



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA



Capturing Coral Reef Ecosystem Services (CCRES)

Professor Peter Mumby, UQ Biological Sciences
Associate Professor Damian Hine, UQ Business School
Dr Erik Simmons, UQ School of Psychology



Project design

- 5 year project funded by GEF under The World Bank (\$4.5m)
- University of Queensland as Project Executing Agency (contributing \$2m cash + \$5m in kind)
- Regional technical assistance
- Indonesia & The Philippines
- Universities (Indo., Philippines, Australia, US)
- Local, provincial, national govnt., NGOs
- Support other World Bank investments
- Final year (continued uptake)



ENGAGEMENT	PROBLEM DEFINITION	SOLUTIONS	OUTCOMES
Community Government	Aspirations for change	Improving livelihood options (current and new)	Greater employment
	Legal obligations	Review & enhance governance	Greater food security
	Issues & factors driving the system	Improved resource management & planning	Healthier ecosystems
	Challenges to overcome	Scalable behaviour change	Social cohesion
	Opportunities		



SESAMME DEMONSTRATION

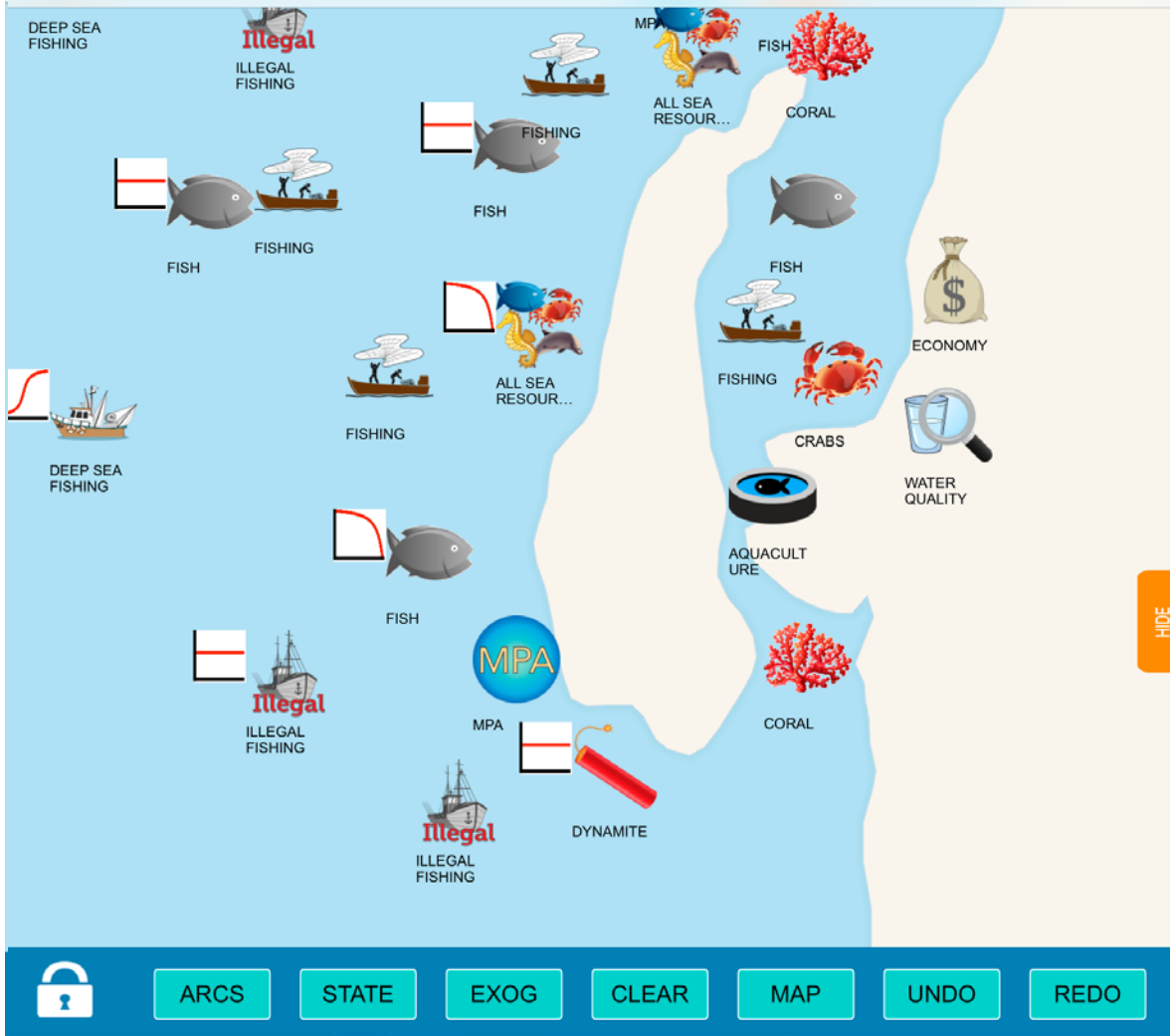
SESAMME

Socio-ecological systems app
for mental model elicitation

Russell Richards
Carl Smith
Novie Setianto

 [More information](#)

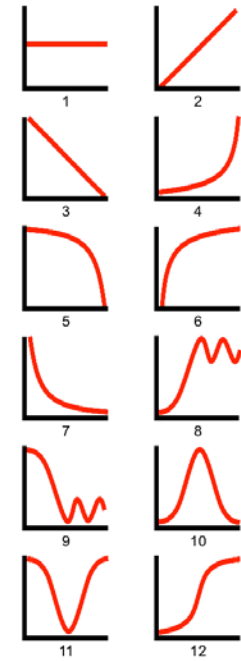
Version beta.1.1A



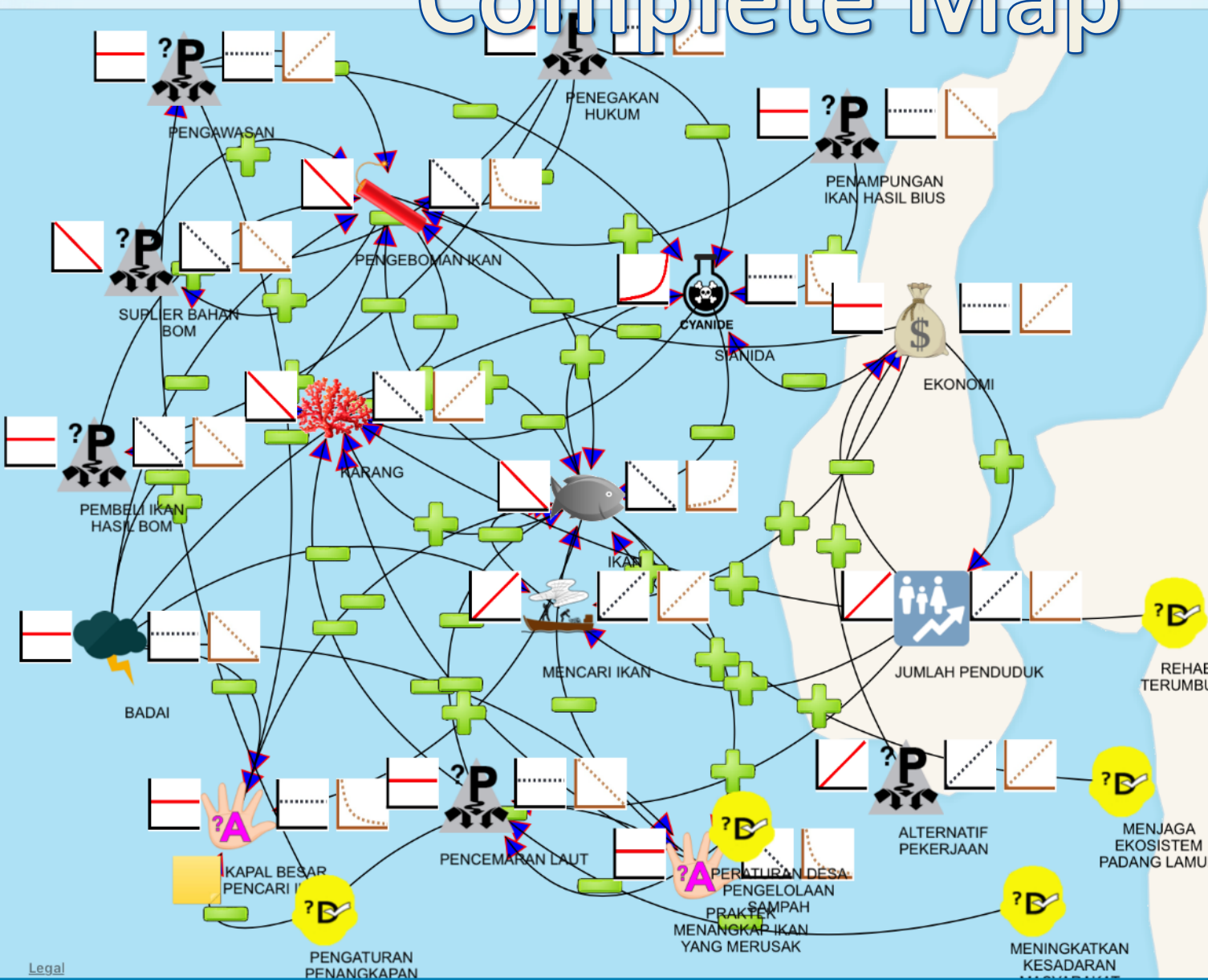
TRENDS

SHOW

HIDE



Complete Map



INTERACTIONS



RESOURCES

ACTIVITIES

PRESSURES

TRENDS

DECISIONS

LABELS

COMMON ARCS



ARCS

STATE

EXOG

CLEAR

MAP

UNDO

REDO

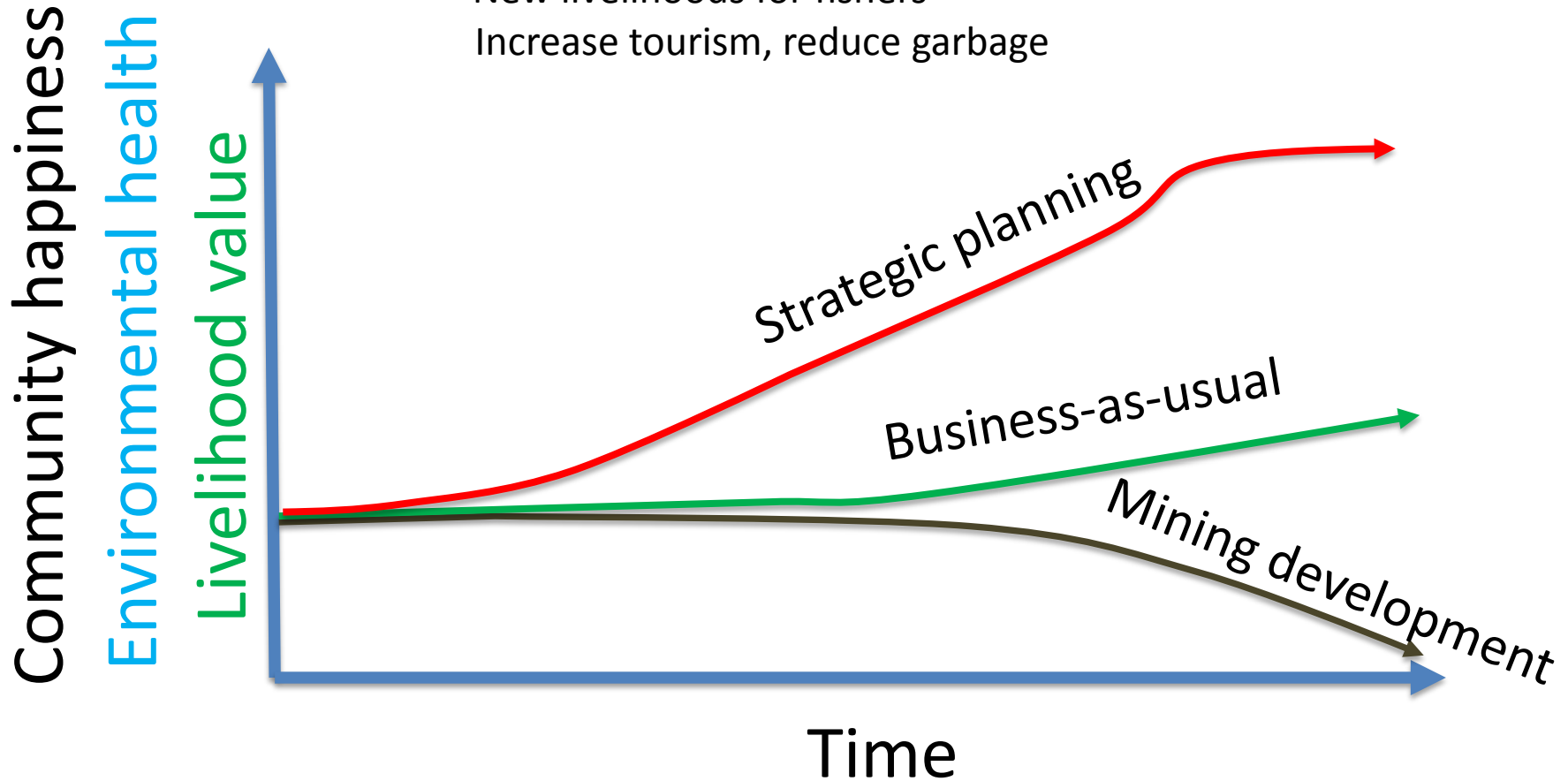
SESAMME

- Simple interface to characterise system and relationships
- Adopted by Palawan Council for Sustainable Development (regional government) & El Nido Foundation (local NGO) for bamboo reforestation project and site selection
- Tested with >1000 users
- Apple App Store (May 2018)
- Minimal training (instructions within app)



Engaging community

- Relocate proposed mining
- Increase price fishers' receive for fish
- Resolve conflict among local vs. regional fishers
- New livelihoods for fishers
- Increase tourism, reduce garbage



2 Pathways Forward

1. Develop new system model

2. Parameterise existing model for your needs



1) New System Simulation

- Simulate components of the system – resources, activities, pressures, decisions – then compare outcomes
- Structure defined by FGDs + SESAMME maps
- Intensive, comprehensive process (months) requiring trained personnel & software
- We provide workshops on best practice + trained partner universities (Stella code + manuals on web)
- Developed two for coastal regions (mixed vs fishery dependent)
- Undertake only in qualitatively different systems

