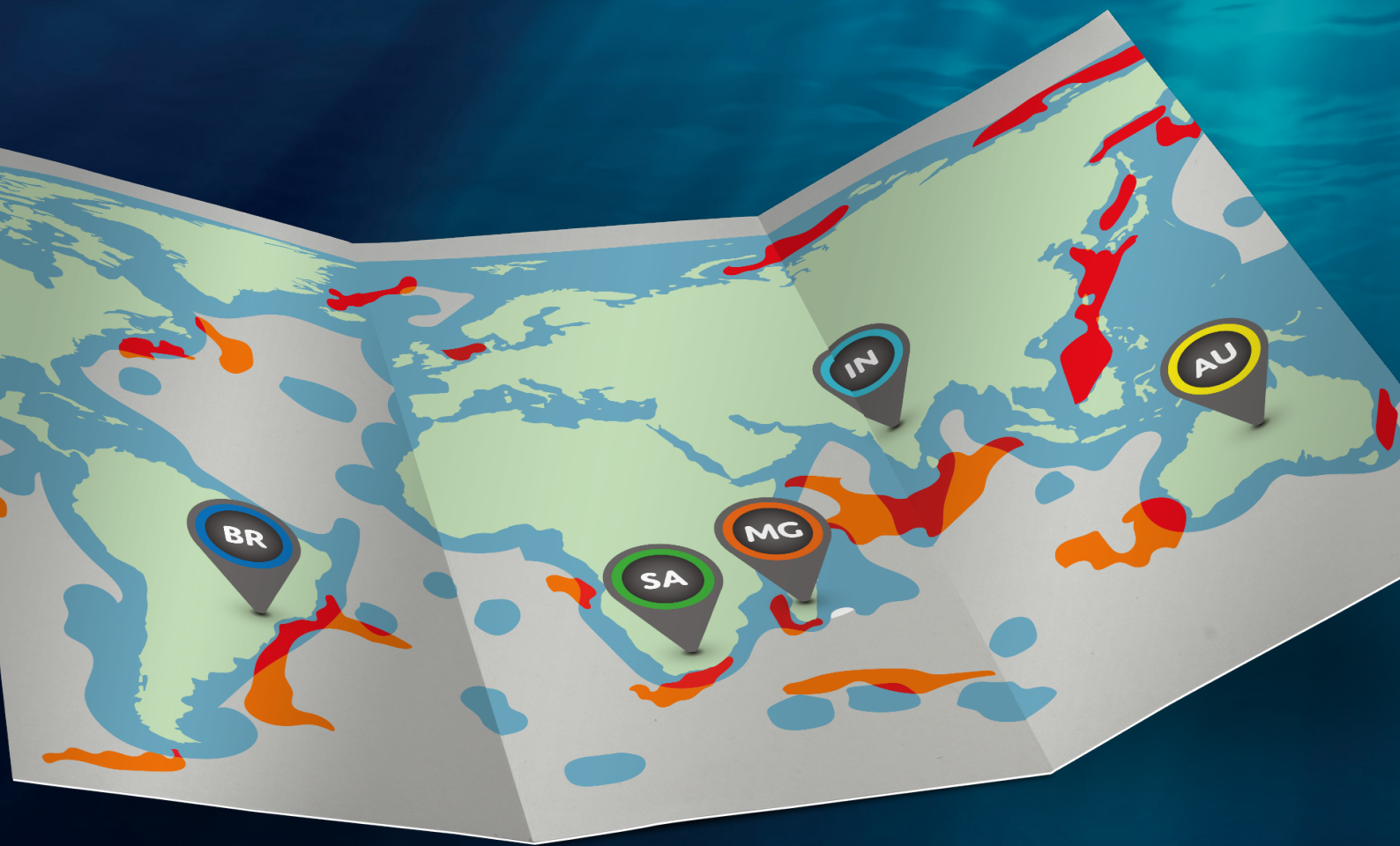# GLOBAL UNDERSTANDING AND LEARNING FOR LOCAL SOLUTIONS (GULLS)

REDUCING VULNERABILITY OF MARINE-DEPENDENT COASTAL COMMUNITIES TO CLIMATE CHANGE

INTRODUCTION

The project 'Global learning for local solutions: Reducing vulnerability of marine-dependent coastal communities' or GULLS, is an international project within the Belmont Forum and G8 Research Councils Initiative on Multilateral Research Funding. The project has been investigating five regional 'hotspots' of climate and social change, defined as fast-warming marine areas and areas experiencing social tensions as a result of change: south-east Australia, Brazil, India, South Africa, and the Mozambique Channel and Madagascar. It has focused on contributing to reducing the vulnerability of coastal communi-ties and other stakeholders dependent on marine resources to adapt

to climate change and variability through an integrated and trans-disciplinary approach. It includes partici-pants from Australia, Brazil, India, Madagascar, South Africa, the United Kingdom and the United States of America. The research programme has been divided into five inter-linked components: ocean and climate change models, species vulnerability, social as-pects, system modelling, governance, and communication and education.

