



Measuring the vulnerability of marine socio-ecological systems to climate impacts

A prerequisite for the identification of climate change adaptations in coastal communities

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INSTITUTE FOR MARINE AND
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NCCARF
National
Climate Change Adaptation
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MARINE BIODIVERSITY AND RESOURCES



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Project rationale

Many small coastal communities are dependent on marine sectors



Marine sectors have been, or are likely to be, impacted by changes in the marine environment (due to climate change)



This is likely to continue



Find out how well communities might cope - based on what we can tell from their vulnerability and what they might do to adapt to climate impacts

Aim

To measure the vulnerability of (coastal) marine socio-ecological systems and identify adaptation options

Integrate the bio-physical with the human dimension of marine climate change

Focussing on

Small coastal communities (<30K residents)

Depending on the which State in Australia - up to 30% of people live in these small coastal communities (van Putten et al 2041)

Marine sectors (recreational and commercial fishing, aquaculture, marine tourism, charter fishing)

Proportion of that work in this sector is (on average) higher in small coastal communities



What we did



52 semi-structured face to face surveys (1-2 hours each)



People from marine sectors

Where we went



Large size coastal community
Between 15,000 – 30,000 people



Surveys in 3
Australian case study
coastal communities



Medium size coastal community
Between 5,000 – 15,000 people

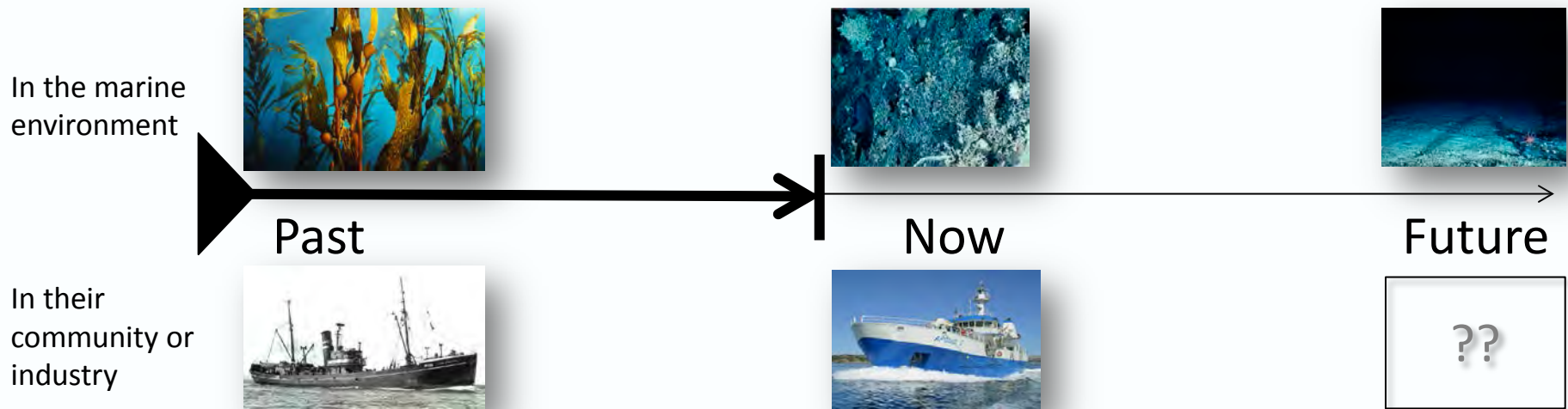


Small size coastal community
up to 5,000 people

What we asked

What changes community members had seen (from past till now)

What they thought caused the change (what they attributed it to)



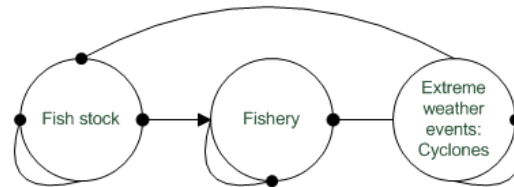
What they had done to deal with the changes
(and what contributed to their adaptation)