Processes included in the simulation model

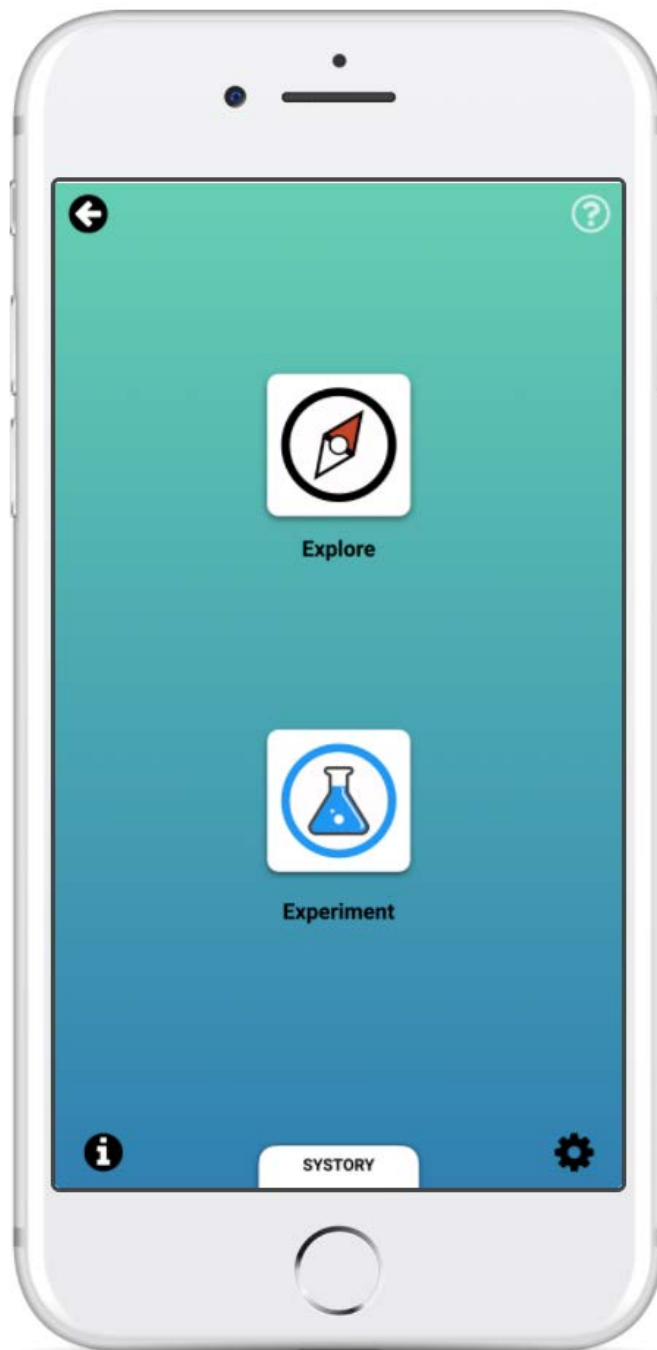
- Catchment runoff (sediment, nutrients)
- Crop and livestock production
- Fish populations (herbivores, predators, squid)
- Fishing (legal and illegal, entry, exit and effort)
- Boats (fishing, tourism)
- Coastal habitats (reefs, mangroves, sea grass)
- Land use (crops, livestock and urban)
- Human population (domestic, tourists)
- Supply, demand and price (fish, crops, livestock)
- Income (from fishing, cropping and livestock production)
- Net exports (export income and import costs from fishing, cropping, livestock production, tourism, other)
- Jobs (from fishing, cropping, livestock production, tourism, other)
- Waste production (septic tanks, stormwater)
- Water use (domestic, crops, livestock)
- Water quality (algal blooms, suspended sediment, nutrients)

2) SYSTORY (system story telling)

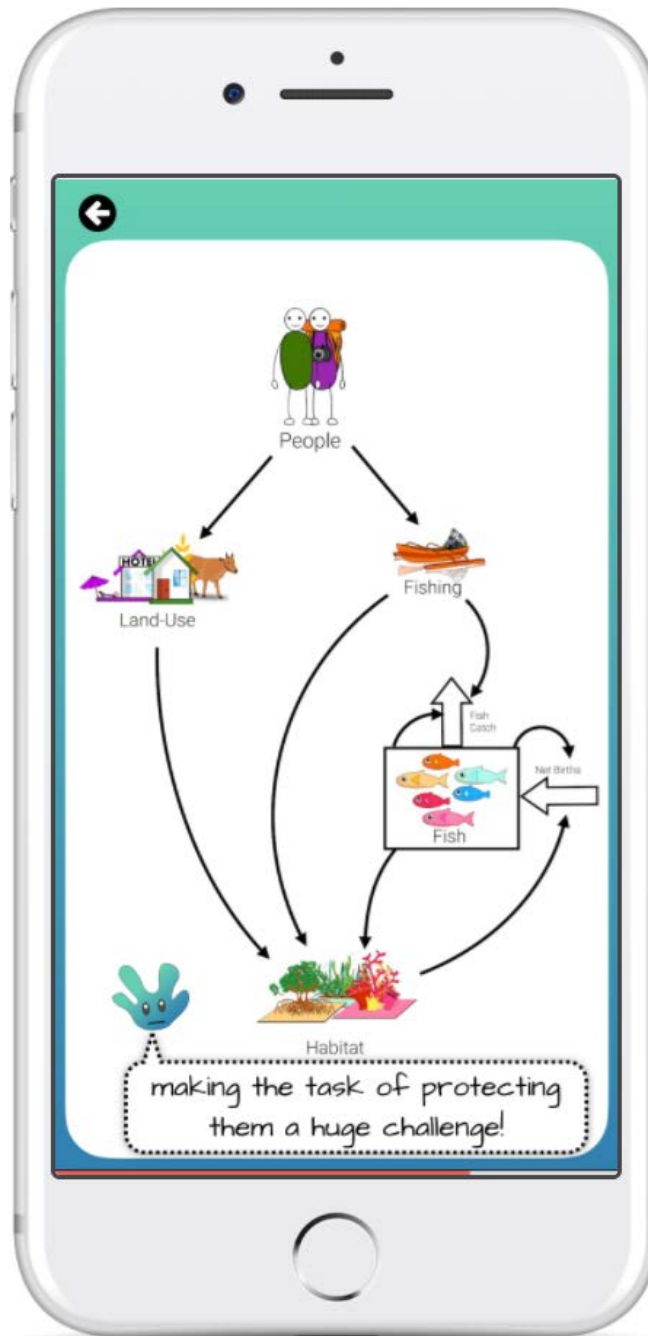
- Simple, free interface to two systems
- Model 1) El Nido (Philippines)
- Fisheries, agriculture, rapid growth of tourism (high & low end)
- Fairly diverse livelihood options
- Model 2) Selayar, Sulawesi (Indonesia)
- High dependence on fisheries for livelihoods & protein
- Agriculture but limited tourism
- Minimal training required
- Android + Apple App Store, May 2018
- Go to <https://marvelapp.com/2507935> to view an interactive mock-up

SYSTORY DEMONSTRATION

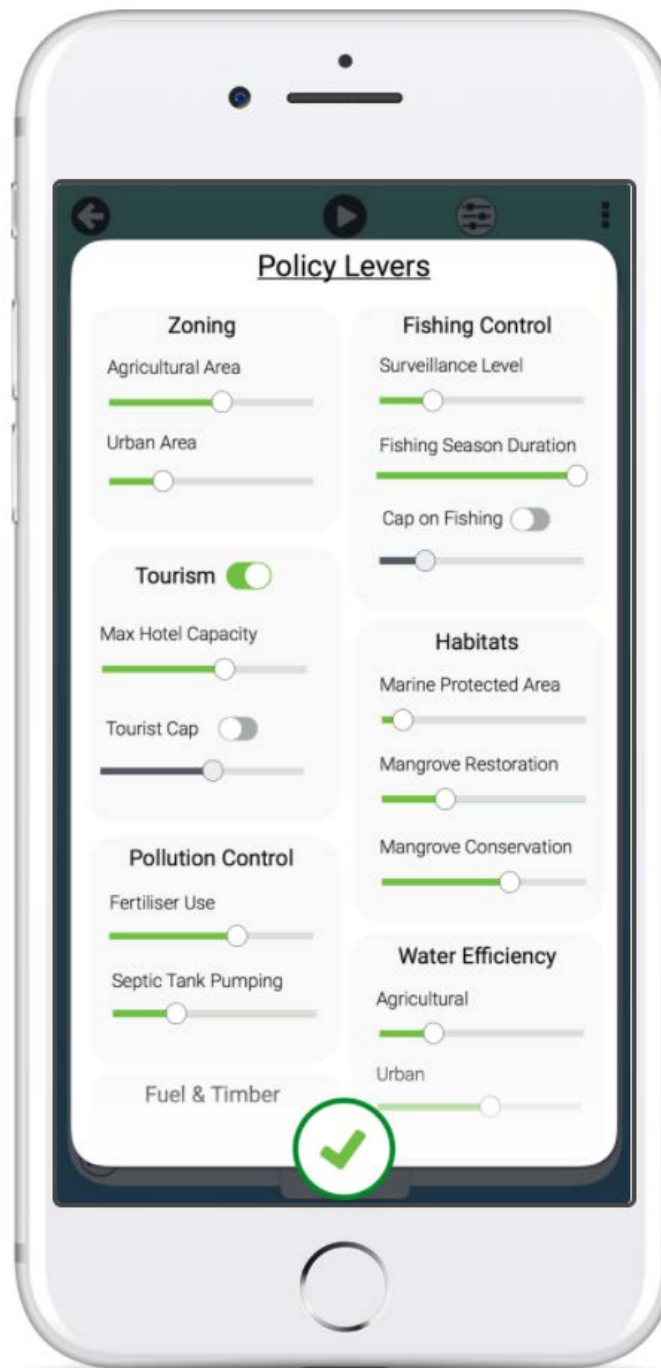


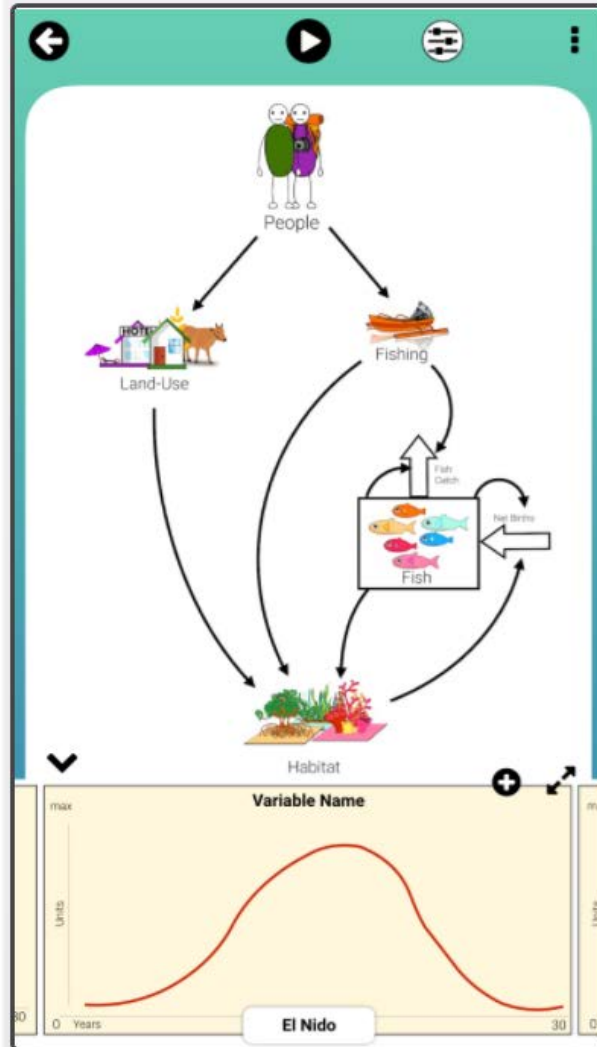


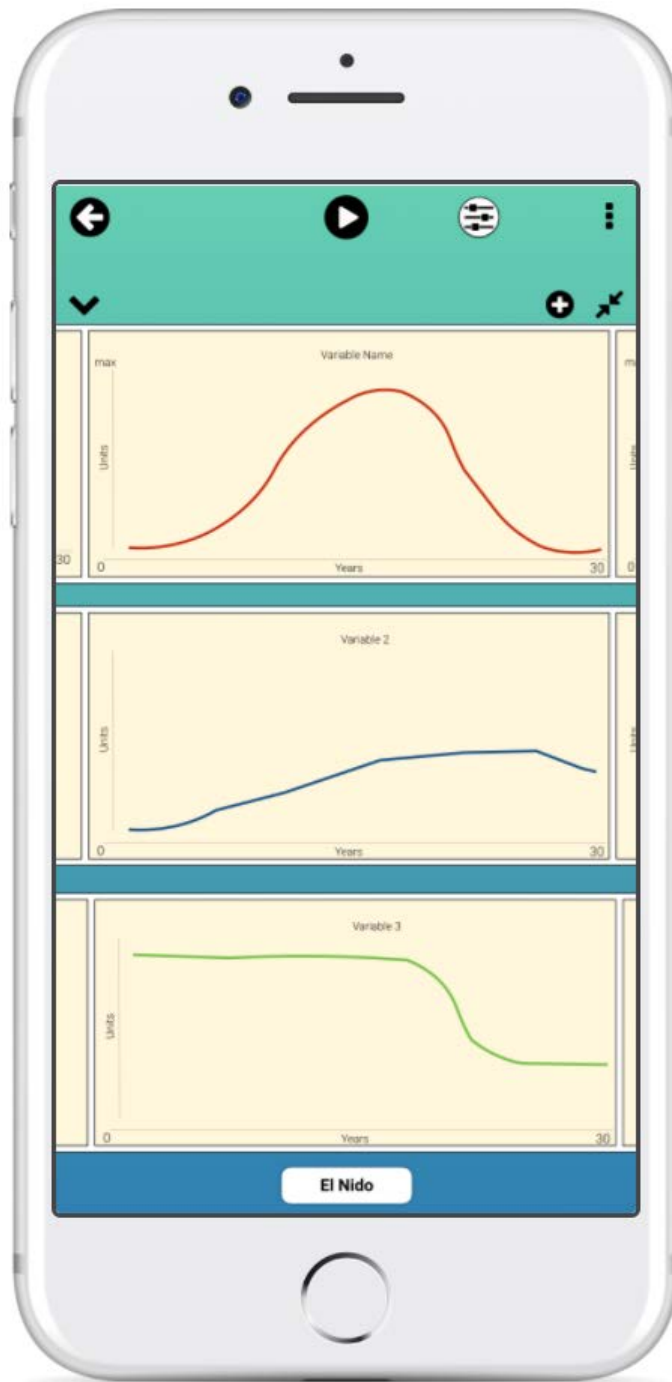
**Explore tells
the story of
how the
system
works**



**Experiment
allows you to
assess
scenarios**







Summary

- Multiple audiences
- **SYSTORY**: Educational and discursive value when used by community and/or decision-making tool for comparable systems
- **SESAMME**: Capturing data and relationships (rapid evaluation or part of larger process)
- **Systems modelling**: Comprehensive analysis of drivers of a system, bottlenecks, causal pathways, targeting intervention points



Solutions

Enhance & diversify livelihoods



Enterprise solutions for identified ecosystem problems – a two pronged approach



Ecosystem-based business development (EbBD)

DATABASE OF EXAMPLES OF SUSTAINABLE ALTERNATIVE LIVELIHOOD PROGRAMS IN COASTAL AND REMOTE COMMUNITIES

#	Organisation/ Project	Type of organization	Supported Economic Activities/ Drivers	Dominant Focus Areas	Sustainability Objectives	Service	Livelihood Systems Supported	About the organization/ project	Mission	Location / Region	Country	Business Model/ Enterprise Type	Business Strategy	Finance/ Funding Sources	Ecosystems (conservation)	Ecosystem Services supported	Website
1	Blueventures/ LMMA	NGO	Local managed marine area (LMMA)	marine conservation, alternative sources of income	economic opportunity, environmental sustainability, conservation of marine ecosystems, livelihoods, health, responsible supply chains	Development agency support	Fisheries	Blue Ventures is a science-led social enterprise that works with coastal communities to develop transformative approaches for nurturing and sustaining locally led marine conservation. They work in places where the ocean is vital to local people, cultures and economies, and where there is a fundamental need to support human development.	By demonstrating that effective marine conservation is in everyone's interest, we're striving for impact at scale'. To reach at least three million people across the world's tropical coastal regions by 2020.	75+ communities West coast of Madagascar, Indian Ocean	Madagascar	Expedition revenue supports local conservation activities and livelihoods; philanthropic investment	BV supports coastal communities to establish dynamic and locally appropriate fisheries management strategies and governance systems that improve fisheries sustainability and climate change resilience	Grants, Foundation Sponsorship	Coral reef, mangroves, fisheries	Provisioning Regulation Habitat Cultural	https://blueventures.org

Global and national solutions for local problems – Indonesia

Global Case Study Repository



Global success cases

National success cases

cases

Local Site



Identify those businesses most likely to adopt the opportunities



Capturing Coral Reef and Related Ecosystem
Services Project

Business Development Indonesia (BDI)

DATA COLLECTION

Design Framework and Research Instrument

Selayar

UQ	LIPI
Associate Professor Damian Hine Dr Anya Phelan	Professor Agus Eko Nugroho Bintang Dwitya Cahyono Nur Hadiati Endah Panky Febiyansah

August, 2016

Develop and run the Ecosystem based
Business Development workshop.