The project is on course to deliver a comprehensive set of options to reduce coastal vul-nerability and position vulnerable coastal communities for an improved future.

COMMUNICATION AND EDUCATION

Education workshops for primary school teachers, high school teachers and other educational professionals on Communicating Ocean Science and Climate Change were held in four countries along with a wide range of education and outreach programs at each of the Hotspots, including professional development to local school teachers and academics through workshops, citizen science programs, and development of locally relevant scientific educational resources.
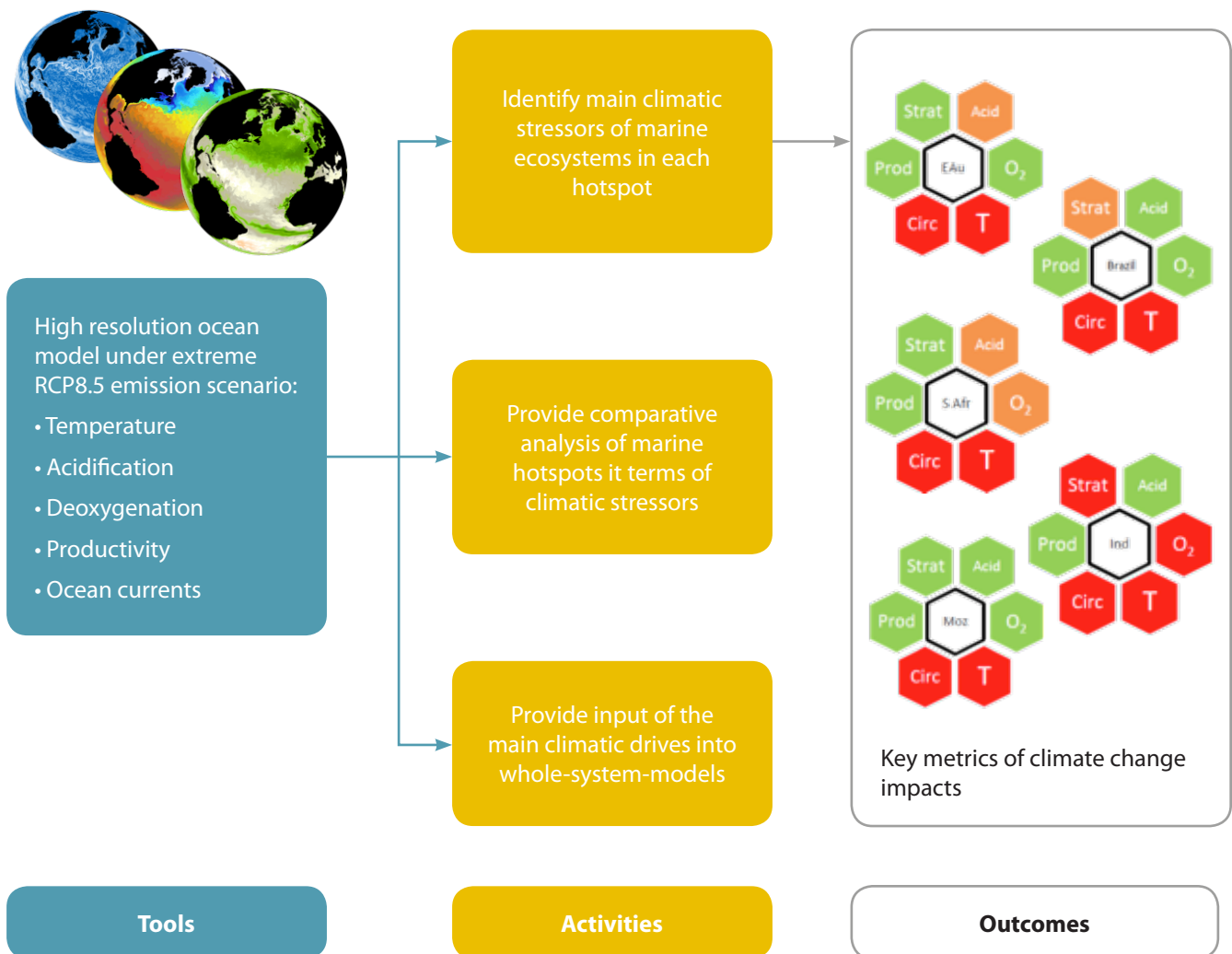

SO WHAT?