What they expected for the future
(what might they do about dealing with any new challenges)

What they said

They had observed various changes in the marine environment (significant Local Ecological Knowledge)

They were able to explain the reasons for the changes they observed and how they affected their industry & community (allowing us to draw qualitative models with feedback systems – Metcalf et al 2013)



Some of the changes people observed they didn't necessarily attribute to climate change (even though the scientists did) (van Putten et al. in limbo)

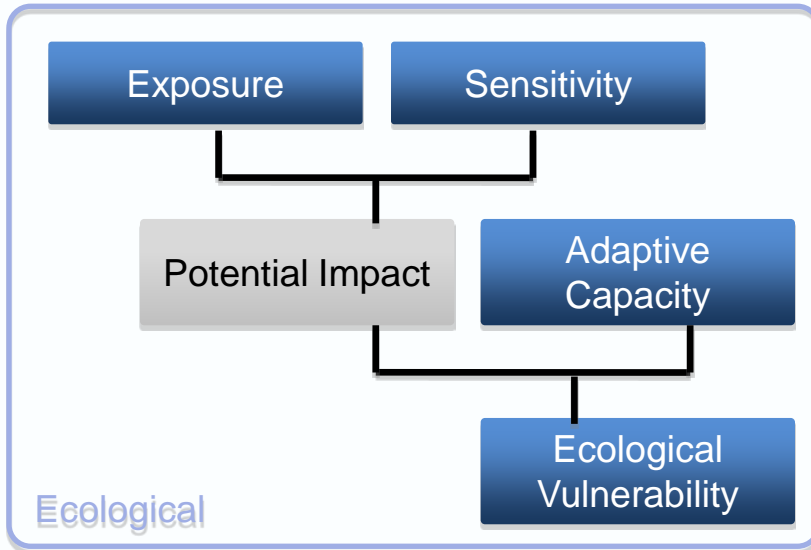
There were many (or maybe more) non-climate drivers that shaped their industry & community (that can also be incorporated into qualitative models)

What we did next

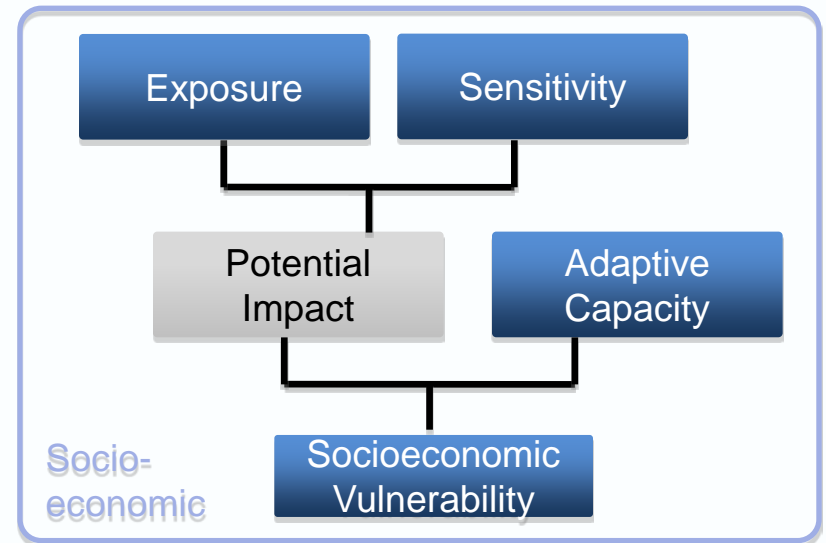
- Developed (generic and location specific) adaptation options – using qualitative models derived from survey results

- Compared case study communities to figure out how socio-ecological characteristics contribute to vulnerability