Purpose: Match national success cases
with likely adopters of new
opportunities and ecosystem solutions

EbBD Workshop design



EbBD National success cases

Sustainable small scale fisheries

- Bali Seafood International – largest sustainable seafood exporter in Indonesia.

Value added products

- Accessible VCO production
- Cashew value added products
- Sustainable ornamental fisheries

Responsible tourism

- Mangrove crab walk, museum and cafe
- Ecotourism village biorock coral formations
- Community based ecotourism
- Ecotourism and reef security

1. Identify the new entrepreneurs

Local solutions for local problems



Eco-Biz Challenge (Eco-Business) Application Form

Maaring ipa-xerox ang application form o magpunta sa inyong Barangay Secretary parasa karagdagang kopya. Kung kinakailangan ng tulong sa pagsagot nitong application at iba pang impormasyon, makipag-ugnayan kay Mr. Roy Bero : 0936 787 2697 / 0947 400 2026

MAYROON KA BANG BUSINESS IDEA UPANG MATUGUNAN ANG MGA SUMUSUNOD NA PROBLEMANG PANGKALIKASAN?

1. Sapat na pagkain sa lahat (Food Security)
2. Kalinisan ng mga anyong-tubig (Water Quality)
3. Pag-kaunti ng huling isda (Declining Fish Stocks)
4. Pag-kaibo ng bakawan (Declining Mangrove Forest)

ANO ANG INYONG MGA MAPAPAKINABANGAN?

1. Makakuha ng mahalagang kaalaman sa pagsasanay sa negosyo
2. Palakasin ang iyong idea upang maging isang business plan
3. Makasama ang mga mahusay na tagapag-turo
4. Maaring Manalo ng Php 50, 000 bilang panimulang puhunan
5. Gawing makatotohanan ang iyong business idea

Pangalan	<i>Imania Savina III</i>	Tirahan	<i>Maremeamea Beach, Sitio Pacalsada</i>	
Pangalan ng Business Idea	<i>Plate to Garden to Plate</i>	Barangay	<i>Coronador</i>	
Cellphone Number	<i>09215919982</i>	Email (Kung mayroon)	<i>iansavinaiii@gmail.com</i>	
Birthday	<i>16 September 1978</i>	Kasarian	Babae <input type="checkbox"/>	Lalake <input checked="" type="checkbox"/>
Pangalan ng Indibidwal o Kooperatiba: <i>Imania Savina III</i>				

Eco-Biz Idea

Ano ang inyong Eco-Biz idea?

Ang ideya ay, kapalit ng user fee, paano pangisawaan (koleksyon, transportasyon, pagproseso sa papamigatan ng composting) ang mga food waste at kitchen waste mula sa mga restaurants, at gagamitin ang compost para sa isang demo farm o di kaya ibenta sa mga gardener at magsasaka.

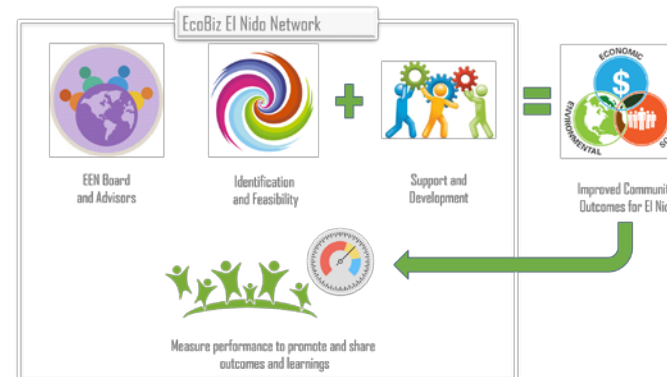


3. Run the semi-finalist workshop around a framework



4. Select the winners from proposals.

2. Assess and select the semi-finalists



5. Local support network to diffuse the innovations



Tatangan **Eco-Biz**



Apakah Anda punya ide bisnis?

Apakah Anda memiliki ide bisnis yang ramah lingkungan dan dapat membuat suatu perubahan? Apakah Anda memiliki gairah tentang terumbu karang, hutan bakau dan ekosistem pesisir lainnya, sambil memiliki gagasan untuk melindungi hak-hak tersebut melalui solusi bisnis? Jika demikian, kami mencari Anda!

Tim Pengembangan Bisnis CCRES akan menggelar **Tantangan Eco-Biz Selayar** — melalui pencarian solusi baru dan inovatif yang dapat mendukung ekosistem pesisir Selayar.

Tantangan Eco-Biz bertujuan untuk mendorong dan mendukung calon pengusaha di Selayar untuk mengembangkan, menerapkan dan menjalankan ide bisnis inovatif untuk kepentingan ekonomi setempat maupun lingkungan.

Tiga finalis akan mendapat hadiah berupa hibah sebesar Rp 15.000.000 masing-masing untuk memulai atau memperluas konsep bisnis mereka. Peserta akan diberikan kesempatan untuk mendapatkan pelatihan keterampilan bisnis yang berharga selama lokakarya yang disesuaikan.



TERAPKAN SEKARANG +
Formulir aplikasi di belakang halaman.

INGIN TAHU LEBIH BANYAK INFORMASI?
Kunjungi halaman Facebook kami [@CCRES.net](#) untuk tetap up to date dengan Tantangan Eco-Biz atau ikut [@CCRESnet](#)

WWW.CCRES.NET

Some of the Eco-Biz Challenge Ideas

Plate to garden to plate
compost and fertiliser

One Student, One
Mangrove

Coconut Eco-Charcoal
to replace mangrove
charcoal

Native nursery to
reduce take from forest

Marine sanctuary
ecotourism

Mangrove ecotourism

Mangrove seedling
nursery

Sustainable handicrafts

Homestay/tour
operator

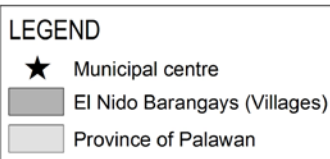
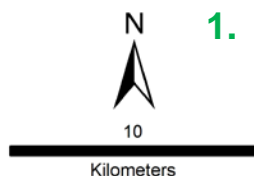
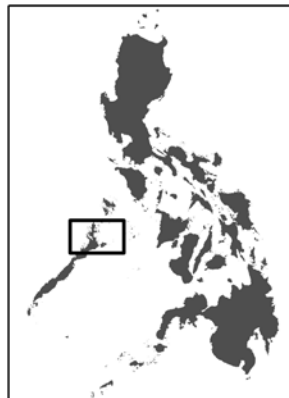
Giant bamboo
plantation to replace
illegally logged timber

Eco-fuel switching for
inboard engines

Ecofriendly diving tours

Plastic recycling and
upcycling women's
cooperative





1. Agri-tourism (mini-plantation) - *F*
2. Organic fertiliser & pesticide - *F*
3. Organic livestock raising - *M*

1. Eco-charcoal - *M*

1. Food waste as fertiliser - *M*

1. Bamboo plantation & production - *F*

1. Ornamental flowering plants - *F*

2. Organic integrated farming - *M*
3. Fisheries, fisheries products - *F*

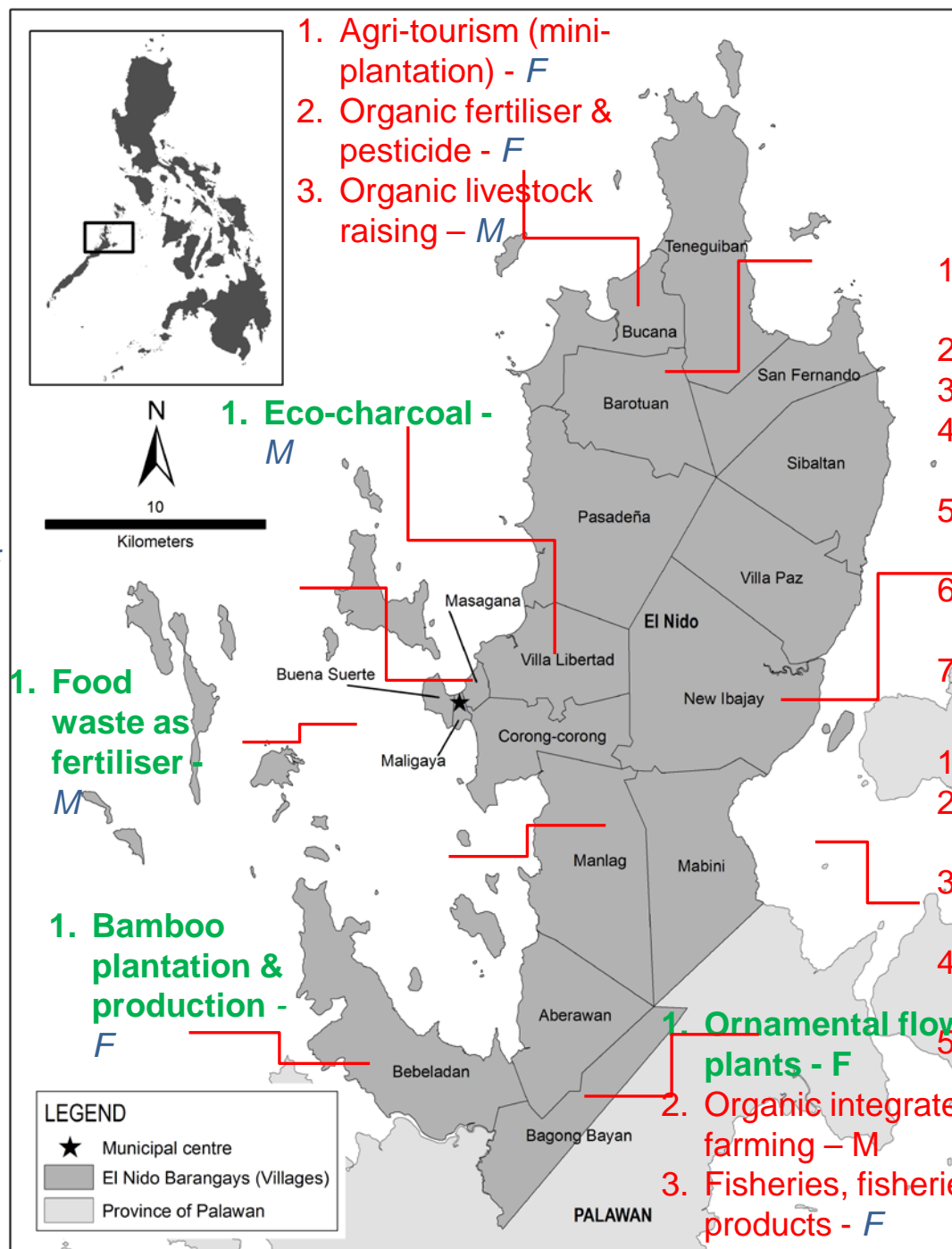
1. Hog raising / meat processing for hotels, restaurants - *M*

1. Catering / food vendor - *F*
2. Rice - *F*
3. Bamboo straws - *F*
4. Grow out mangroves - *M*
5. Mangrove eco-tours - *M*
6. Basket / handicraft making - *F*
7. Water refilling station - *F*

1. Seaweed farming - *M*
2. Sea cucumber culture - *M*
3. Floating fish cage culture - *M*
4. Materials recovery, vinegar making - *F*
5. Marine sanctuary - *M*

1. Straw bag making - *F*
2. Piggery - *M*
3. Fisheries or fish products - *M*
4. Kayak & aquatic gear rental - *M*

1. Ready to plant mangrove seedlings - *M*
2. Sari-sari store - *M*



Participation

Selayar (Indonesia)	El Nido (The Philippines)
Promotion and socialisation to 30+ villages across Selayar	Creativity workshops – covered all barangay in El Nido. 85 participants

What is the EcoBiz tool?

- A business competition and development program.
- Uncovers nascent entrepreneurs with new ideas for sustainable enterprise that are positive for the coastal ecosystem. Then supports their development through mentoring so the innovations get diffused across a region.
- Can be used by local governments, NGOs, Social enterprises, chambers of commerce, collectives and cooperatives.



Uptake

- Packaging the tools for easy uptake – electronic and hardcopy toolboxes
- Initial uptake – Ayala Foundation, Asia Foundation in El Nido.
- Working with Permodalan Nasional Madani (PNM) to gain traction in Indonesia. LIPI's Centre for Innovation key partner
- LIPI – Indonesia - vehicle for uptake
- PEMSEA – Philippines - vehicle for uptake
- Palawan State University's Incubator – Ongoing support for EcoBiz businesses.