Expanding climate literacy and understanding the potential consequences of climate change are imperative for ensuring that citizens throughout the world will be better prepared to mitigate climate change and to respond to both the economic and environmental challenges, as well as the opportunities that climate change will bring.

OCEAN AND CLIMATE CHANGE MODELLING

Anthropogenic climate change is a global phenomenon. However, their impact on living marine resource and dependent communities is local and often unique. Information from global ocean models is immensely complex and includes a multitude of environmental characteristics. Long term trends of these variables are of limited value for planning local climate change adaptation unless the model output is translated into a form that meets local needs. The main challenge for the GULLS global modelling team was to find unifying parameters and metrics of climate change common between all hotspots, so their commonalities and differences in respect to the strength of climate stressors can be compared. This was achieved by working closely together with the ecological vulnerability group to identify key stressors threating the most commercially important species. One of the novel studies conducted by ocean climate group in GULLS included a demonstration of the important role of the climatically driven changes of the ocean currents in ecosystem change.

Ocean Models – Climate change projections

High resolution ocean model under extreme RCP8.5 emission scenario:

- Temperature
- Acidification
- Deoxygenation
- Productivity
- Ocean currents

Identify main climatic stressors of marine ecosystems in each hotspot

Provide comparative analysis of marine hotspots it terms of climatic stressors

Provide input of the main climatic drives into whole-system-models

Key metrics of climate change impacts

Tools	Activities	Outcomes

SO WHAT?

Successful adaptation to climate change can only be achieved using a participatory approach which combines climate science with local data and knowledge to identify impacts on species critical to the livelihoods and wellbeing of the communities involved.
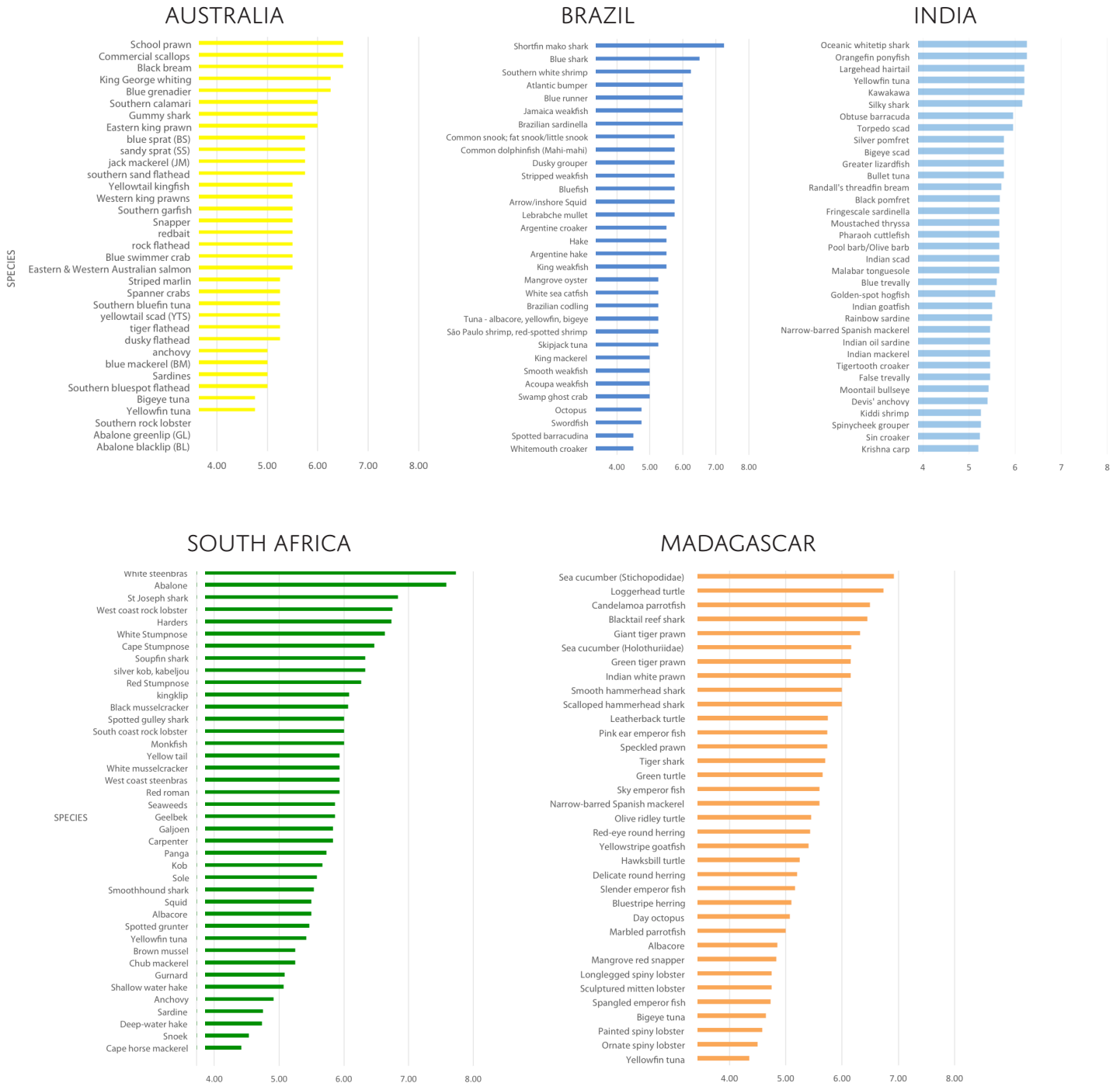
SPECIES VULNERABILITY