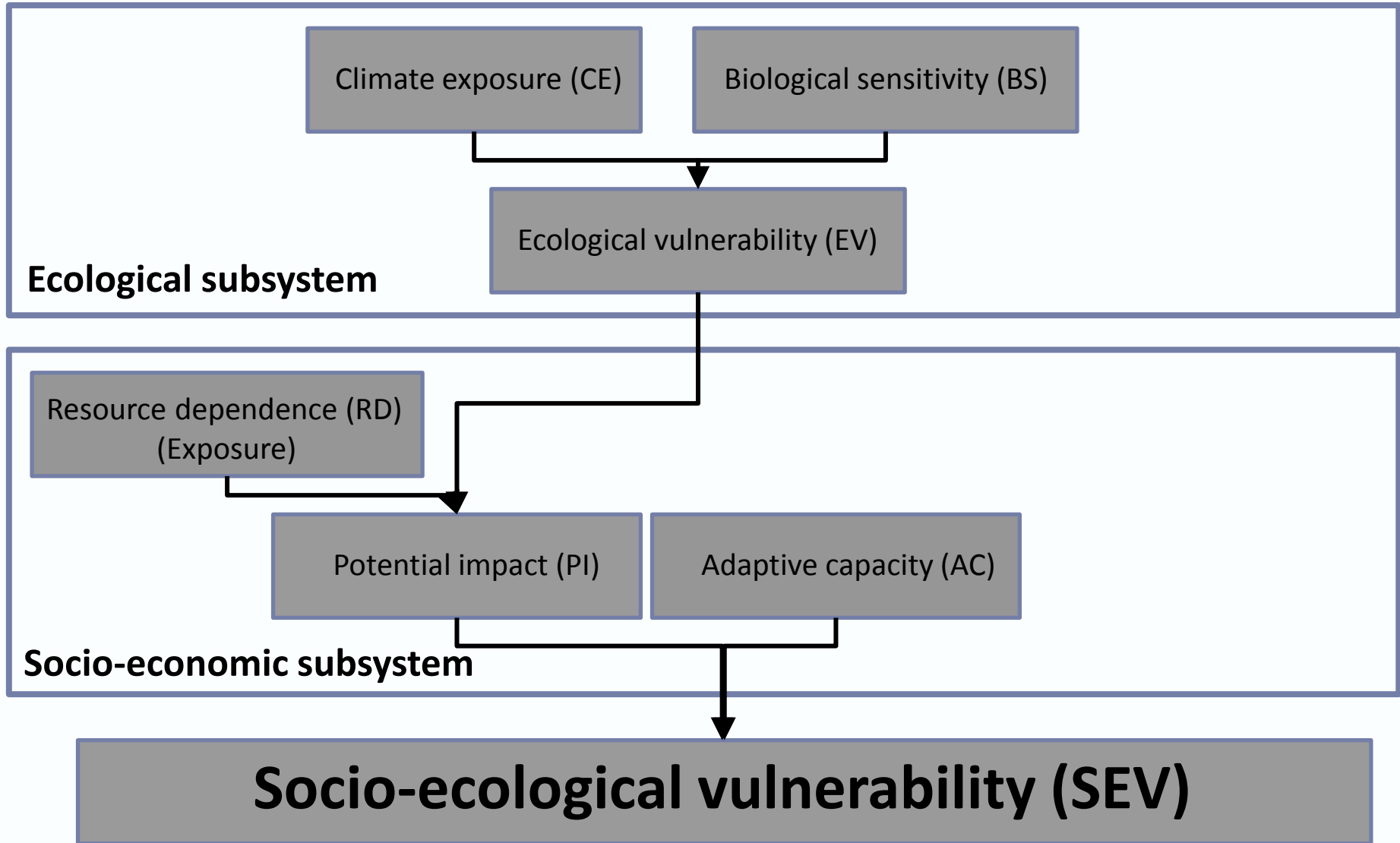
How we did that



Operationalised an established framework (and changed it a bit) to calculate Socio-Ecological Vulnerability



