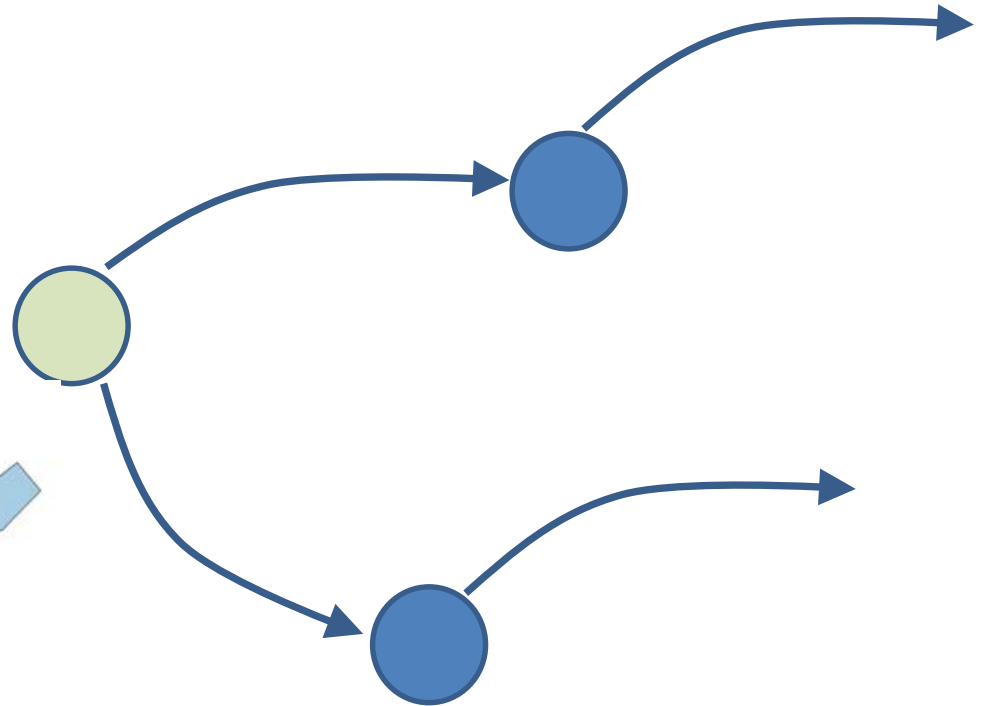
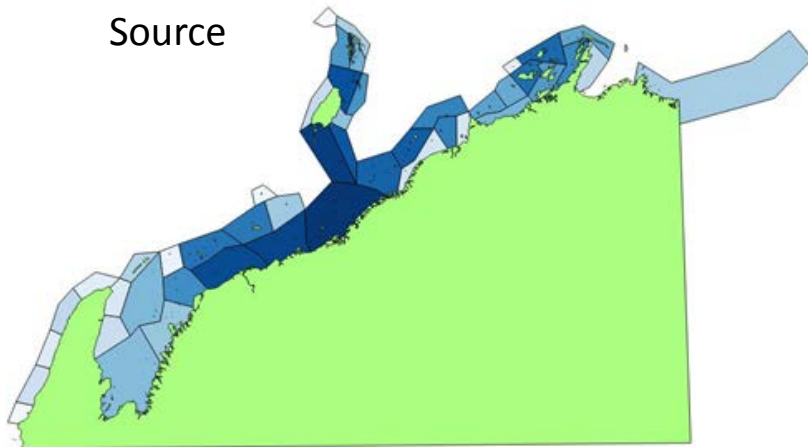
Self-seeding %





Components of connectivity – which are most important to a network of reefs?