We estimated sensitivity of species to climate change drivers based on:

- **Abundance**—measures of potential for biological productivity (e.g. egg production)

- **Distribution**—measures of capacity to shift (e.g. larval dispersal)

- **Phenology**—measures of potential impact on timing of life cycle events (e.g. temperature as a cue for moulting or spawning)

AUSTRALIA

School prawn, Commercial scallops, Black bream, King George whiting, Blue grenadier, Southern calamari, Gummy shark, Eastern king prawn, blue sprat (BS), sandy sprat (SS), jack mackerel (JM), southern sand flathead, Yellowtail kingfish, Western king prawns, Southern garfish, Snapper, redbait, rock flathead, Blue swimmer crab, Eastern & Western Australian salmon, Striped marlin, Spanner crabs, Southern bluefin tuna, yellowtail scad (YTS), tiger flathead, dusky flathead, anchovy, blue mackerel (BM), Sardines, Southern bluespot flathead, Bigeye tuna, Yellowfin tuna, Southern rock lobster, Abalone greenlip (GL), Abalone blacklip (BL)

BRAZIL

Shortfin mako shark, Blue shark, Southern white shrimp, Atlantic bumper, Blue runner, Jamaica weakfish, Brazilian sardinella, Common snook; fat snook/little snook, Common dolphinfish (Mahi-mahi), Dusky grouper, Stripped weakfish, Bluefish, Arrow/inshore Squid, Lebrabche mullet, Argentine croaker, Hake, Argentine hake, King weakfish, Mangrove oyster, White sea catfish, Brazilian codling, Tuna - albacore, yellowfin, bigeye, São Paulo shrimp, red-spotted shrimp, Skipjack tuna, King mackerel, Smooth weakfish, Acoupa weakfish, Swamp ghost crab, Octopus, Swordfish, Spotted barracudina, Whitemouth croaker

INDIA

Oceanic whitetip shark, Orangefin ponyfish, Largehead hairtail, Yellowfin tuna, Kawakawa, Silky shark, Obtuse barracuda, Torpedo scad, Silver pomfret, Bigeye scad, Greater lizardfish, Bullet tuna, Randall's threadfin bream, Black pomfret, Fringescale sardinella, Moustached thryssa, Pharaoh cuttlefish, Pool barb/Olive barb, Indian scad, Malabar tonguesole, Blue trevally, Golden-spot hogfish, Indian goatfish, Rainbow sardine, Narrow-barred Spanish mackerel, Indian oil sardine, Indian mackerel, Tigertooth croaker, False trevally, Moontail bullseye, Devis' anchovy, Kiddi shrimp, Spinycheek grouper, Sin croaker, Krishna carp