Solutions

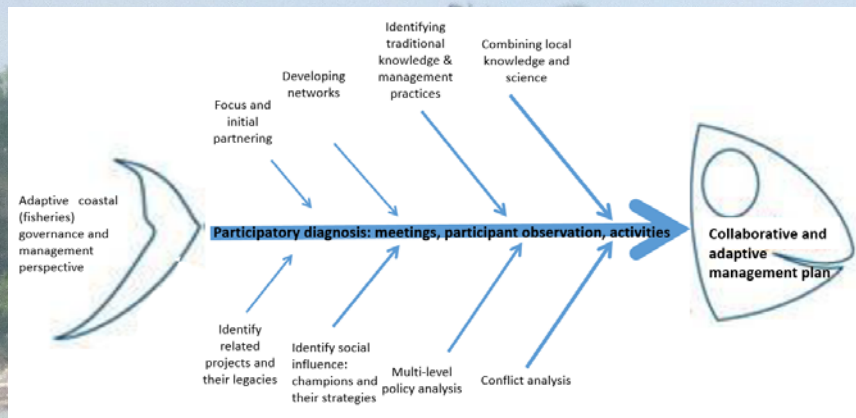
Review and enhance governance



Introducing FishCollab:

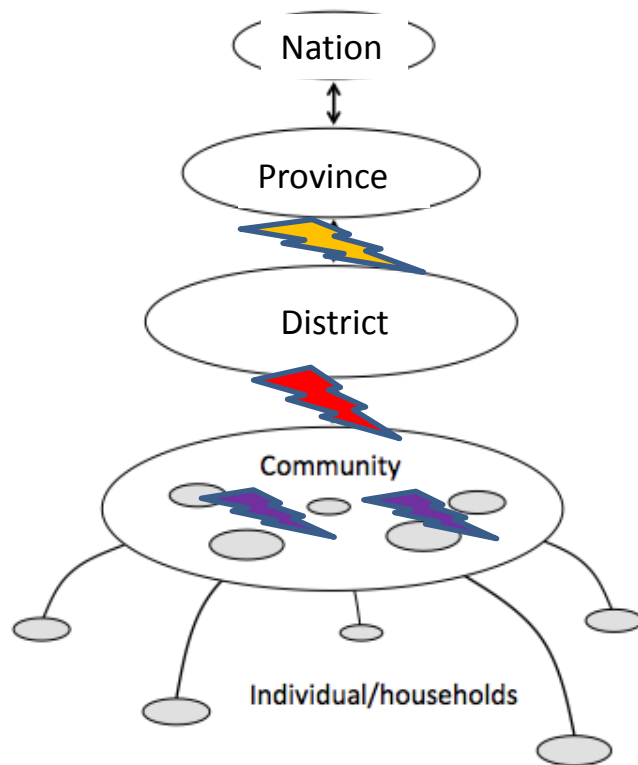
A toolkit to support community and government collaboration in coastal management

Team: Helen Ross (UQ), Dedi Adhuri, Ali Yansyah Abdurrahim, (LIPI), Andi Penrang (district), Andi Rismayani and Andi Ismainna (communities)



Why do we need such a toolkit?

Improve government – community relationships in coastal co-management



Poor 'vertical' linkages

- conflicting government regulations & policies
- community resistance
- levels of government policy may conflict

Challenging 'horizontal' relations within and among communities

How can government (3 levels) and community combine their influences?

Two parts

1. The FishCollab toolkit

Participatory process (with fishbone diagram)

- With rationale
- Stepped process, examples, hints
- Enabling factors
- Suggestions for measurement

2. Champion profiles

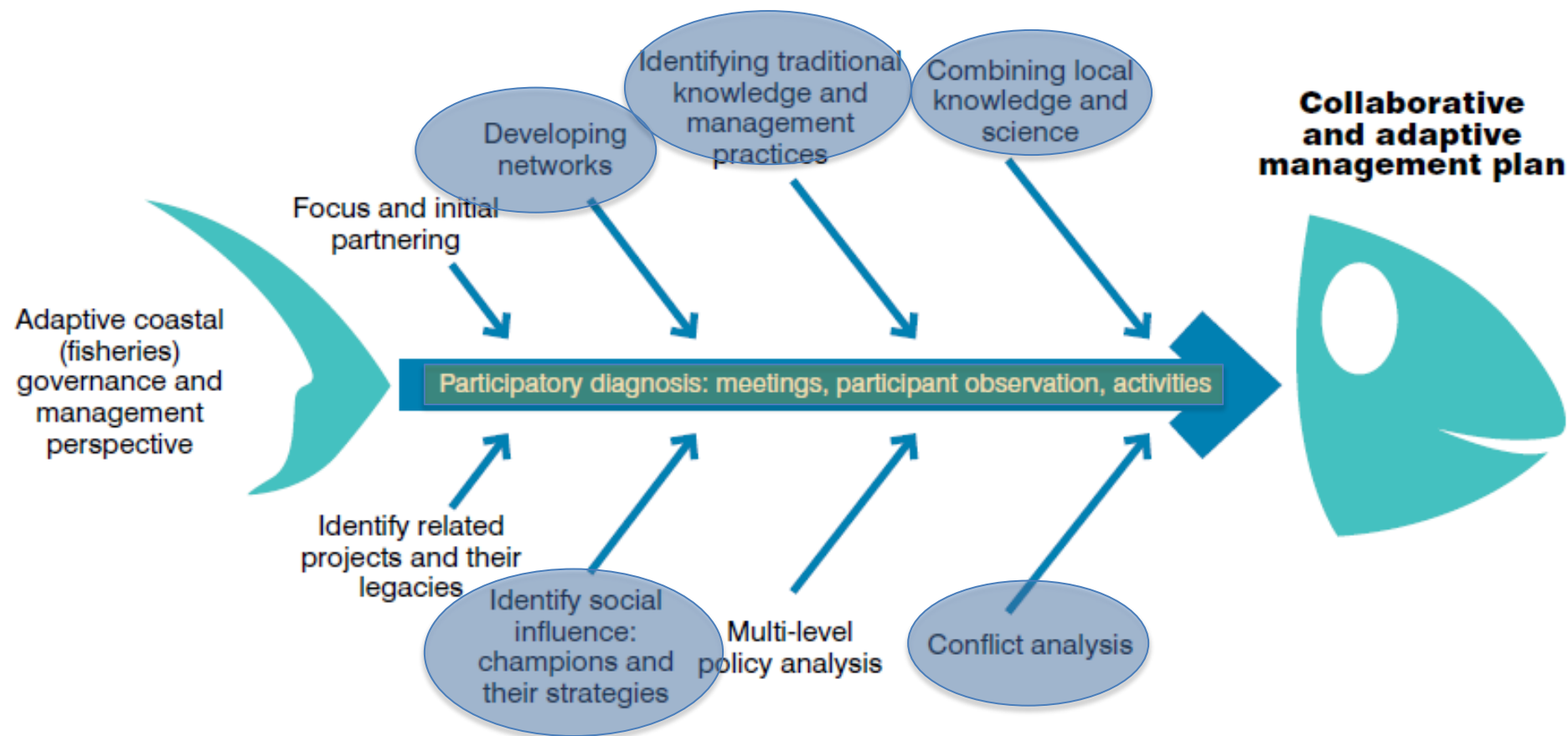
To inspire and inform

How do individuals galvanise behaviour change to protect ecosystem services?



FishCollab toolkit components

Participatory Diagnostic Tool



Menara
Indah

TP
Bongaya

TP
Bongaya

Bungaiya

3 mil

TP
Lambongan

LAT 1
3 mil

Barat Lambongan



FishCollab

- Developed and piloted in Selayar, Indonesia
- If unfamiliar with participatory methods a 4 day training course
- Otherwise two sets of instructional materials on CCRES.net
- Supported new community-level regulation for coastal management signed December 2017 by the Mayor.



Solutions

Improved marine resource management & planning



Marine resource management

1. Rebuilding reef fisheries toolkit
2. Reef vulnerability and projections
3. Mapping coastal protection
4. Policy brief: importance of seagrass



1. Designing reserves to rebuild reef fisheries

- Policy guidelines
- Reserve size tool
- Reserve design with connectivity
- Training software on reserve design
- Policy brief on prioritisation of reefs



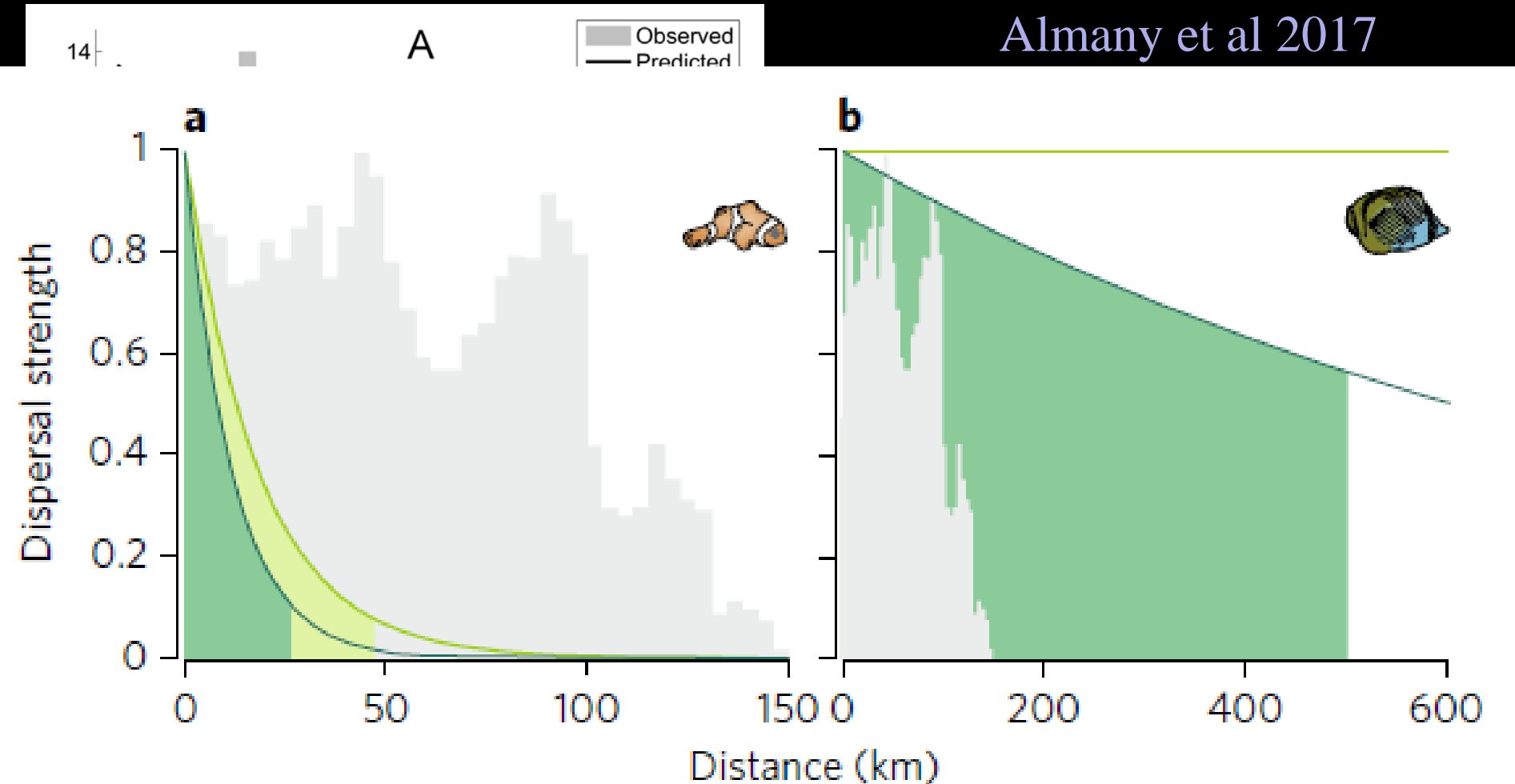
Importance of larval dispersal



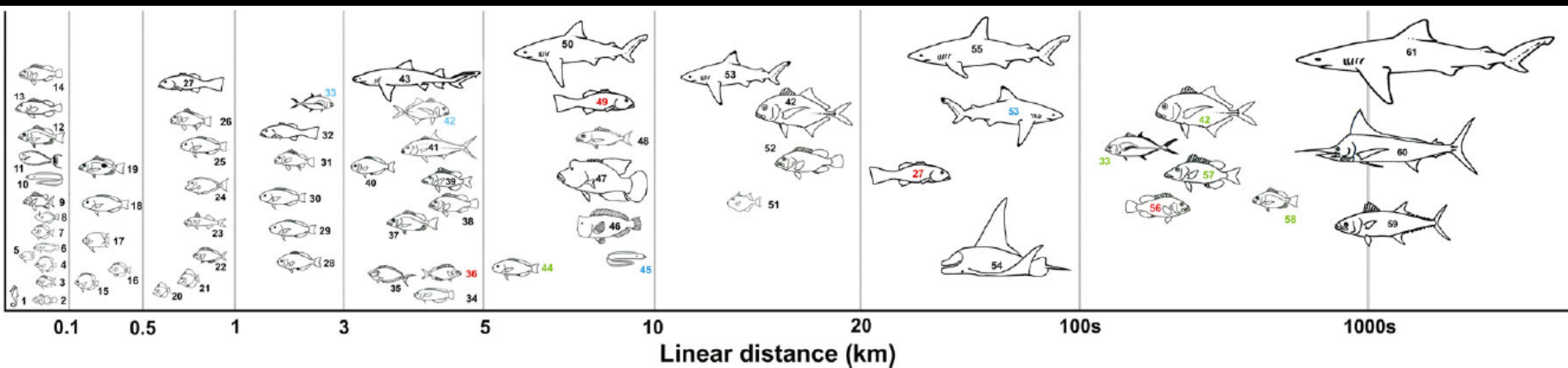
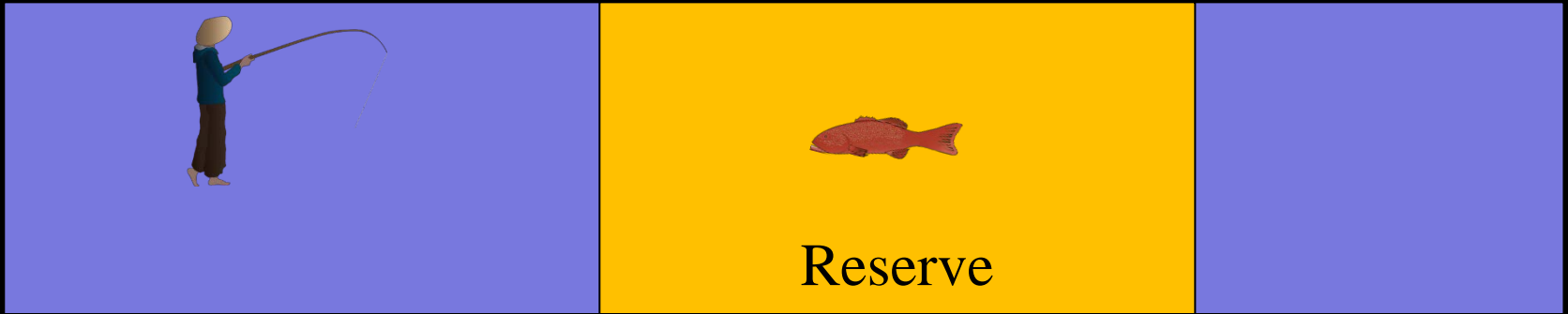
Larval dispersal kernels now measured empirically

Harrison et al 2012

Almany et al 2017



Adult home range (spillover)



(Green et al 2014 Biological Reviews)