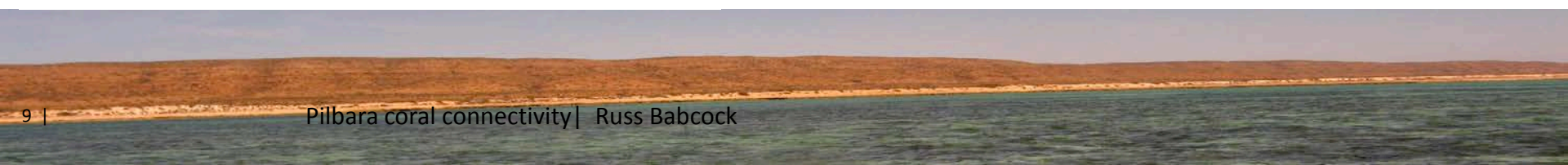
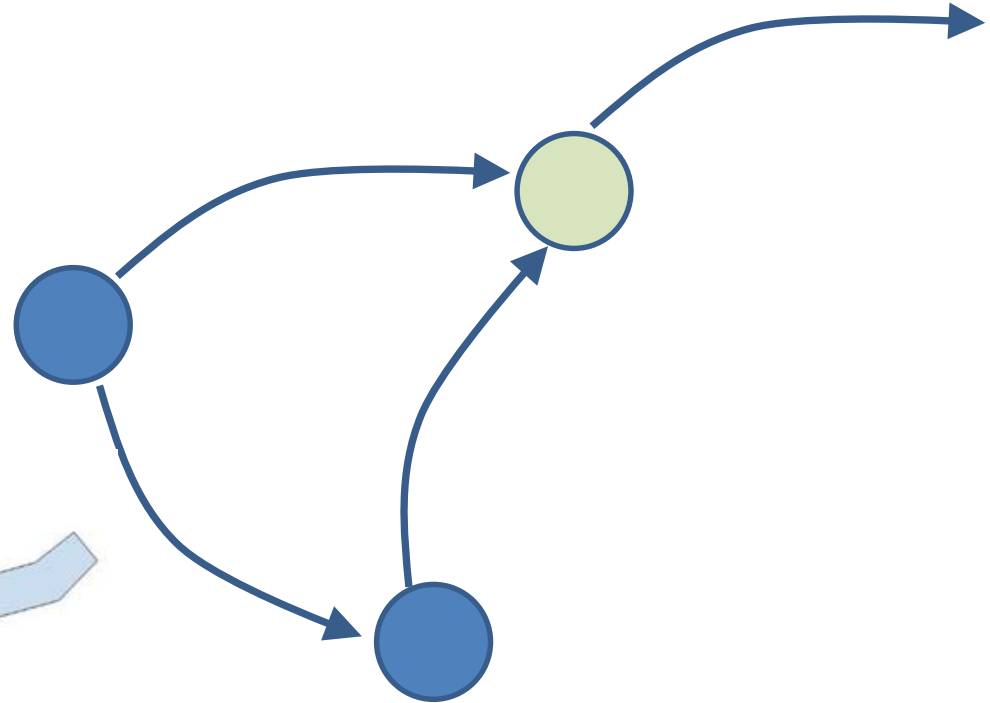
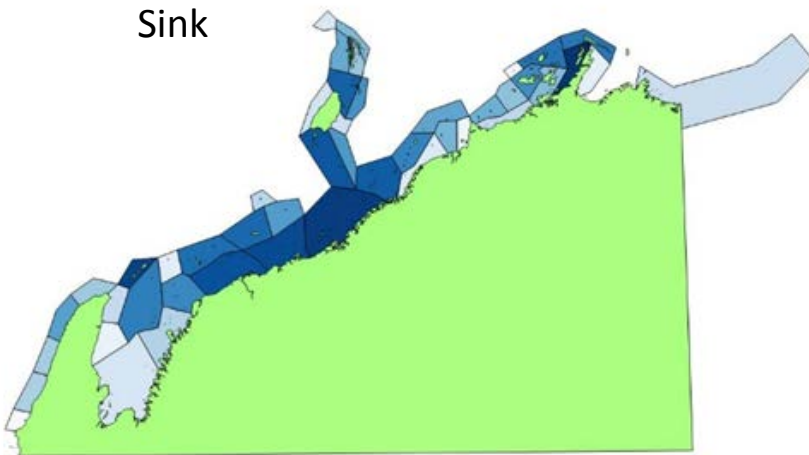
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Components of connectivity – which are most important to a network of reefs?

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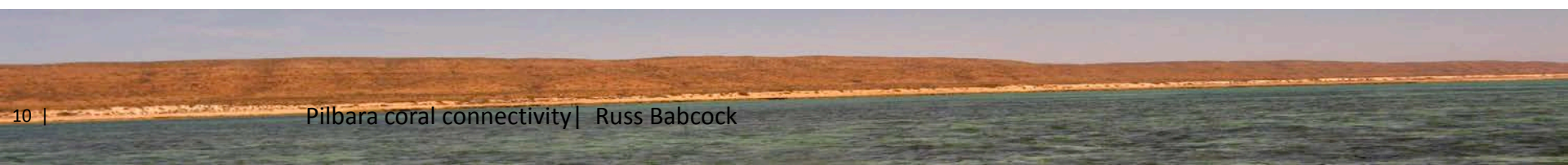
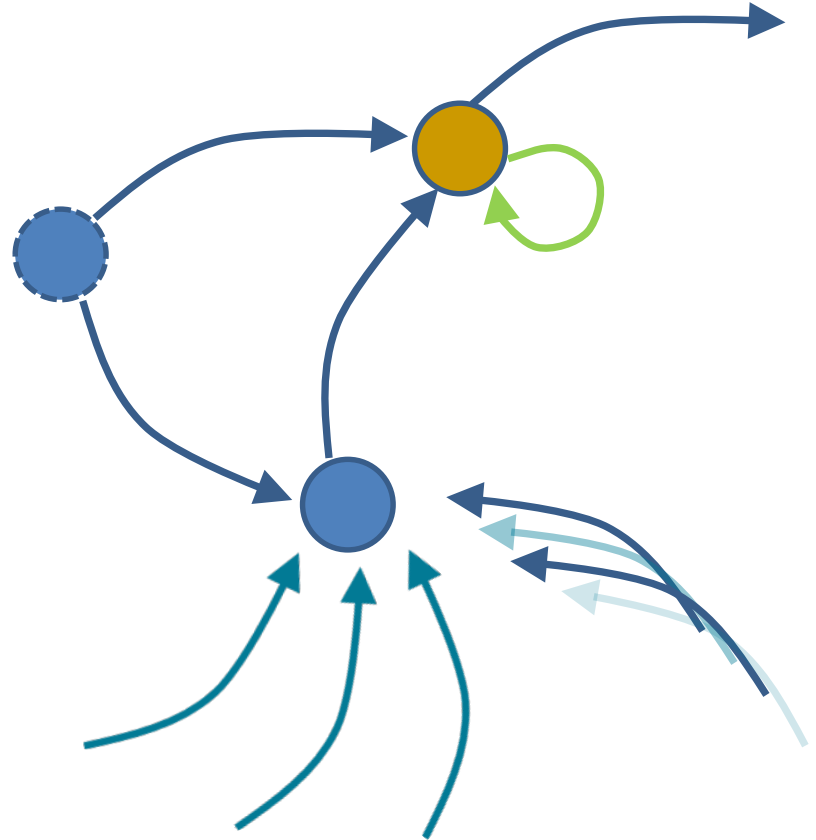