SOUTH AFRICA

White steenbras, Abalone, St Joseph shark, West coast rock lobster, Harders, White Stumpnose, Cape Stumpnose, Soupfin shark, silver kob, kabeljou, Red Stumpnose, kingklip, Black musselcracker, Spotted gulley shark, South coast rock lobster, Monkfish, Yellow tail, White musselcracker, West coast steenbras, Red roman, Seaweeds, Geelbek, Galjoen, Carpenter, Panga, Kob, Sole, Smoothhound shark, Squid, Albacore, Spotted grunter, Yellowfin tuna, Brown mussel, Chub mackerel, Gurnard, Shallow water hake, Anchovy, Sardine, Deep-water hake, Snoek, Cape horse mackerel

MADAGASCAR

Sea cucumber (Stichopodidae), Loggerhead turtle, Candelamoa parrotfish, Blacktail reef shark, Giant tiger prawn, Sea cucumber (Holothuriidae), Green tiger prawn, Indian white prawn, Smooth hammerhead shark, Scalloped hammerhead shark, Leatherback turtle, Pink ear emperor fish, Speckled prawn, Tiger shark, Green turtle, Sky emperor fish, Narrow-barred Spanish mackerel, Olive ridley turtle, Red-eye round herring, Yellowstripe goatfish, Hawksbill turtle, Delicate round herring, Slender emperor fish, Bluestripe herring, Day octopus, Marbled parrotfish, Albacore, Mangrove red snapper, Longlegged spiny lobster, Sculptured mitten lobster, Spangled emperor fish, Bigeye tuna, Painted spiny lobster, Ornate spiny lobster, Yellowfin tuna
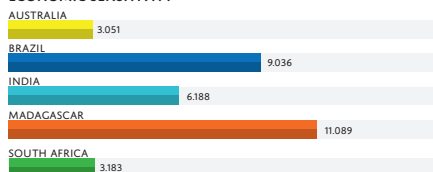
SO WHAT?

Our traits-based sensitivity assessments are transparent, repeatable and relatively rapid, and thus can quickly identify priority species that are likely most sensitive, even where fisheries are data poor. Our approach can enable fisheries managers to understand likely changes to fisheries under a range of climate change scenarios, highlights critical research gaps and priorities, and assists marine industries to identify adaptation strategies that maximise positive outcomes.
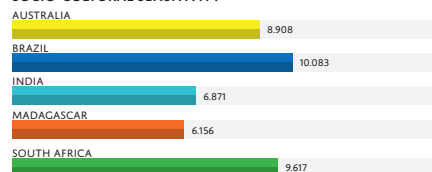
SOCIAL ASPECTS

At the heart of GULLS are the people who live in coastal communities who depend on marine resources. People in coastal communities, especially in marine hotspot areas, are already experiencing the knock-on impacts of a changing ocean, like increasing temperatures and changing current systems. The context of coastal people differs depending on where they live and work, and to which extent their livelihood depends on marine resources. Context matters because it will influence how well they deal with change now, and how well they are likely to deal with expected future change. For instance, to build resilience in coastal communities in Brazil attention has to be paid to their high cultural attachment to fishing whereas in Madagascar economic factors are paramount. Knowing about people's personal beliefs, perspective, and attitude, as well as their personal flexibilities – and flexibility of the governance institutions –will provide even more insight. For instance, our study shows that having less institutional flexibility may in fact impact a wealthy country like Australia more than some less prosperous countries. We used an integrated and participatory approach to gather primary data that informs exactly how resilient to change people living in coastal communities are, and their potential for adaptation.

SENSITIVITY

ECONOMIC SENSITIVITY

AUSTRALIA	3.051
BRAZIL	9.036
INDIA	6.188
MADAGASCAR	11.089
SOUTH AFRICA	3.183

SOCIO-CULTURAL SENSITIVITY

AUSTRALIA	8.908
BRAZIL	10.083
INDIA	6.871
MADAGASCAR	6.156
SOUTH AFRICA	9.617

ADAPTIVE CAPACITY

CAPITAL ASSETS

AUSTRALIA	11.600
BRAZIL	14.050
INDIA	11.228
MADAGASCAR	7.092
SOUTH AFRICA	5.670

FLEXIBILITY

AUSTRALIA	2.657
BRAZIL	2.717
INDIA	
MADAGASCAR	3.115
SOUTH AFRICA	2.594
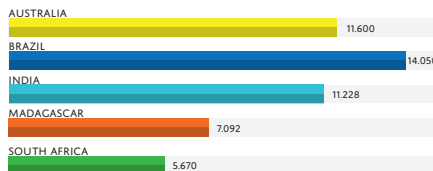
EXPOSURE