Made the framework quantitative to calculate Socio-Ecological Vulnerability (and also added a few things)



Framework for calculating Socio-Ecological Vulnerability

Climate exposure (CE)

$$CE = \text{sum}(a^{local}SST, b^{local}Ac, c^{local}R, d^{local}Cy)$$

Metric/species score

Sea Surface Temperature change (SST) °C warming*

Acidification (Ac)[#]

Rainfall (R) projected % reduction for 2030^{##}

Storms & cyclones ** (Cy)

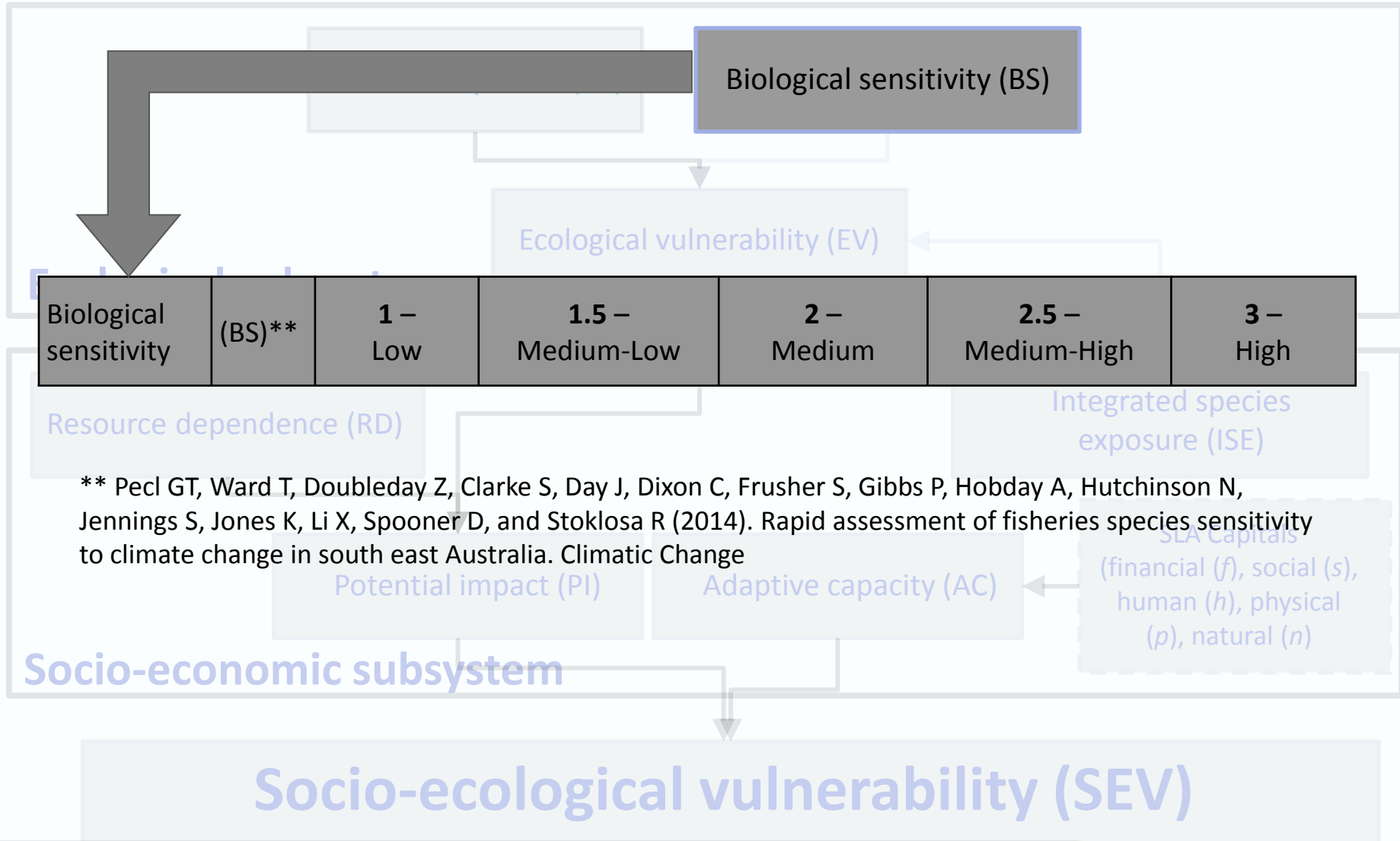
* Degrees higher in 2009 compared to an average value for the period 1880-2009 for that state, based on the HadISST dataset.