Components of connectivity – which are most important to a network of reefs?

- In reality, sources, sinks, self seeding, retention are all important

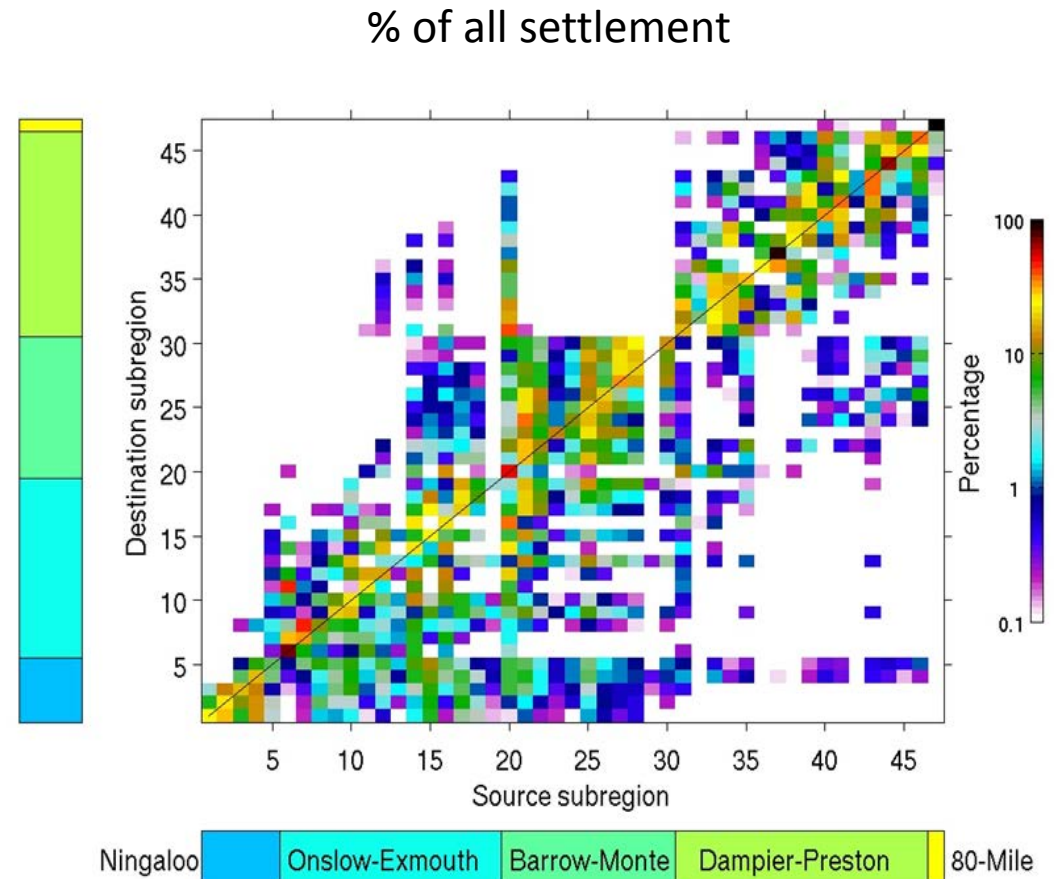
Dependency on context

- Patterns of disturbance & Environmental gradients
- Spatial scale
- Time scales