OBSERVED CHANGE

AUSTRALIA	2.553
BRAZIL	
INDIA	5.395
MADAGASCAR	7.813
SOUTH AFRICA	6.144

EXPERIENCE CHANGE

AUSTRALIA	12.590
BRAZIL	9.375
INDIA	8.735
MADAGASCAR	10.375
SOUTH AFRICA	11.051

PERCEPTIONS & ATTITUDE

AUSTRALIA	5.971
BRAZIL	6.546
INDIA	5.819
MADAGASCAR	10.063
SOUTH AFRICA	9.469
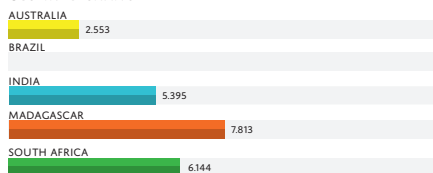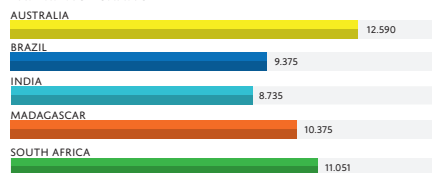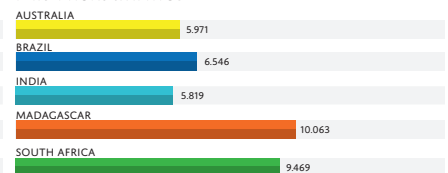
SO WHAT?

People need to deal with change that is currently happening and change that is yet to come. To prepare effectively , the social, cultural, economic and institutional characteristics that make people better at adaptation or increase their resilience needs to be understood. By knowing how people make decisions in complex environmental and institutional contexts, governments will be able to make the necessary adjustment and investment to create prosperous coastal communities in the future.

GOVERNANCE

Effective governance at national and local levels is essential for addressing and adapting to the impacts of climate change. The project development of an holistic ap-proach to assessing governance structures for marine resource management in hotspots.

Governance involves formal and informal processes and interactions among many actors in society beyond government (Turner et al., 2014 p. 105). These interactions encompass norms, institutional arrangements and substantive policies (Miles 1999, p. 1). Governance centres on the interplay between state directed regulatory and administrative processes, economic and market based approaches and instruments, and community based actions. Knowledge and information, their exchange are also important components. While a simple tripartite characterisation of governance distinguishes between state-centred regulation, market approaches and community-based cooperation, the real world is more complicated and these categories and categorisations are not mutually exclusive.

Governance maps organise and represent knowledge of both institutions and organisations affecting a living resource such as fish. The map depicts the actors—both individuals and organisations—in social positions (e.g., investors, fishers, regulators) and their existing or potential relationships and interactions among each other and with the resource. The resulting governance map shows the effects of interactions of institutions and organisations with each other and with the resource, and potential consequences of these interactions on the resource and its distribution.

Miles, E. L. (1999) 'The concept of ocean governance: Evolution toward the 21st century and the principle of sustainable ocean use', *Coastal Management*. 27: 1–30.

Turner, R.A., C. Fitzsimmons, J. Forster, R. Mahon, A. Peterson, S.M. Stead (2014) Measuring good governance for complex ecosystems: Perceptions of coral reef-dependent communities in the Caribbean'. *Global Environmental Change*. 29: 105-117.