1.1 How much area to protect?

RESEARCH ARTICLE

Marine Reserve Targets to Sustain and Rebuild Unregulated Fisheries

Nils C. Krueck^{1,2*}, Gabby N. Ahmadia³, Hugh P. Possingham^{2,4}, Cynthia Riginos⁵, Eric A. Treml^{2,5}, Peter J. Mumby^{1,2*}

1 Marine Spatial Ecology Lab and Australian Research Council Centre of Excellence for Coral Reef Studies, The University of Queensland, St Lucia Campus, Brisbane, Queensland, Australia, **2** School of Biological Sciences, The University of Queensland, St Lucia Campus, Brisbane, Queensland, Australia, **3** Oceans Program, World Wildlife Fund (WWF), Washington, D.C., United States of America, **4** Australian Research Council Centre of Excellence for Environmental Decisions, The University of Queensland, St Lucia Campus, Brisbane, Queensland, Australia, **5** School of Biosciences, The University of Melbourne, Melbourne, Victoria, Australia

* nils.krueck@uqconnect.edu.au (NCK); p.j.mumby@uq.edu.au (PJM)

Abstract

Overfishing threatens the sustainability of coastal marine biodiversity, especially in tropical developing countries. To counter this problem, about 200 governments worldwide have committed to protecting 10%–20% of national coastal marine areas. However, associated impacts on fisheries productivity are unclear and could weaken the food security of hundreds of millions of people who depend on diverse and largely unregulated fishing activities. Here, we present a systematic theoretic analysis of the ability of reserves to rebuild fisheries under such complex conditions, and we identify maximum reserve coverages for biodiversity conservation that do not impair long-term fisheries productivity. Our analysis assumes that fishers have no viable alternative to fishing, such that total fishing effort remains constant (at best). We find that realistic reserve networks, which protect 10%–30% of fished habitats in 1–20 km wide reserves, should benefit the long-term productivity of almost any complex fishery. We discover a “rule of thumb” to safeguard against the long-term catch depletion of particular species: individual reserves should export 30% or more of locally produced larvae to adjacent fishing grounds. Specifically on coral reefs, where fishers tend to overexploit species whose dispersal distances as larvae exceed the home ranges of adults, decisions on the size of reserves needed to meet the 30% larval export rule are unlikely to compromise the protection of resident adults. Even achieving the modest Aichi Target 11 of 10% “effective protection” can then help rebuild depleted catch. However, strictly protecting 20%–30% of fished habitats is unlikely to diminish catch even if overfishing is not yet a problem while providing greater potential for biodiversity conservation and fishery rebuilding if overfishing is substantial. These findings are important because they suggest that doubling or tripling the only globally enforced marine reserve target will benefit biodiversity conservation and higher fisheries productivity where both are most urgently needed.

OPEN ACCESS

Citation: Krueck NC, Ahmadia GN, Possingham HP, Riginos C, Treml EA, Mumby PJ (2017) Marine Reserve Targets to Sustain and Rebuild Unregulated Fisheries. *PLoS Biol* 15(1): e2000537. doi:10.1371/journal.pbio.2000537

Received: July 11, 2016

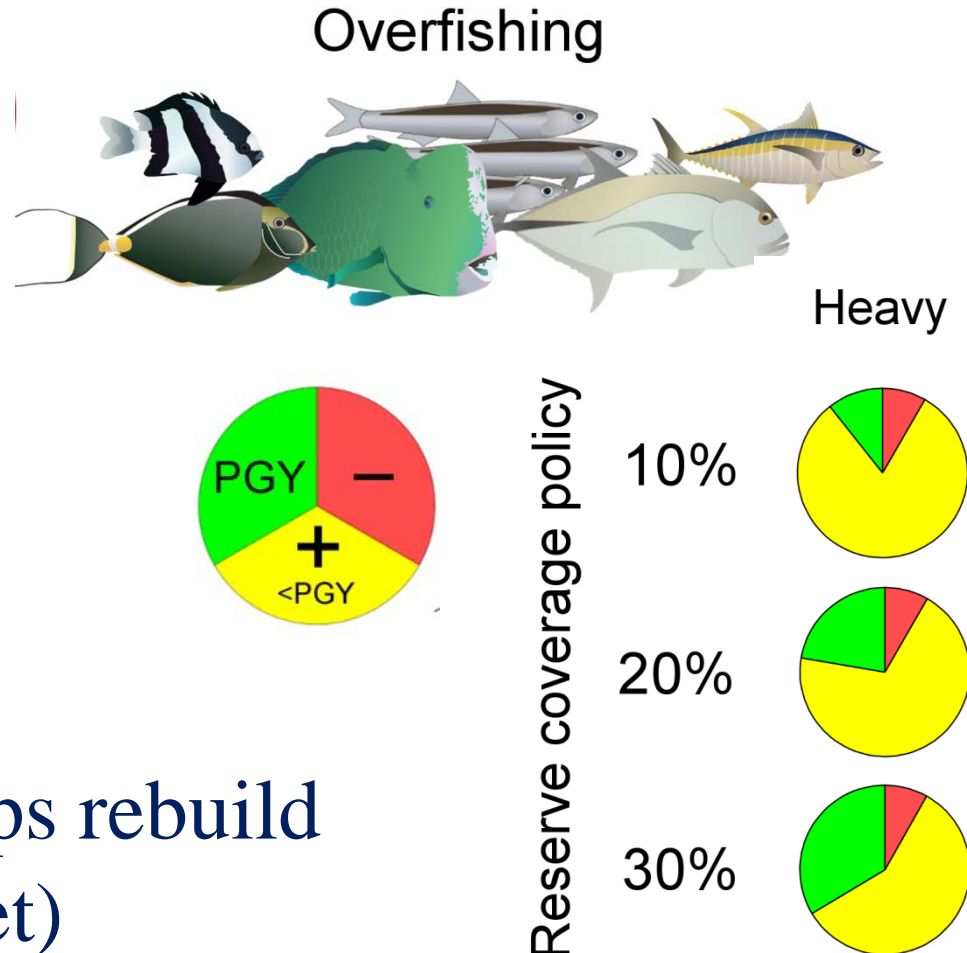
Accepted: November 25, 2016

Published: January 5, 2017

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Data Availability Statement: Averaged reserve coverage target results are contained in the Supporting Information (S2 Table). Raw results files are available from the Zenodo database (DOI: [10.5281/zenodo.105393](https://doi.org/10.5281/zenodo.105393)).

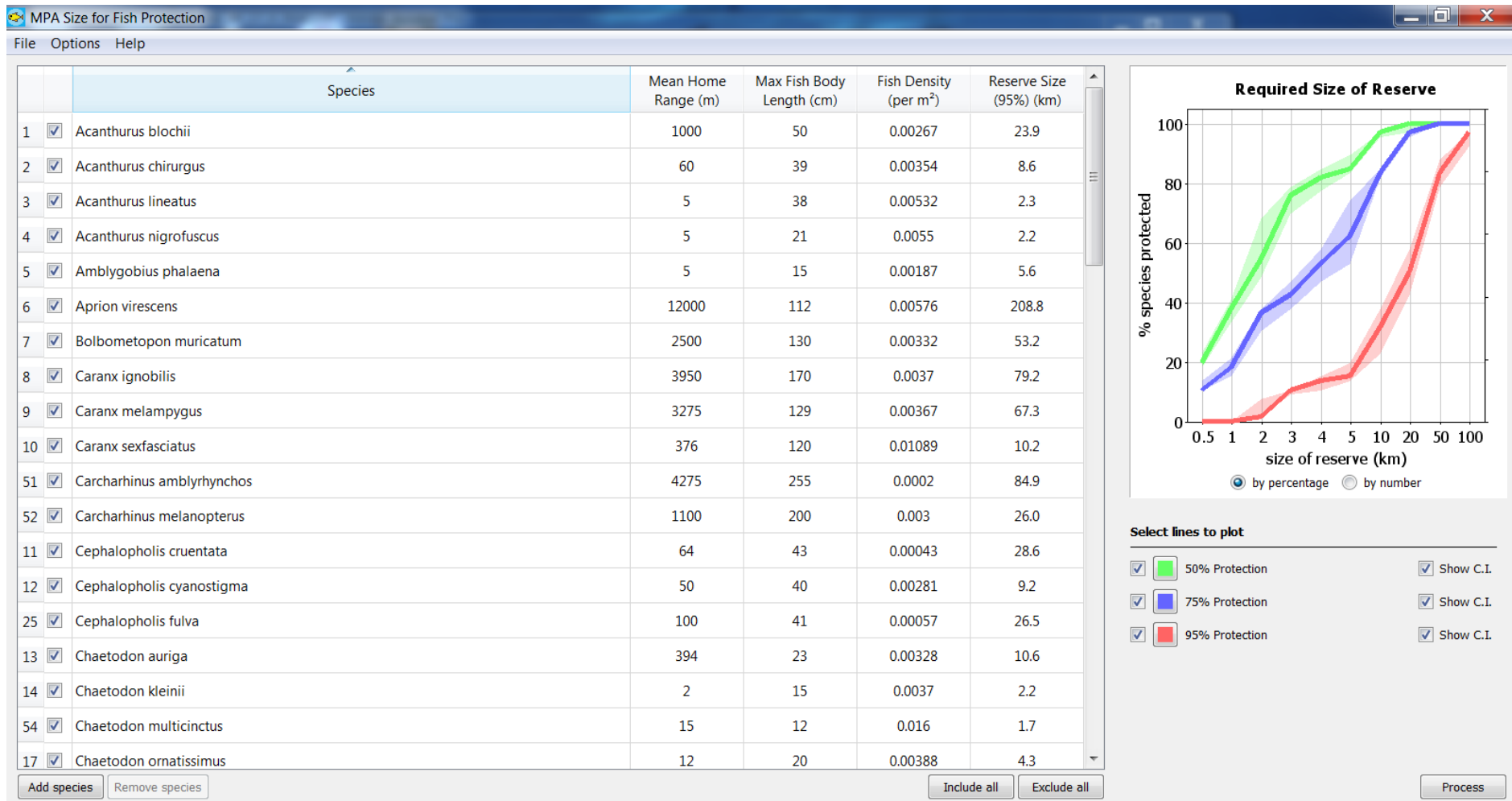
Funding: Australian Research Council (<http://www.arcs.gov.au/>) grant number LP120200493. The work was supported by an Australian Research Council Linkage Project co-funded by the World Wildlife Fund (WWF) (Indonesia) (awarded to RMT, EAT, HPP, and CR). The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. World Bank/GEF (Capturing Coral Reef & Related Ecosystem Services). This work was also



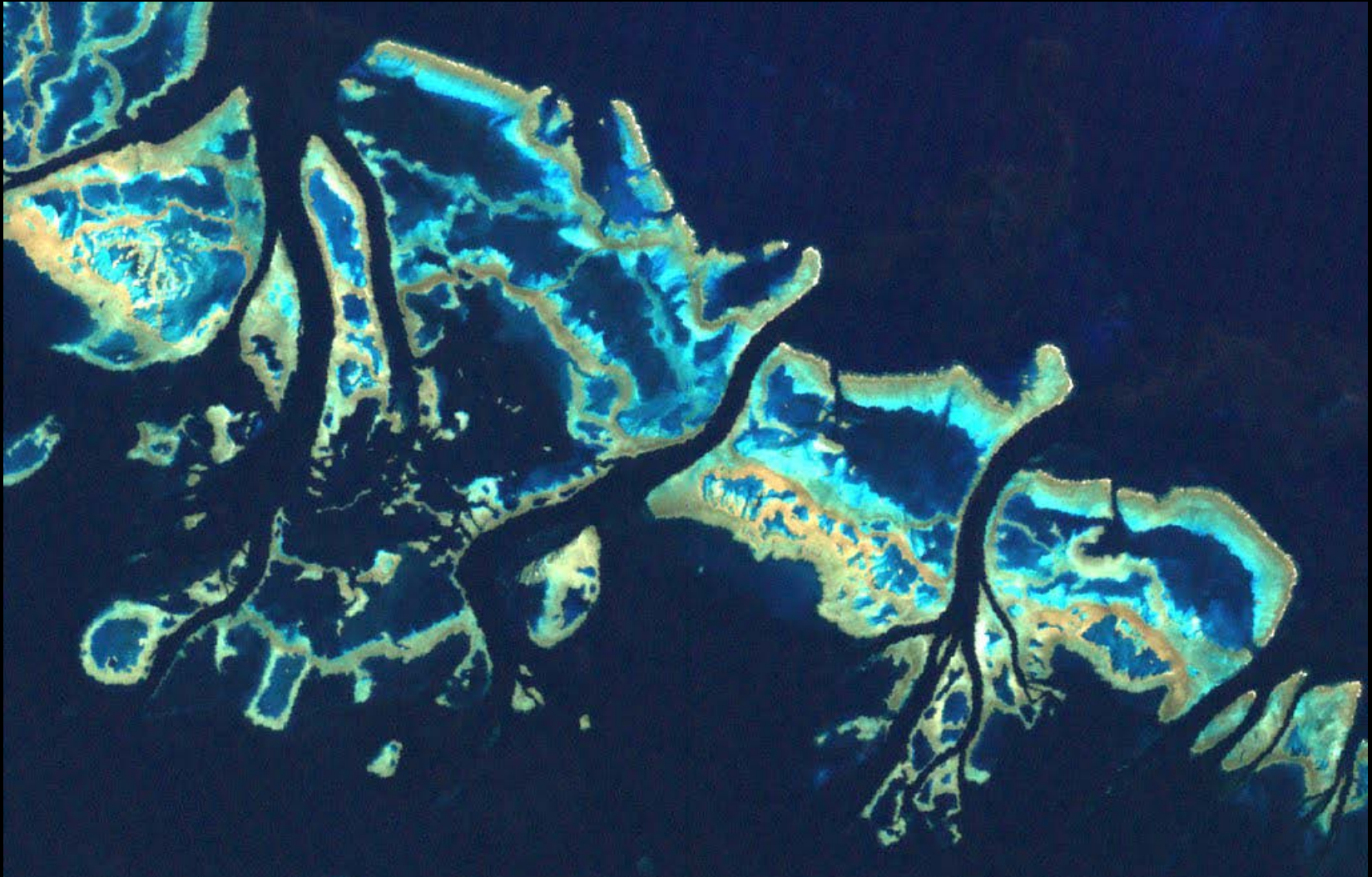
Even 10% core zone helps rebuild fisheries (UN Aichi target)