Connectivity Matrix

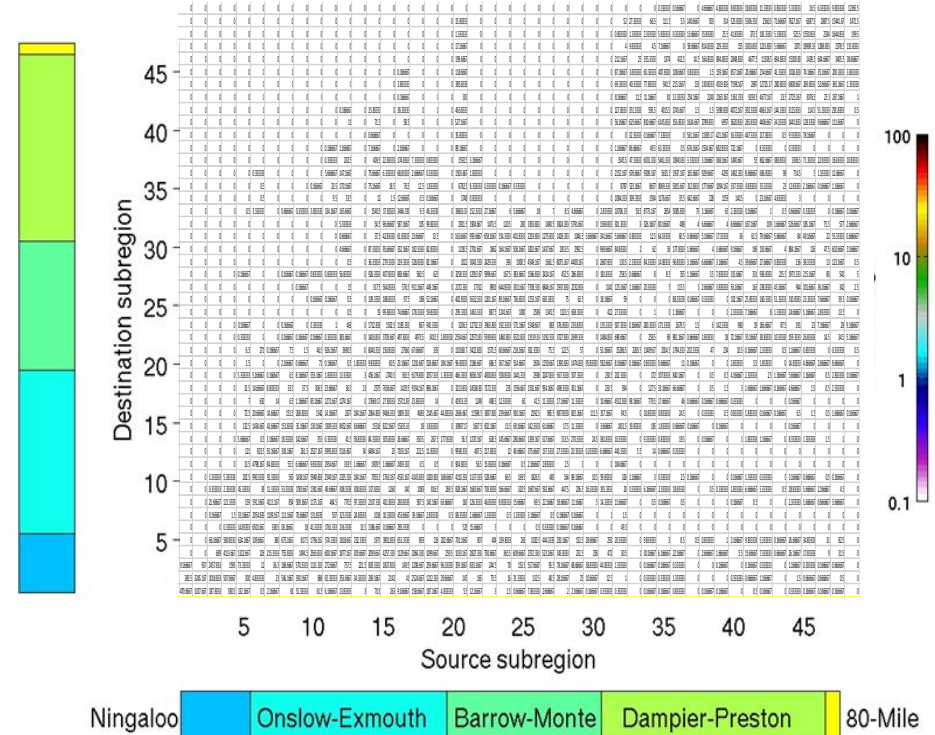
- Predominantly southward transport (but see sub-region 20)
- Discontinuity between Dampier Region and further south
- 80-mile region isolated



Matrix / network analysis

Matrix operations

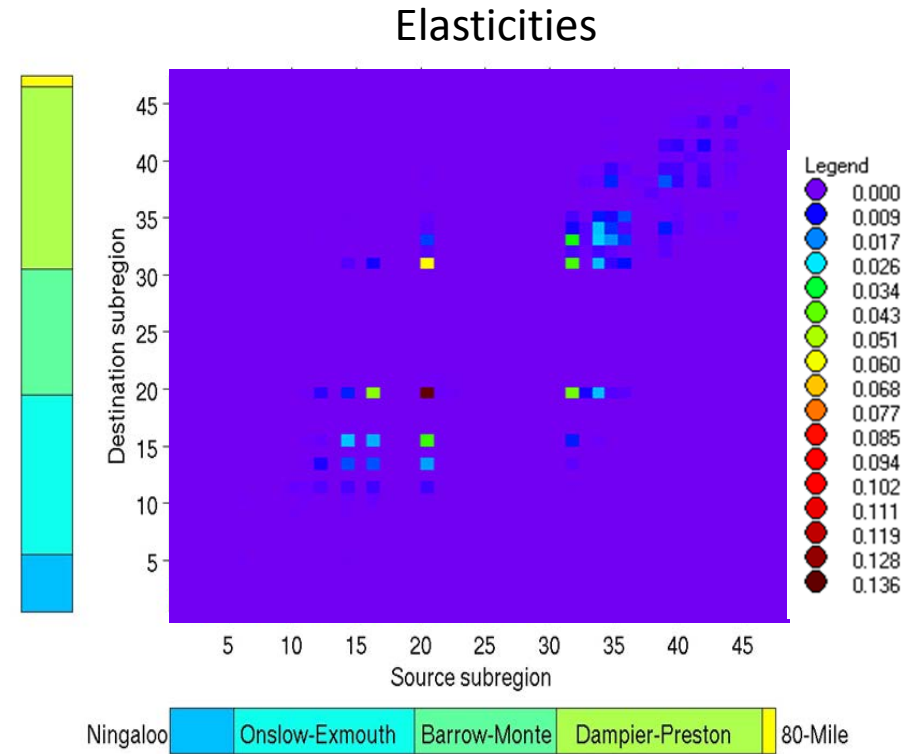
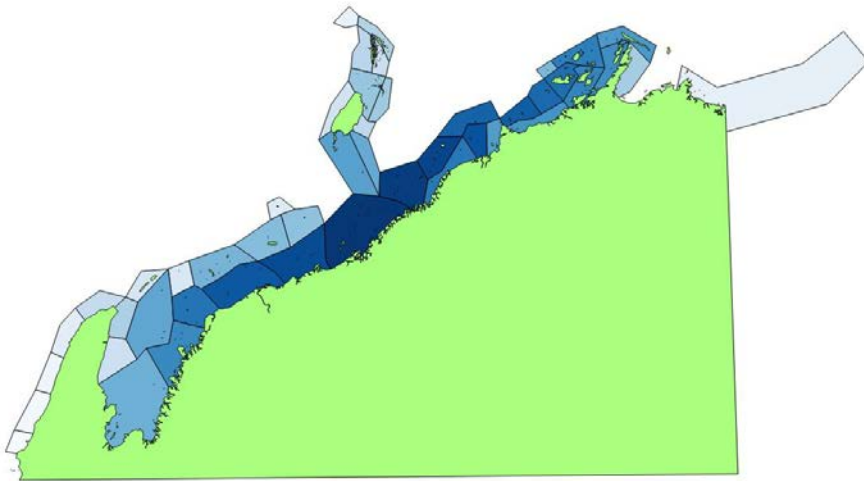
- Iterate properties of the matrix until a stable point is reached
- Overall net properties of a matrix/network
- Useful therefore for examining the long term consequences of connectivity