[#] Based on CSIRO acidification modelling (significant change=2, some change=1, no change=0).

^{##} Projected per cent change relative to 1990 state wide annual average rainfall, best-estimate outcome in a no-mitigation case from CSIRO (2008).

** Based on average increase in projected occurrences from BOM website data (greater =2, some change=1, no change =0)

Framework for calculating Socio-Ecological Vulnerability

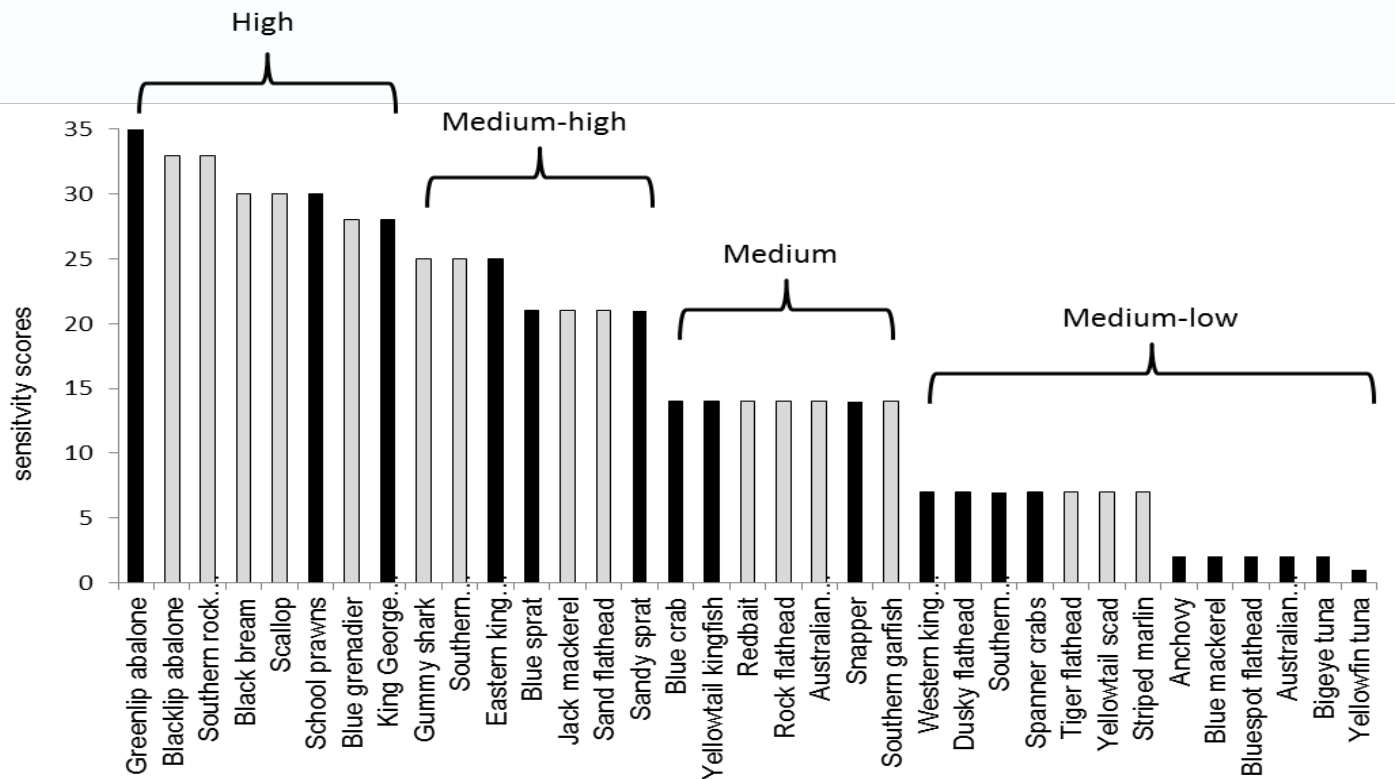