Governance Map
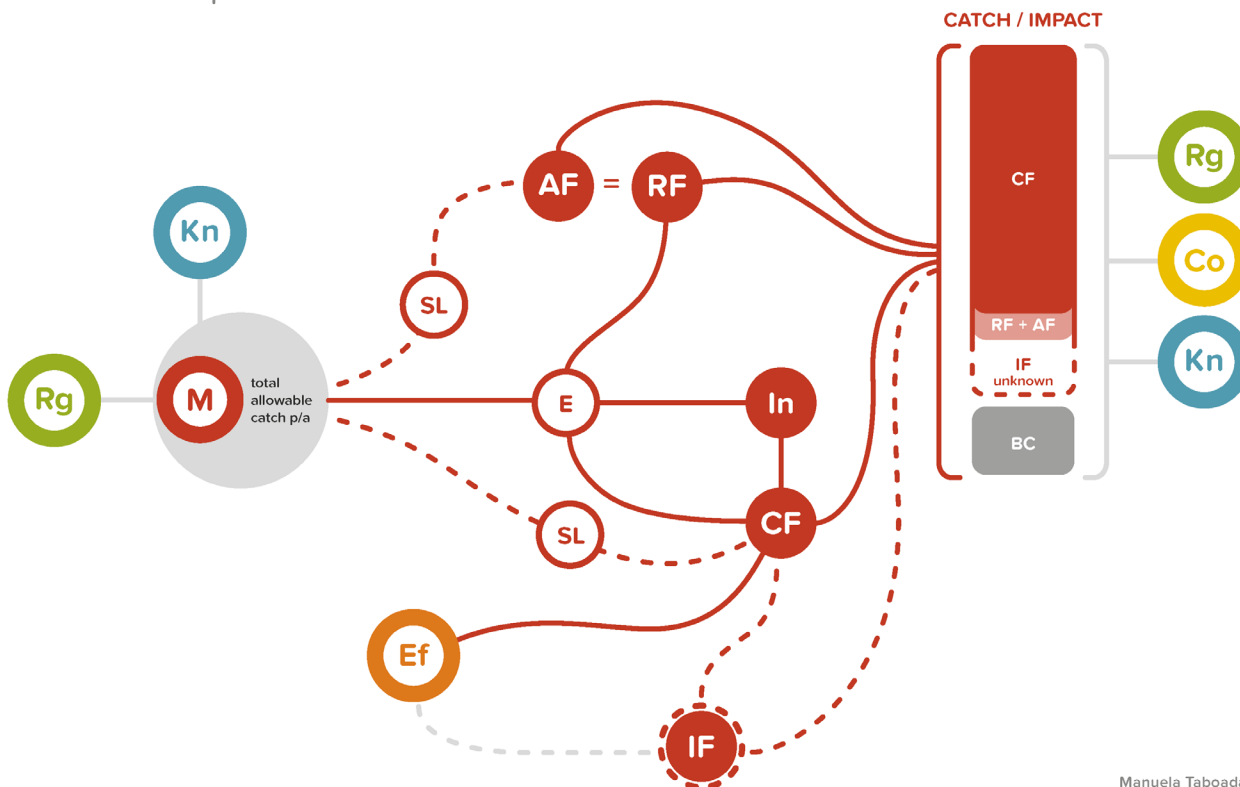
Manuela Taboada
21 July 2016

Rg = regulation
M = Ministry/Department
Kn = knowledge

CF = commercial fishers
Ef = enforcement
IF = illegal fishers

In = investors
SL = special license
AF = aboriginal fishers

BC = bycatch
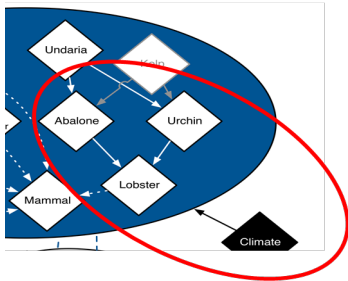Co = consumption arena
RF = recreational fishers

E = entitlements

SO WHAT?

Many problems observed in the marine environment, such as pollution and over-fishing, can be attributed to governance systems: actors (individuals, organisations) and the rules or 'institutions' that structure their interactions. Understanding how actors and institutions function is therefore an important step to promote climate adaptation.
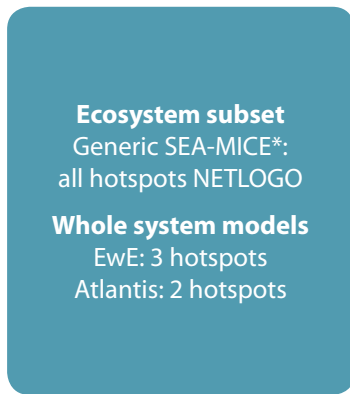
SYSTEM MODELLING

System modelling provides tools for the synthesis of the climate stressors of marine ecosystems impacting marine hotspots in all project locations. System models, at differing degrees of detail, were developed or modified for each of the hotspots.