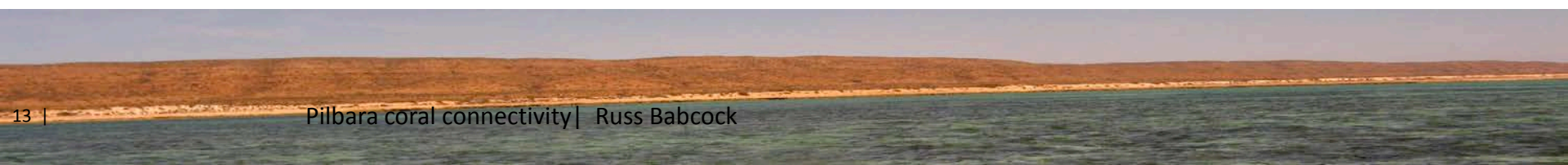
Matrix / network analysis

What parts of the network contribute most to the next generations?

- Elasticity values of the matrix measure this contribution



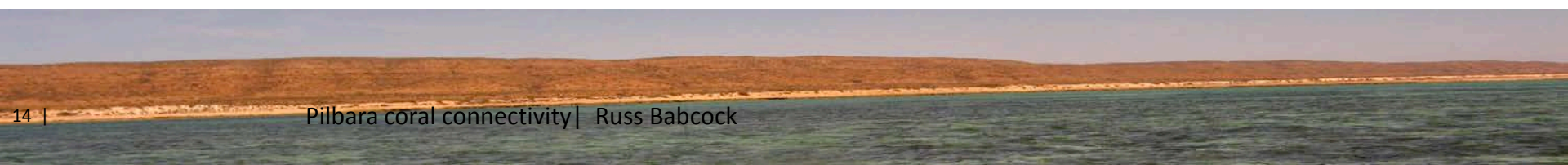
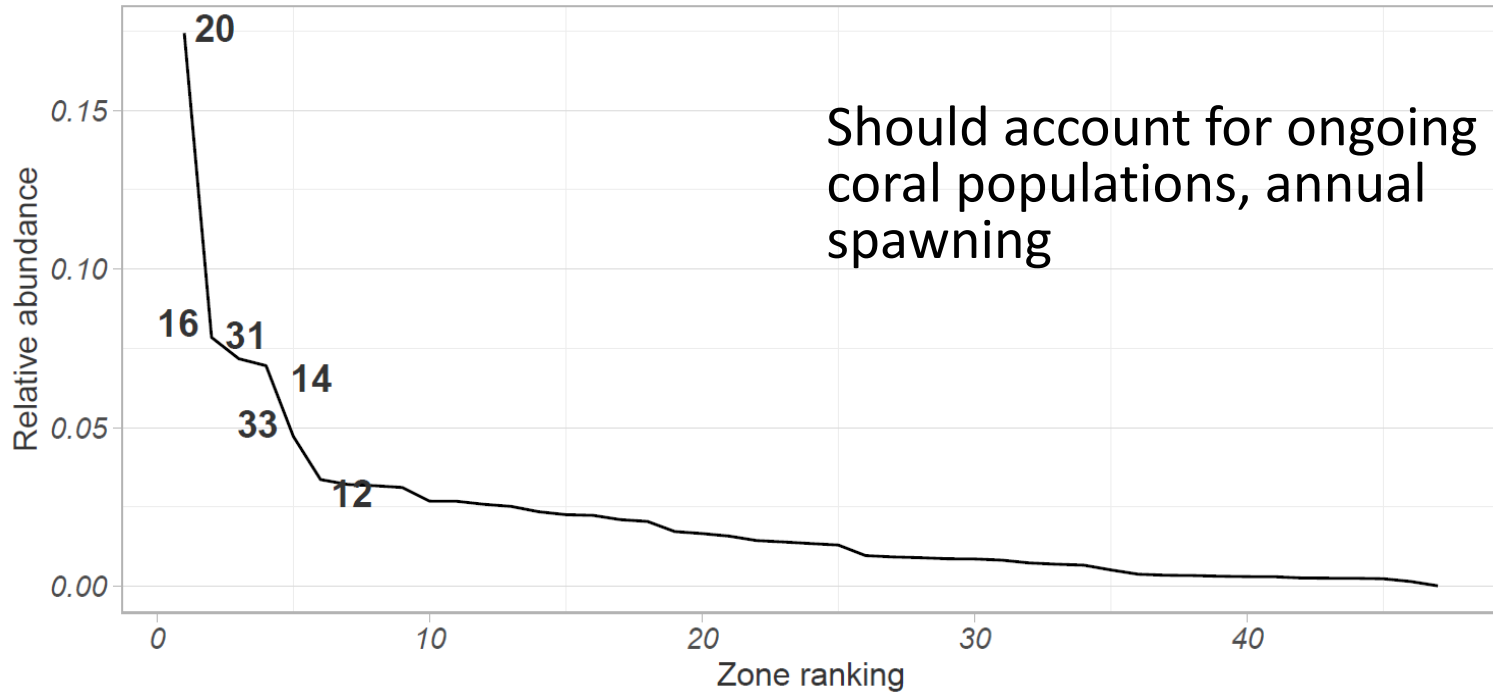
zones 20, 16, 31, 14, 33, 12