** Pecl GT, Ward T, Doubleday Z, Clarke S, Day J, Dixon C, Frusher S, Gibbs P, Hobday A, Hutchinson N, Jennings S, Jones K, Li X, Spooner D, and Stoklosa R (2014). Rapid assessment of fisheries species sensitivity to climate change in south east Australia. Climatic Change

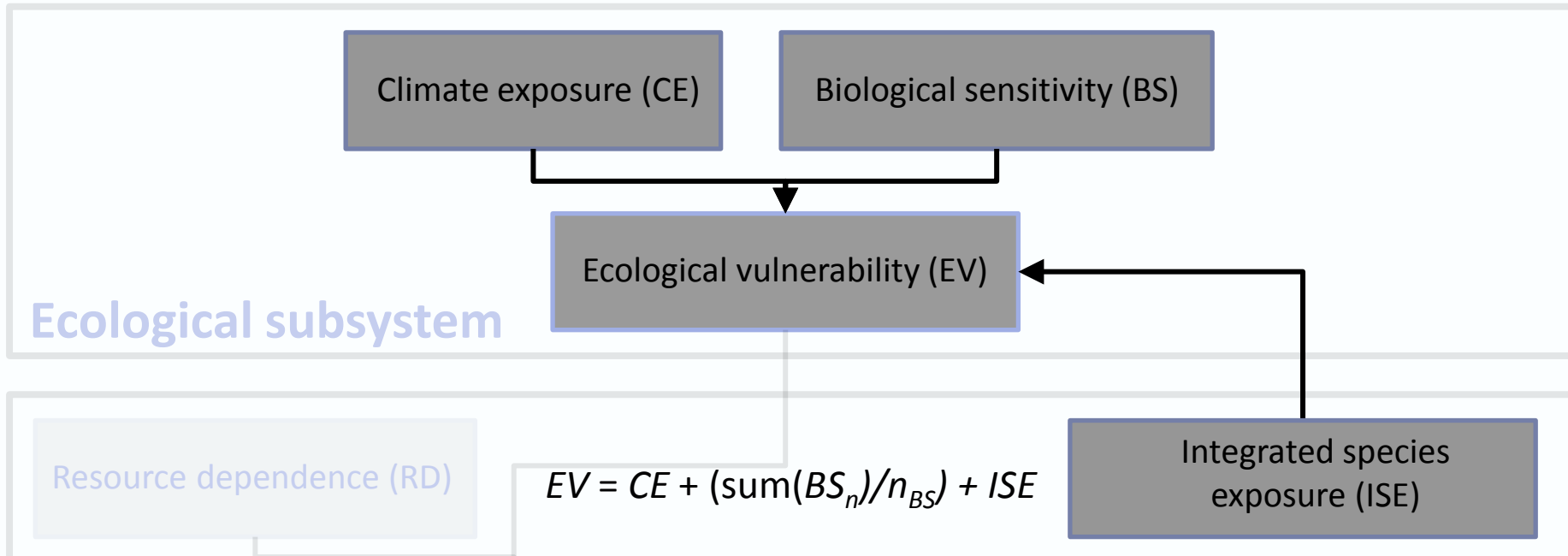
Species sensitivity assessment

Biological sensitivity (BS)**	1 – Low	1.5 – Medium-Low	2 – Medium	2.5 – Medium-High	3 – High
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Estimate sensitivity of species to climate drivers based on ABUNDANCE, DISTRIBUTION and PHENOLOGY