1.2 Size of reserves to be effective?

Downloadable & customisable software tool

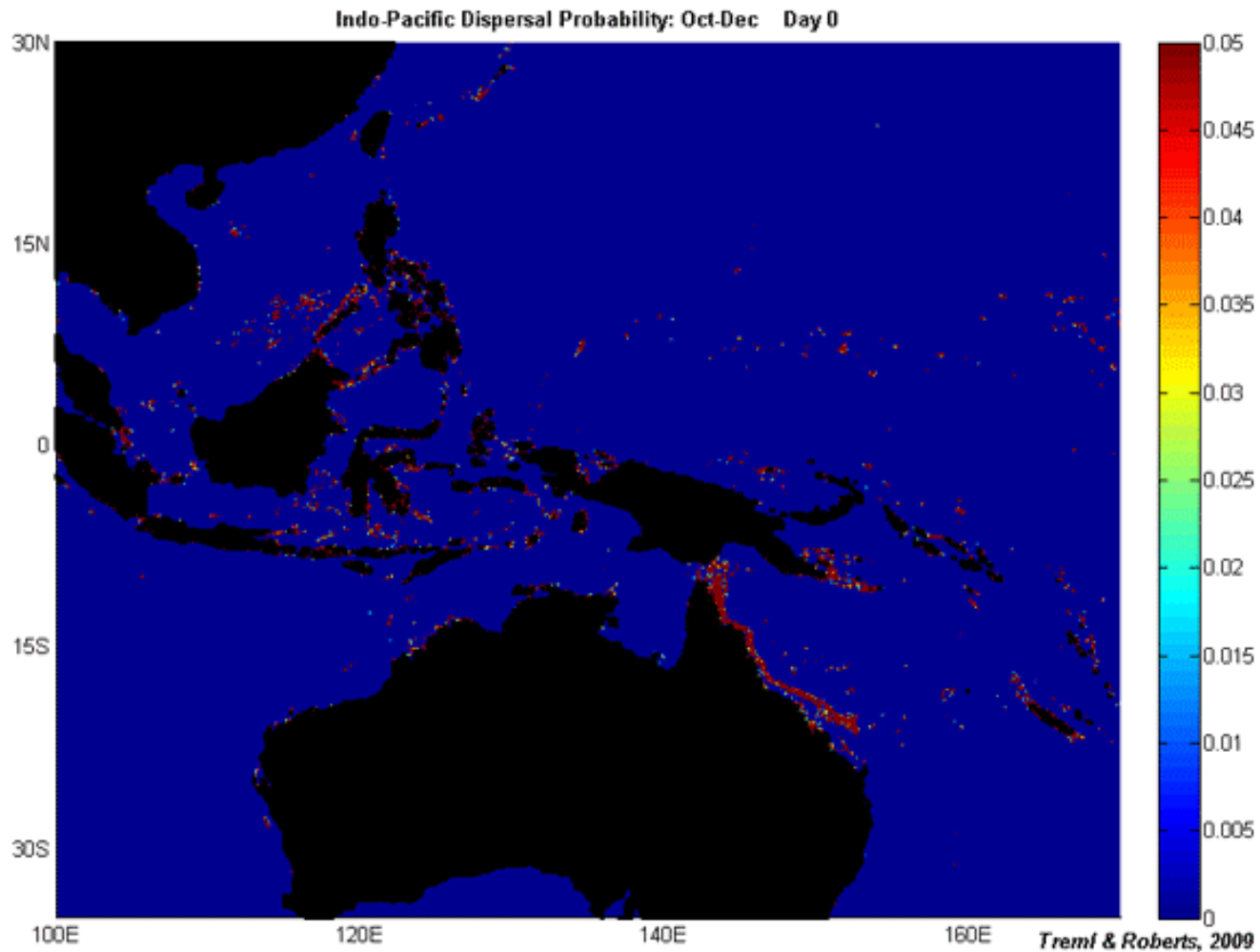


Where to protect?



Krueck NC, Ahmadiya GN, Green A, Jones GP, Possingham HP, Riginos C, Trembl EA, **Mumby PJ** (2017) Incorporating larval dispersal into MPA design for both conservation and fisheries. **Ecological Applications** 27: 925-941

Connectivity



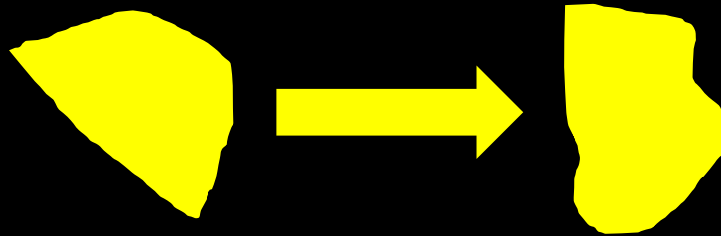
Prioritizing larval flow: conservation



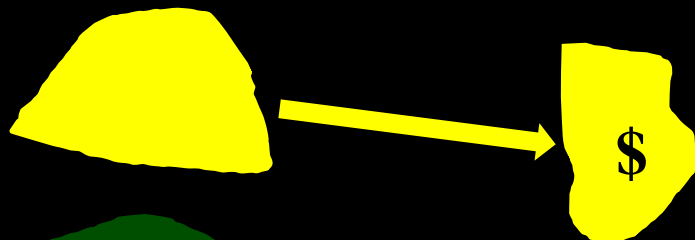
1. High self-replenishment

- Populations are robust to upstream disturbance
- But, they do not necessarily subsidize fished areas