Assessments of connectivity and resilience

Rank order of zone abundance in stable state

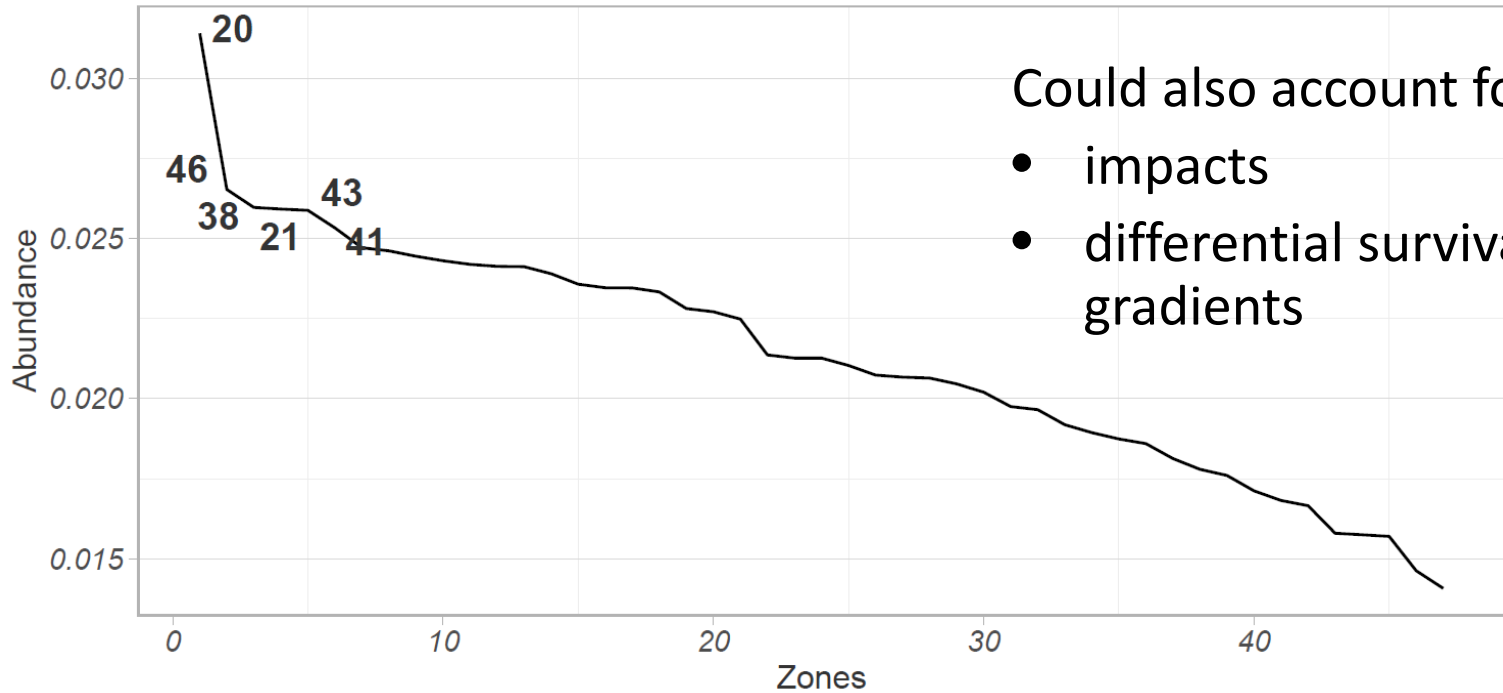




Assessments of connectivity and resilience