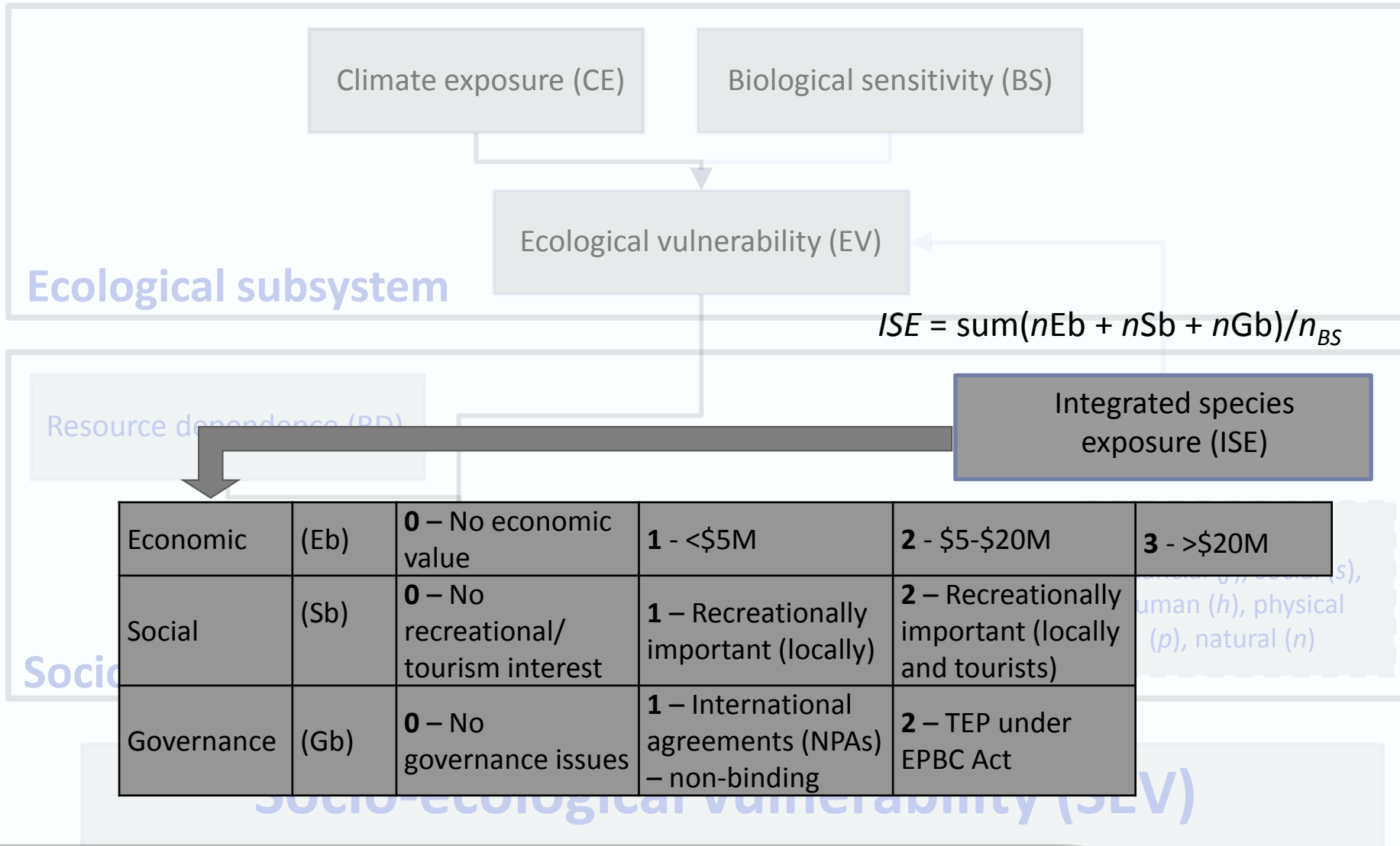
Additional variable that affects ecological vulnerability