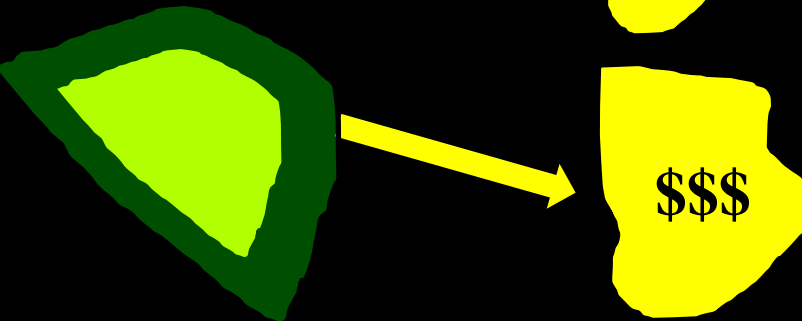
Prioritizing larval flow: fisheries



1. Subsidize other areas

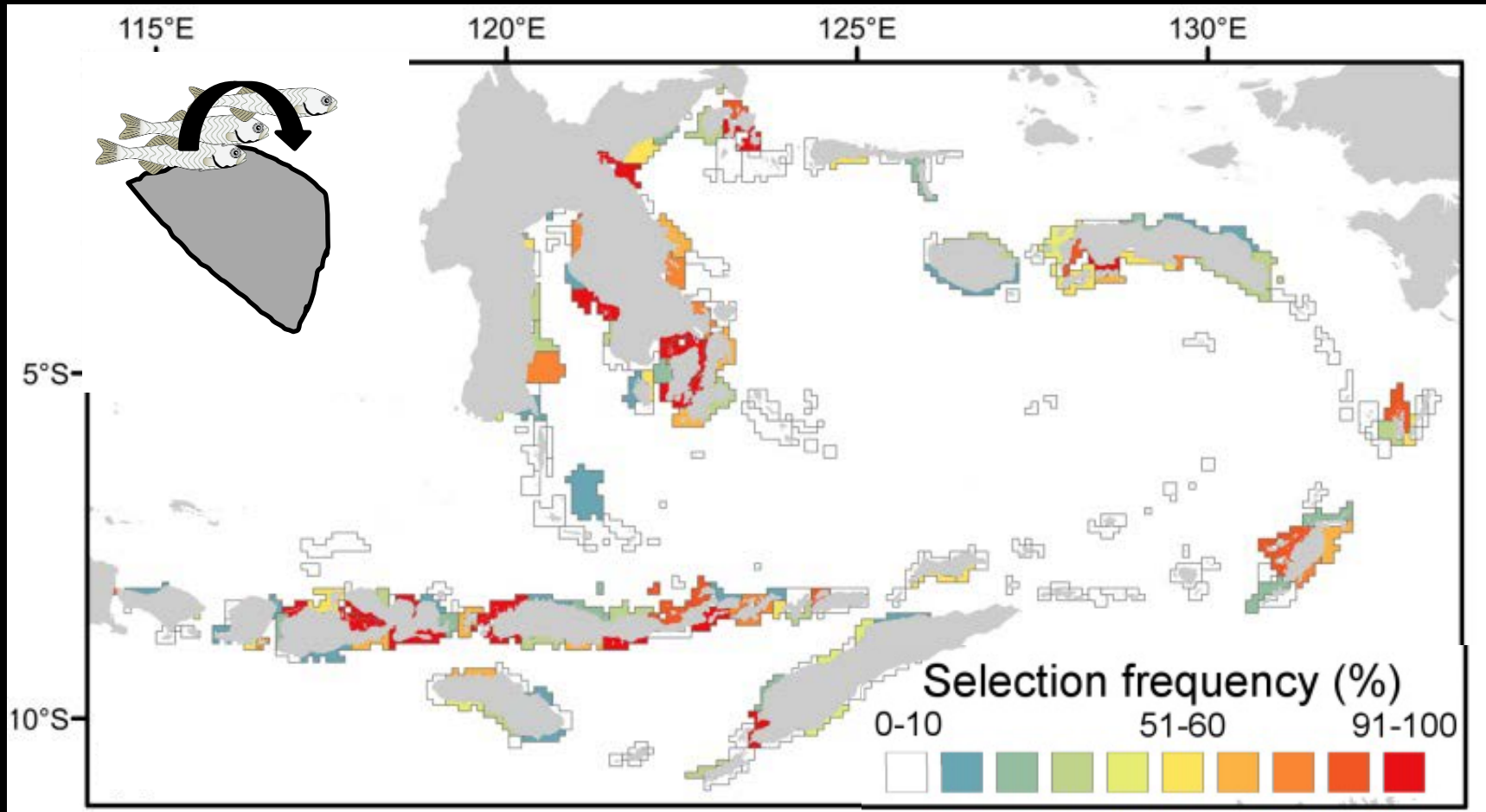


2. Specifically the most important fished areas



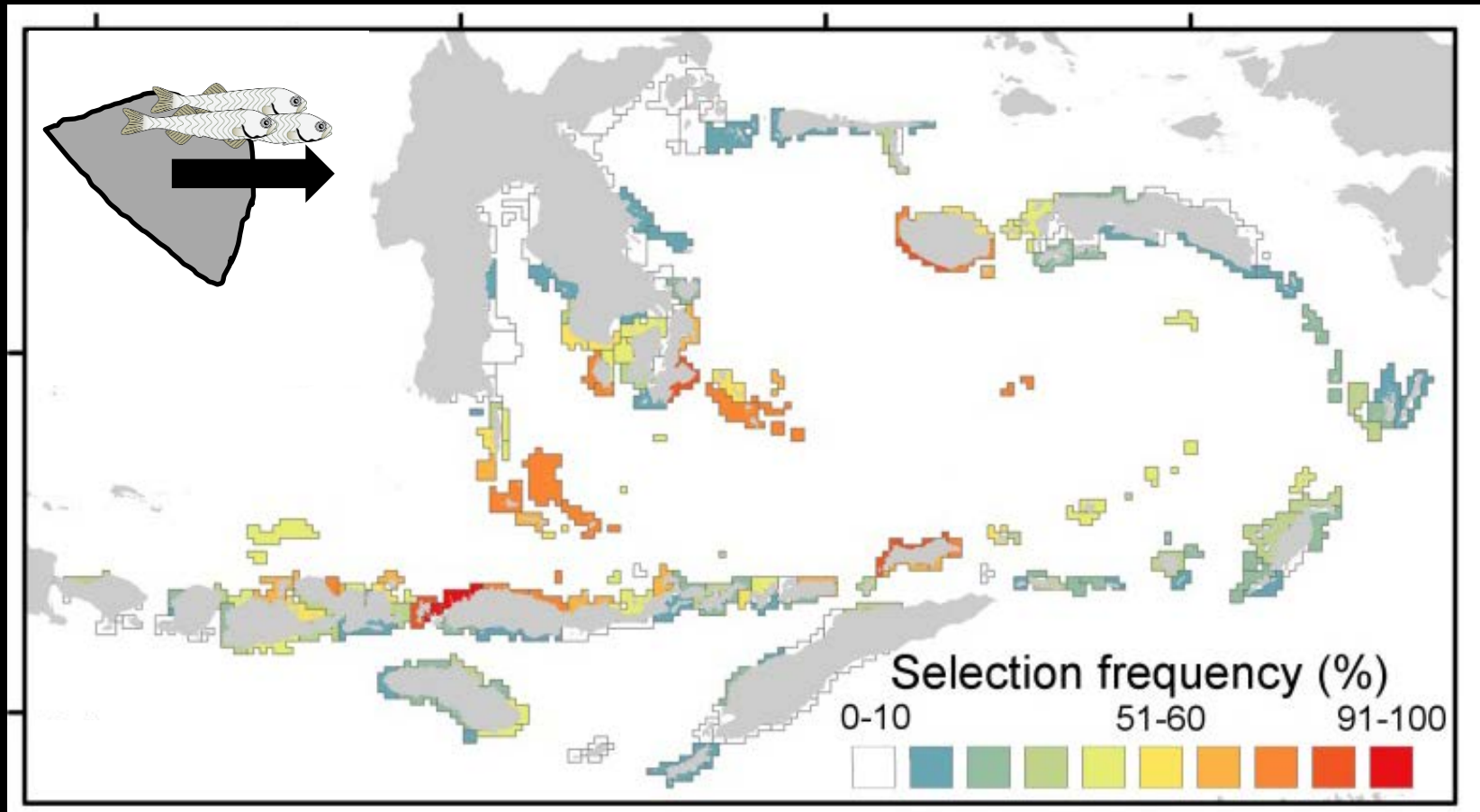
Using dispersal data for MPA design

Retention: Larvae stay at home

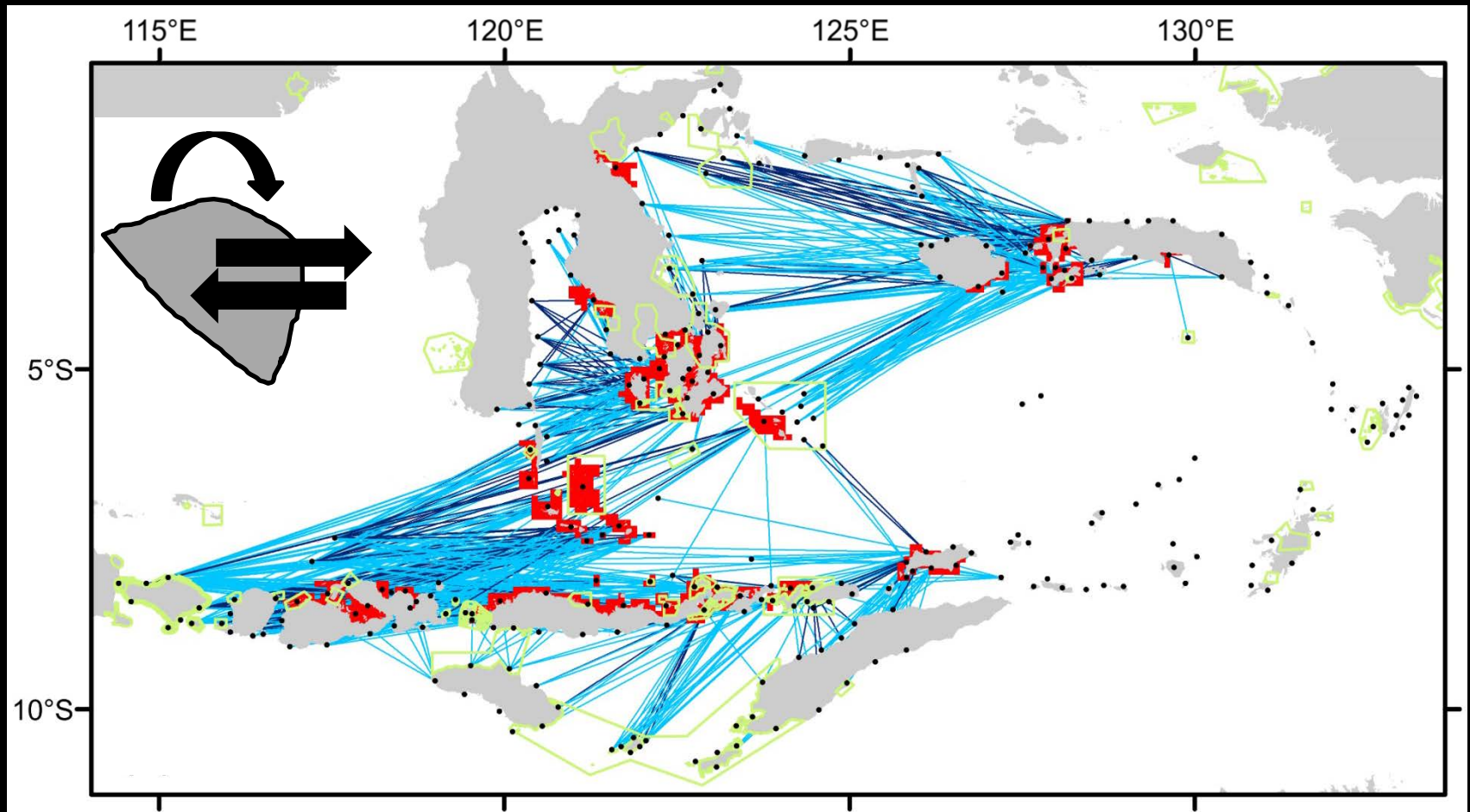


Using dispersal data for MPA design

Export: Larvae leave to other locations



Best MPA network design for Sunda Banda



1.3) Reserve design tool to rebuild fisheries

Dispersal Matrix Processor

File Options Help

Cost

total cost

planning unit

Status: Need to load location data and dispersal matrix

Import Weighting Factor (w_i): 0.5000

Balances local retention against the import of larvae in protected locations, allowing to adjust MPA designs to likely disturbance regimes. A value of zero places full weight on local retention, a value of one places full weight on the external import of larvae into protected locations.

Import Scaling Parameter (z_i): 0.0000

Adjusts whether connection strength (numbers of larvae) or connection diversity (numbers of sources of import) are prioritized. Values should vary between zero (to prioritize connection diversity) and one (to prioritize connection strength).

Export Weighting Factor (w_e): 0.5000

Balances local retention and/or import against larval export, placing full weight on persistence in protected areas if set to zero and full weight on the support of unprotected populations when set to one.

Export Scaling Parameter (z_e): 0.0000

Has the same effect as the import scale factor described above, but representing the export of larvae to unprotected locations.

Connectivity Strength Modifier (CSM): 1.000

This value determines the importance of larval dispersal compared to other objectives (costs) for the MPA design. If no costs are specified, the CSM should be set to 1. Otherwise, we recommend starting to explore values between 0.01 and 10.

Prioritize larval flow from desirable locations: ☐

Prioritizes larval flow out of desirable locations into protected locations based on the supplied import desirability score (D_i). Deselect if there is no interest in exporting larvae from particular areas.

Prioritize larval flow to desirable locations: ☒

Prioritizes larval flow from protected locations into desirable locations based on the supplied export desirability score (D_e). Deselect if there is no interest in supporting particular areas with larvae.

Use square-root transform: ☐

Apply a square-root transform to input results to achieve a more even data distribution.

- Requires: GIS (free), Marxan (free), 3 days training or self-teach
- Utilised by WWF-Indonesia to plan reserve networks in 17 regions
- COREMAP-CTI

- Trained 190+ users so far



1.4) Training software in reserve design

Spatial Fisheries Model

File Planning Units Distances View Options Help

	MPA	Area (km ²)	FID_plar
1	<input type="checkbox"/>	0.013	61
2	<input type="checkbox"/>	0.054	62
3	<input type="checkbox"/>	0.010	115
4	<input type="checkbox"/>	0.449	116
5	<input checked="" type="checkbox"/>	0.879	117
6	<input checked="" type="checkbox"/>	0.637	118
7	<input checked="" type="checkbox"/>	0.008	119
8	<input type="checkbox"/>	0.024	170
9	<input type="checkbox"/>	0.683	171
10	<input type="checkbox"/>	0.272	172
11	<input type="checkbox"/>	0.378	173
12	<input checked="" type="checkbox"/>	0.435	174
13	<input type="checkbox"/>	0.118	226
14	<input type="checkbox"/>	0.681	227
15	<input type="checkbox"/>	0.143	228
16	<input type="checkbox"/>	0.654	229
17	<input type="checkbox"/>	0.015	230

Number planning units: 150
Total area : 24.05 km²
MPA planning units: 3
MPA area : 1.52 km²

Lat-long (-2.73415,128.998) PU: 17

Planning Units (PU) Distance Matrix Model Optimisation Review

Species

Name	Dispersal (km)	Home range (km)	s	p	h	wPre	wRec	Weight
1. Coral Trout	20 ± 20	1 ± 1	0.631	0.272	0.800	0.1000	0.1272	1

Larval output: ☒ PU area ☐ PU data ☐ Spatial

Habitat quality: ☒ Uniform ☐ PU data ☐ Spatial

Fishing effort: ☒ Uniform ☐ PU data ☐ Spatial

Costs

☐ Uniform ☒ PU data

Model run

Results: Results_1 Years to run: 100 Year of MPA implementation: 25

Last result: Catch 63.6 % of MSY by 55 years, 3 PUs, Area 1.52 km², Cost 354

Run 100%

Total Over Time

Biomass (% of Initial or MSY)

time (year)

Selected Planning Units

Biomass (% of Initial or MSY)

time (year)

Selected planning units

1. PU: 12 ☒ (click)

2. (none) ☐ (shift-click)

Distance: -

Results_1 ☒ ☒

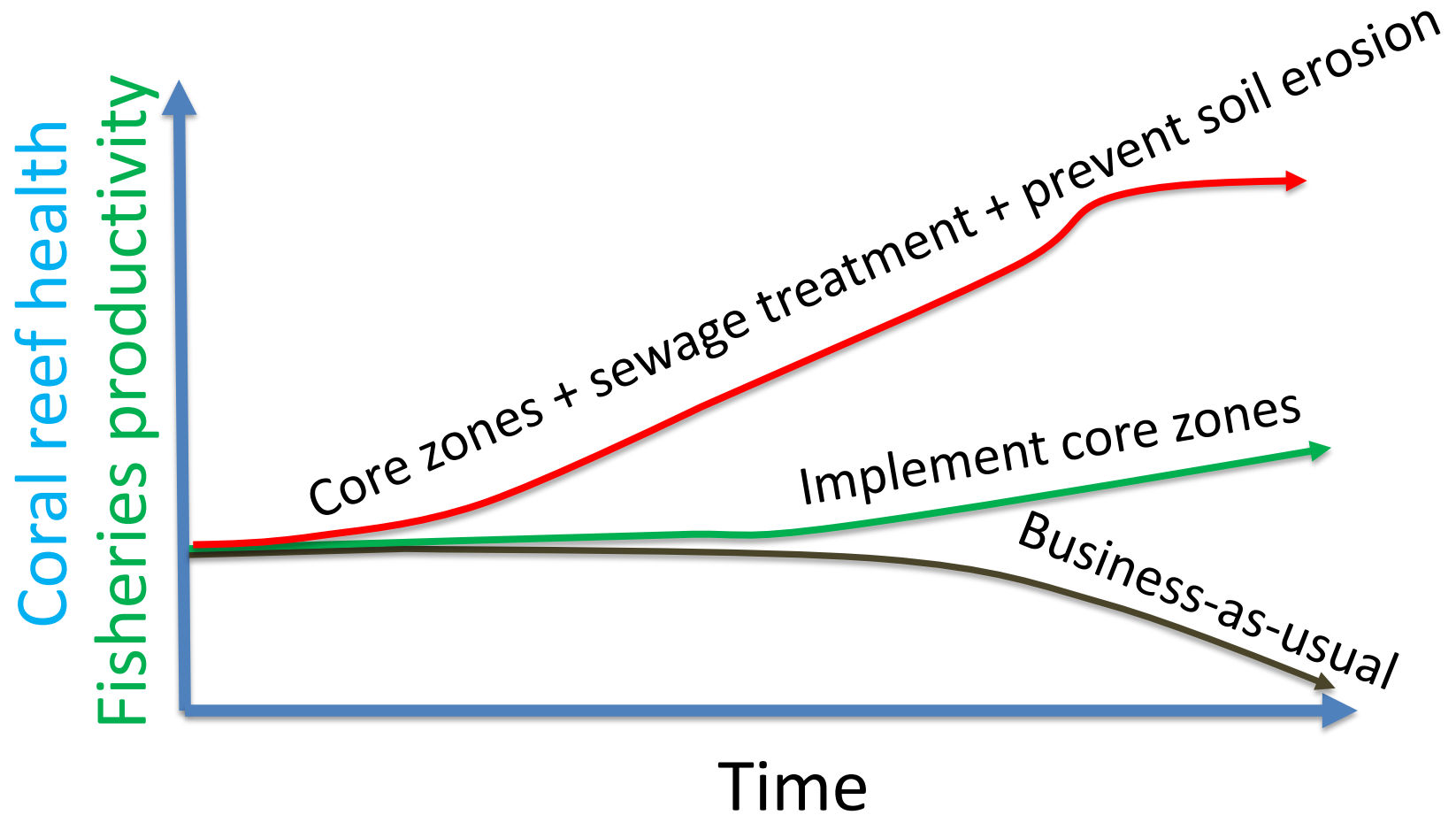
Add Line

2) Reef React

- Software to predict reef outcomes
- Effects of local pressures (pollution, over-harvesting, crown-of-thorns starfish, cyclones)
- Effects of global stressors (coral bleaching under multiple GHG emissions)
- Multiple time periods
- Synthesizes hundreds of scientific studies
- Software tool downloadable & accessible online
- Final beta testing in mid April before release
- Used by COREMAP-CTI
- Available now

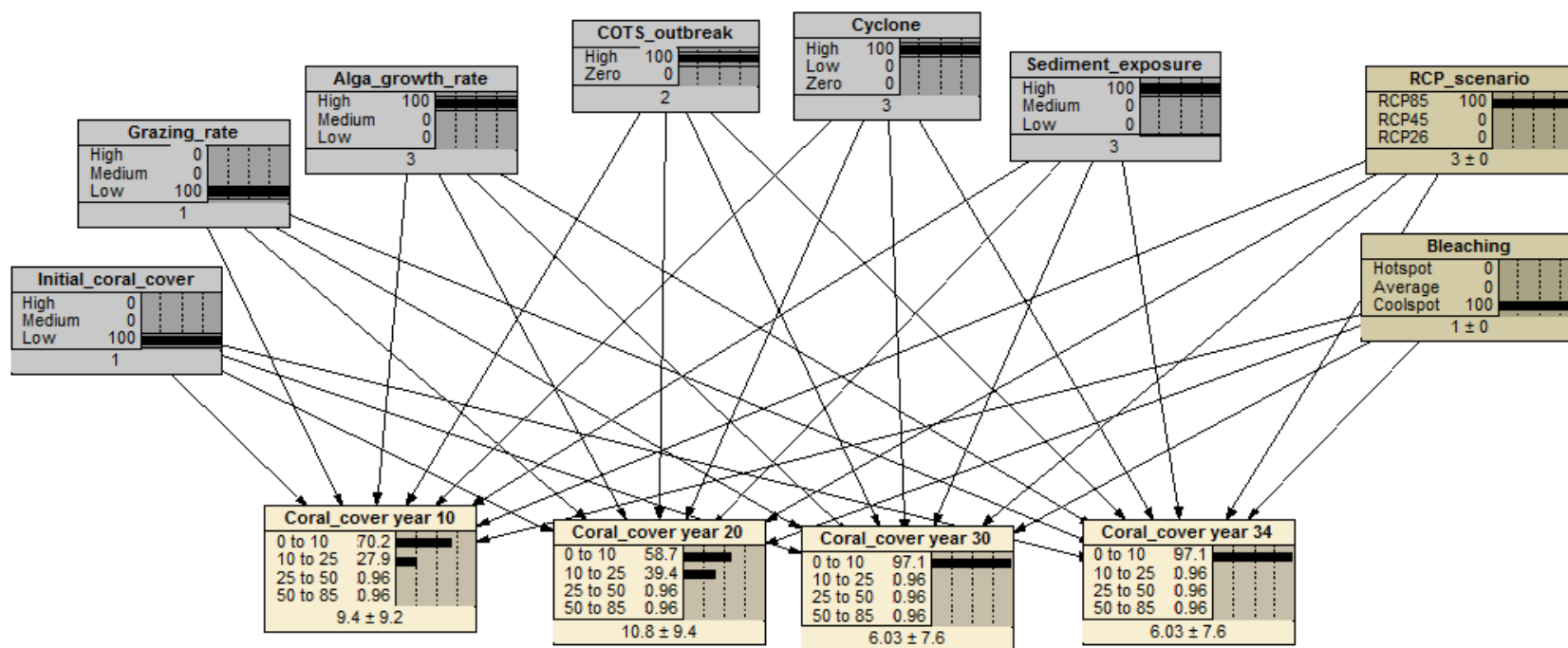


Coral reef projections



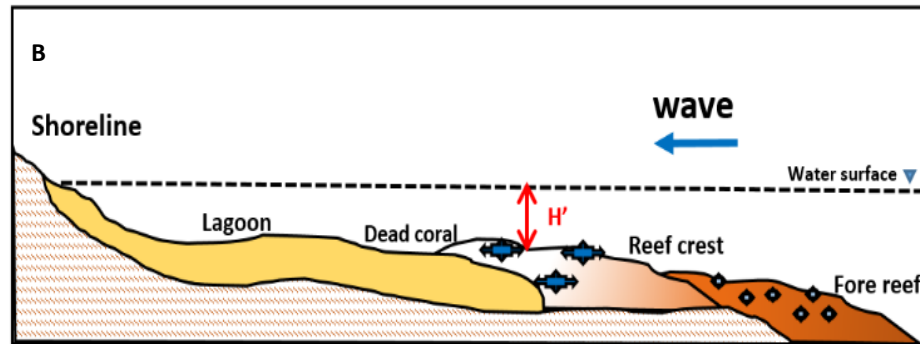
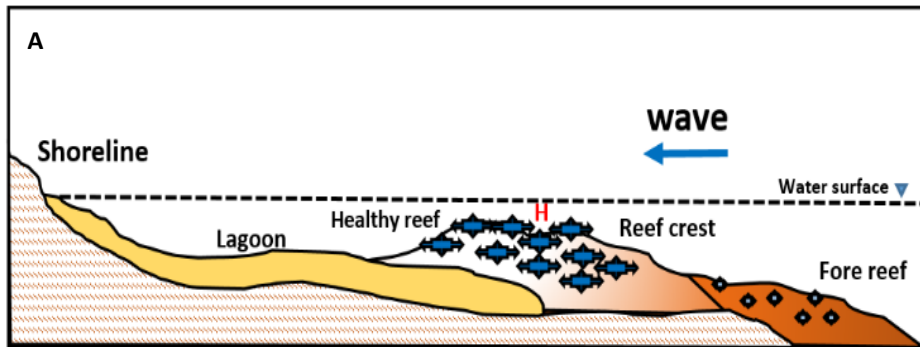
Netica - [RCP_85coolspot_with_bleach]