With dynamic coral populations

Final state in dynamical model



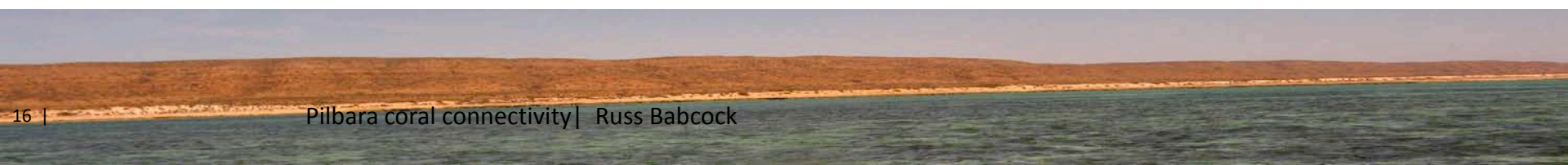
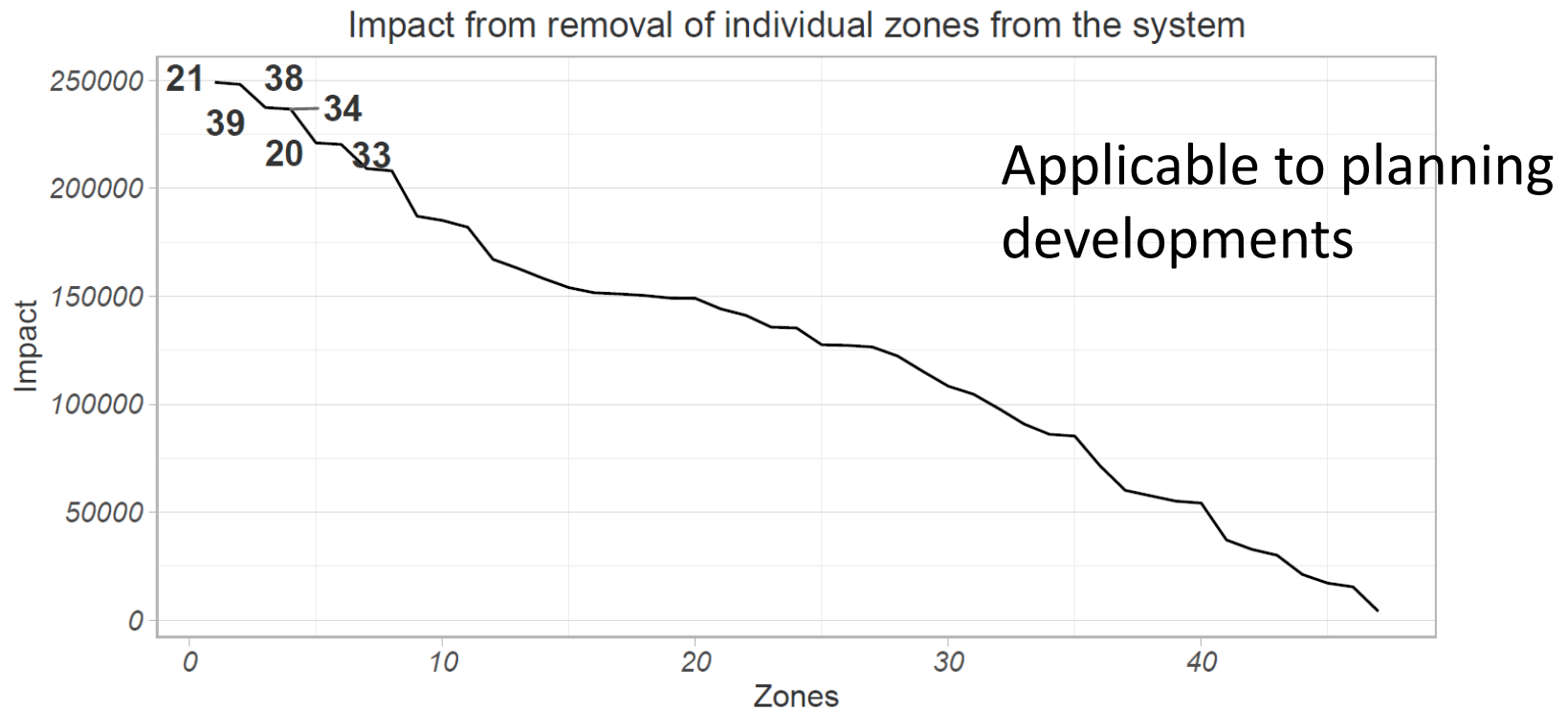
Could also account for