System Models

Focus on subset of ecosystem

Tools

Ecosystem subset
Generic SEA-MICE*:
all hotspots NETLOGO

Whole system models
EwE: 3 hotspots
Atlantis: 2 hotspots

FIT
TO
DATA

Activities

Identify **key species** in each hotspot (e.g. from vulnerability analysis) and develop models/fit to available data

Identify key climate stressors and project resources based on future climate and fishing impacts

Compare performance under alternative future **adaptation scenarios**

Outcomes

Projections with fishing and climate change versus with adaptation scenario

Modelling Toolbox
Alternative models + common SEA-MICE approach for improving understanding and testing performance of alternative adaptations across 5 ocean warming hotspots

Integrated understanding
Modelling framework being extended to link with social and governance studies e.g. test adaptation option with improved governance = improved compliance

* Socio-Ecological Adaptations Model of Intermediate Complexity for Ecostsyems

SO WHAT?

The GULLS regions differ in modelling capability and data availability, therefore we developed a simple generic method for linking future projected biological variables to changing environmental variables as well as social and governance analyses. Comparing hotspot regions in a consistent manner improves global learning and sharing of knowledge.

ADAPTATION PLANNING

GULLS is undertaking a synthesis of the climate stressors of marine ecosystems impacting marine hotspots in all project locations. Contributions of the different GULLS working groups to integrated vulnera-bility assessments and adaptation planning.
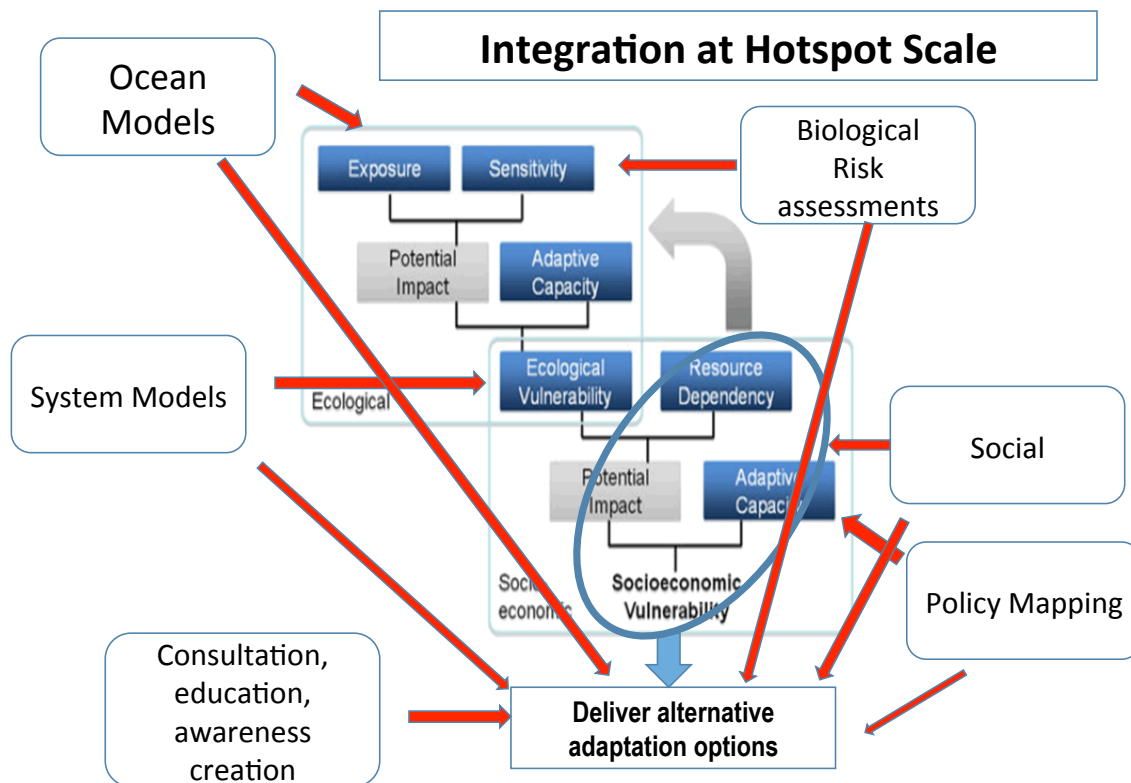
IPCC. (2001). Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the IPCC

SO WHAT?

Climate change must be considered as one more factor confronting coastal communities in their struggle for viable livelihoods. GULLS addresses the complex social and ecological environment as a whole and has pursued a multi-disciplinary and integrative approach to assessing vulnerability and considering priority needs and options for adaptation to changes.

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For further information and publications, visit http://www.marinehotspots.org/index.php/featured-projects/gulls