File Edit Layout Modify Table Network Cases Report Style Window Help



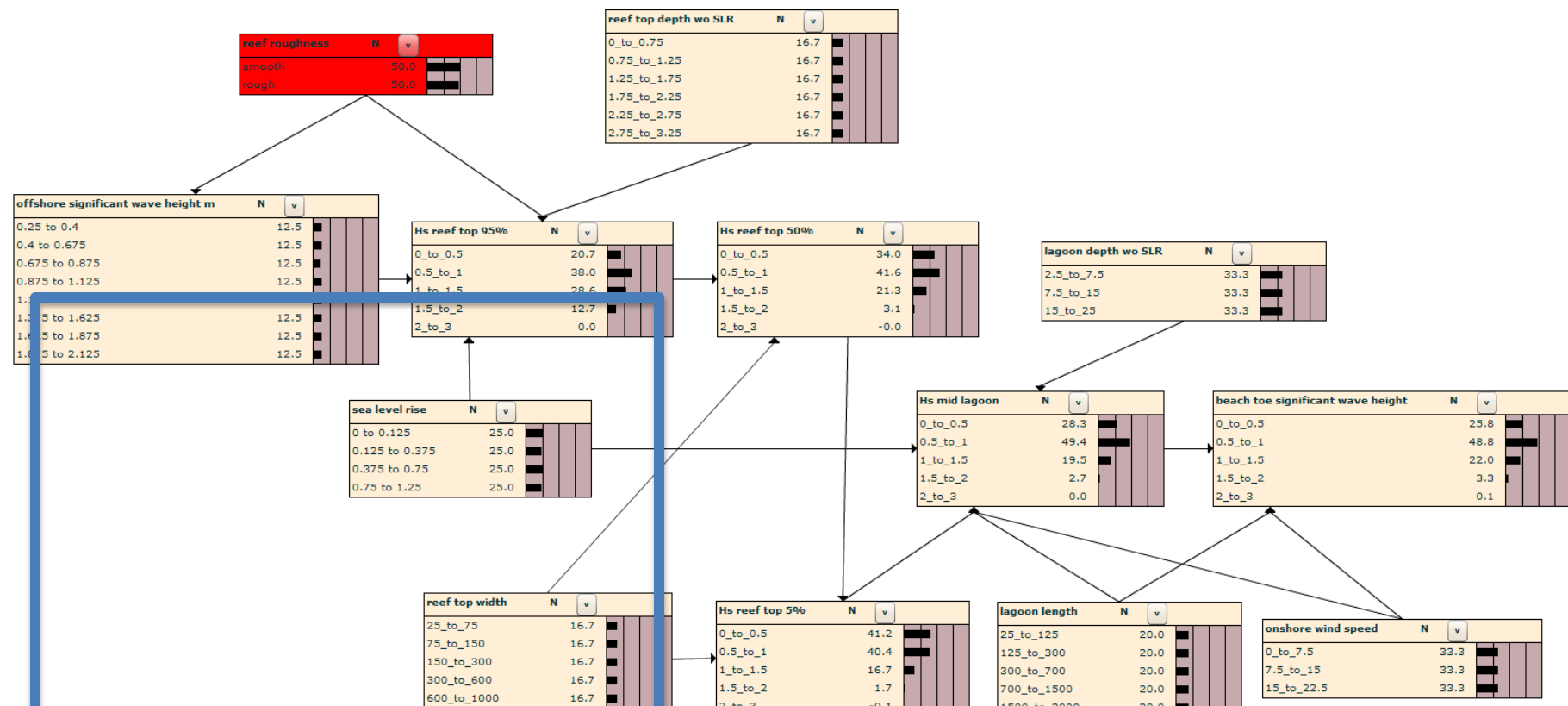
3) Protection of coastal infrastructure

- Tools to factor in the importance of reefs in protecting the shoreline especially under **sea level rise**



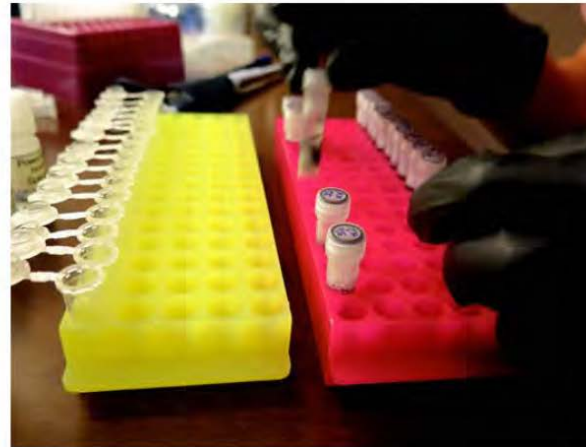
Mapping key protective reefs





4. Seagrasses and disease reduction

- Can seagrass beds improve health?
 - Evidence of 3-fold reduction in potential human bacterial pathogens inside seagrass beds
 - Reduce fish & invertebrate pathogens by 50%
 - Co-location of aquaculture



Solutions

Behaviour Change



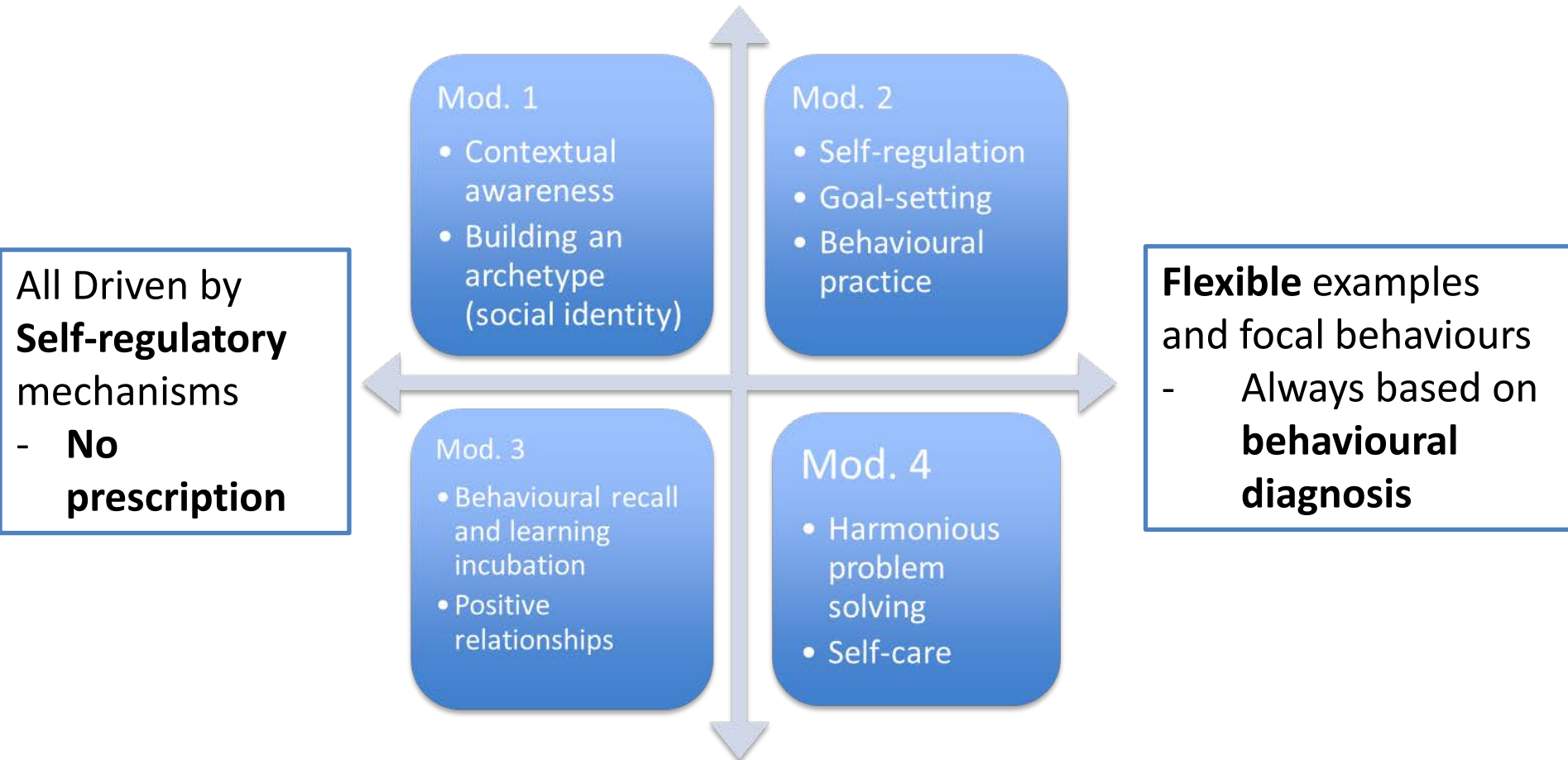
5) My Future, My ocean

- A step-by-step guide for **promoting behaviour change**, for use by villages and government which seek to foster sustainable behaviours in parents and children living in coastal households of Indonesia

- Adapted from Triple-P (positive parenting programme)



Evidence- Based Delivery Structure



- Focus on diagnosing problem causing undesirable behaviour

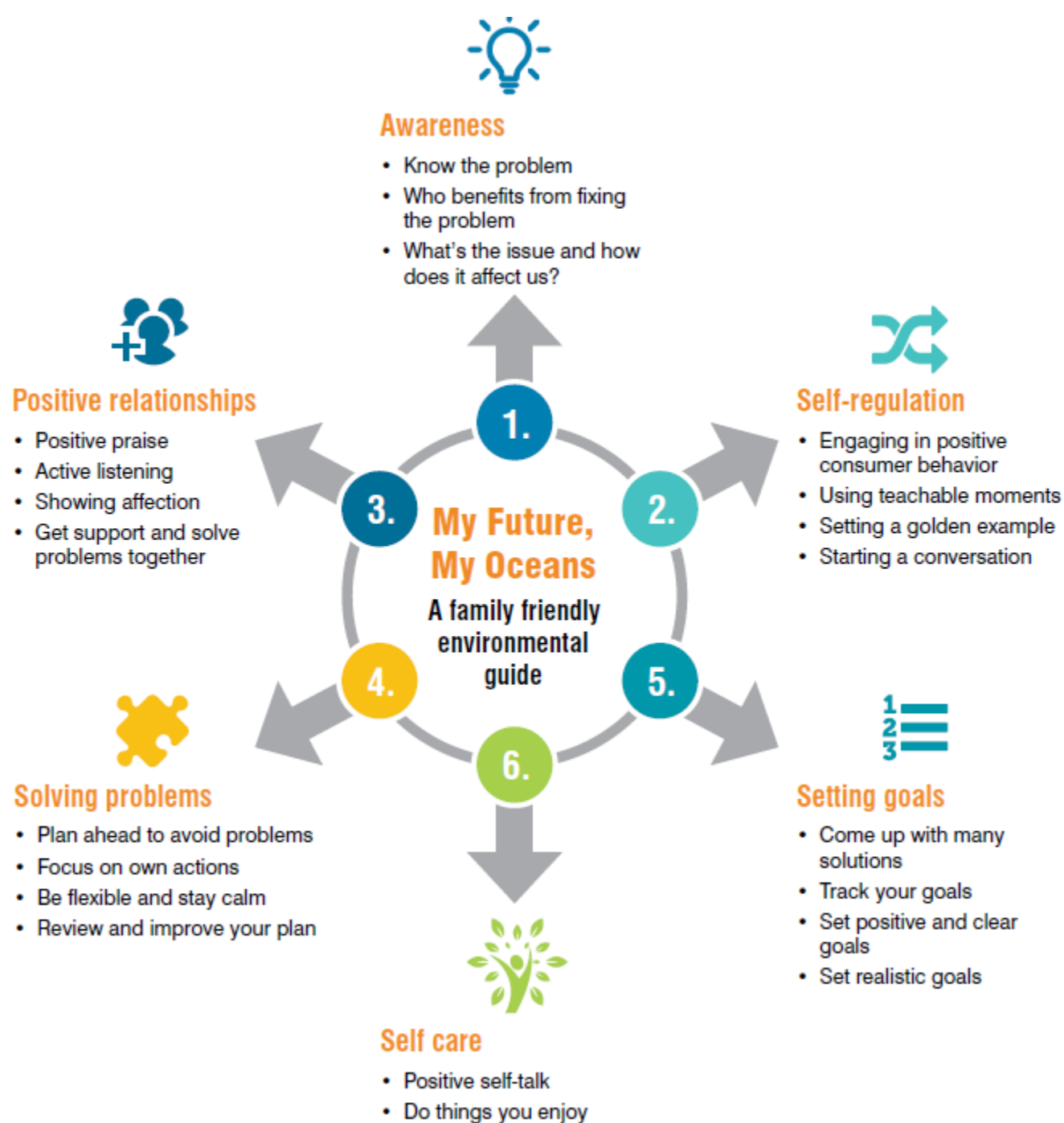


■ Exercise 2 Why managing our garbage is hard

Check the boxes that most apply to you:

- ☐ Our ocean is being ruined by others
- ☐ There is too much garbage
- ☐ I do not have time
- ☐ I doubt my ability to change anything
- ☐ Sometimes the problem seems too big
- ☐ My behavior does not matter
- ☐ I am not sure what to do
- ☐ I am not strong enough to help fix our garbage problems
- ☐ I do not have the supplies to clean up garbage
- ☐ Starting conversations about garbage is hard
- ☐ I am too tired to do much

- Focus on positive actions and outlooks



- Focused on garbage and ocean plastics
- Two training / work books on ccres.net
- Trialled in Selayar (village of Bontolebang)
- 10-fold increase in the size of water bottles being used
- 100 bags of plastic collected during pilot – later given to recycling plant
- Village nominated for ‘Cleanest village’ of Indonesia and now a finalist after 3 rounds. Interest from neighbouring villages and as far afield as Banda Aceh

Next steps

- Opportunity for synergism when tools deployed in concert
- Many tools can be adapted for use in other contexts
- Taking these approaches in new directions
- How useful are these tools for other projects?