- impacts
- differential survival gradients





Assessments of connectivity and resilience: impacts

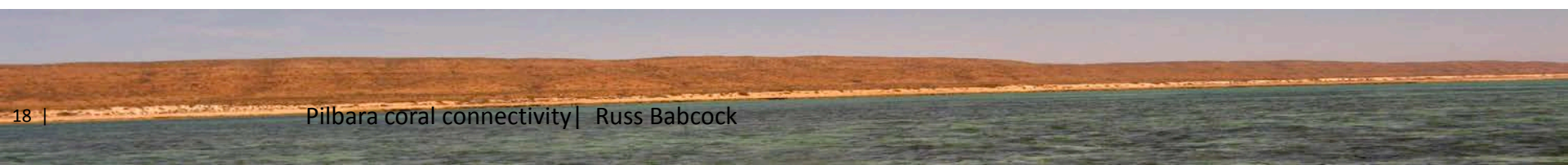
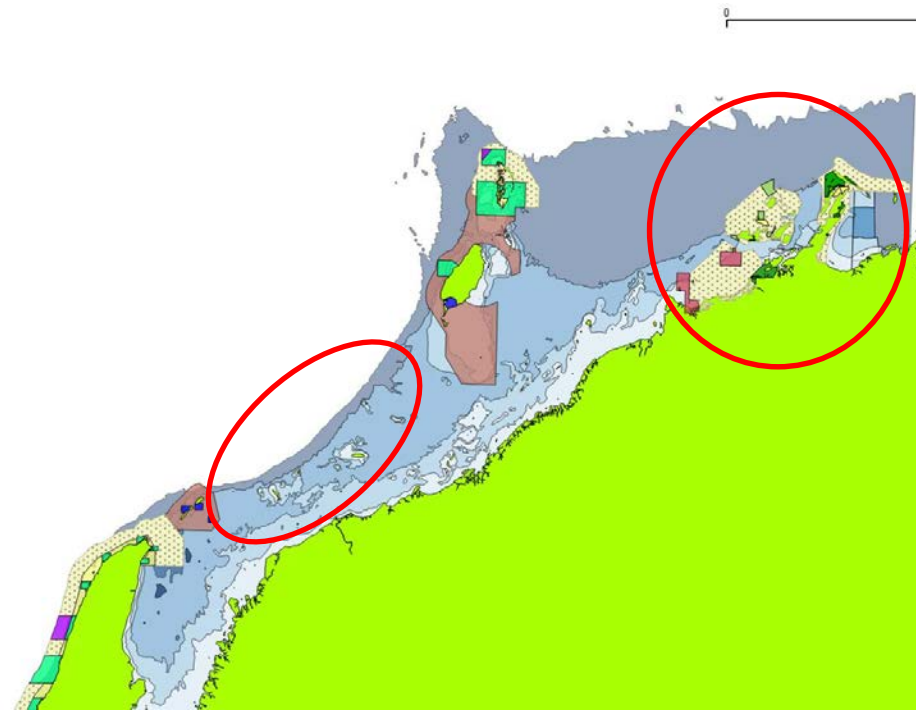




Application to management

Can this work be used to advise management?

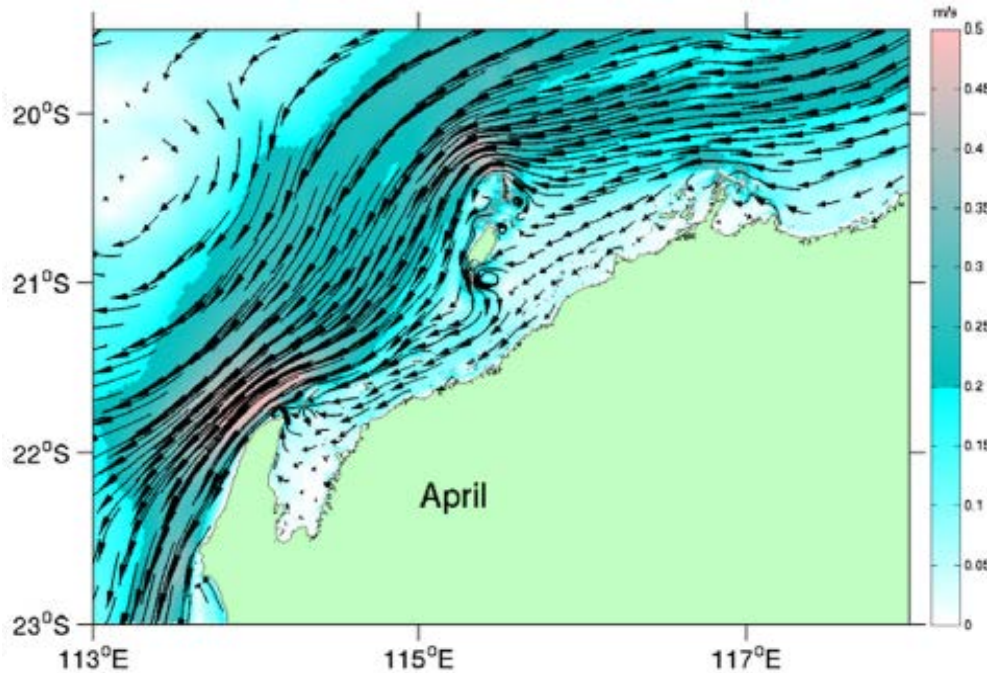
- We have a lot of work to do in order to provide the level of confidence likely to be needed by managers in order to use connectivity information for decision making
- We have the tools to start doing this work, including models and empirical data
- New methods of analysis likely also needed (network analysis?)





Ranking of zones per effectiveness as source of recovery

- Variable between years



Zones which allow for faster recovery for different years

mean	20	31	33	34	16	35	43	14	38	39
2009	41	43	39	40	42	46	44	45	47	38
2008	46	44	45	43	40	41	47	1	2	3
2007	20	16	31	33	14	34	35	12	21	6
2006	14	20	6	16	11	12	21	15	10	18
2005	33	20	34	31	35	43	32	38	39	41
2004	6	7	8	10	9	5	20	13	16	14
	1	2	3	4	5	6	7	8	9	10

zone ranking



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Thank you

Acknowledgements

Gorgon Barrow Island
Net Conservation Benefits Fund
www.ncb.org.au