Some species worth more (commercially) than others
Some have more social/recreational value
Some species are better managed than others



Framework for calculating Socio-Ecological Vulnerability



Framework for calculating Socio-Ecological Vulnerability

Human capital

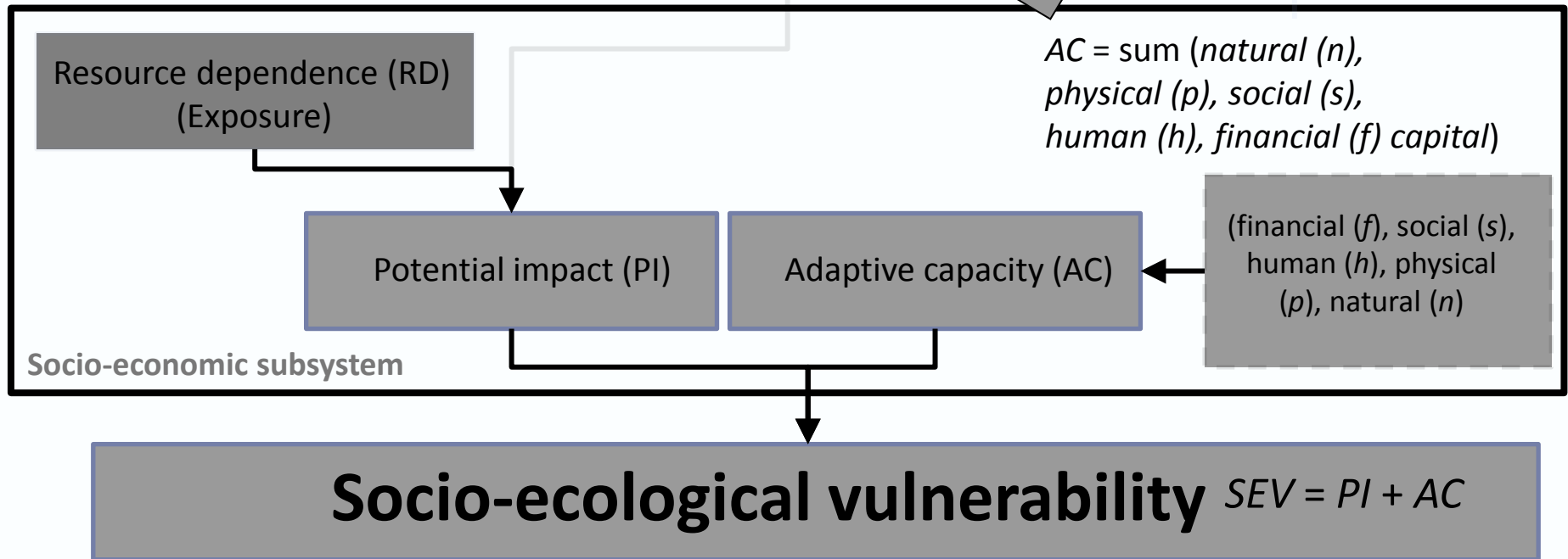
Education levels
Full time vs part-time employment
Females employed (proportion)
People requiring social assistance (proportion)

Financial capital

Mortgage repayments
Age dependency ratio

Social capital

People who volunteer (proportion)
Unoccupied dwellings (proportion)
Population change



Socio-ecological vulnerability values for the coastal communities

Metric or variable
Biological sensitivity (BS)
Integrated species exposure (ISE)
Climate exposure (CE)
Ecological vulnerability (EV)
Potential impact (PI)
Adaptive capacity (AC)
Socio-ecological vulnerability (SEV)

Put SEV in context of adaptation options

Website with climate information

Calculate the SEV for your community

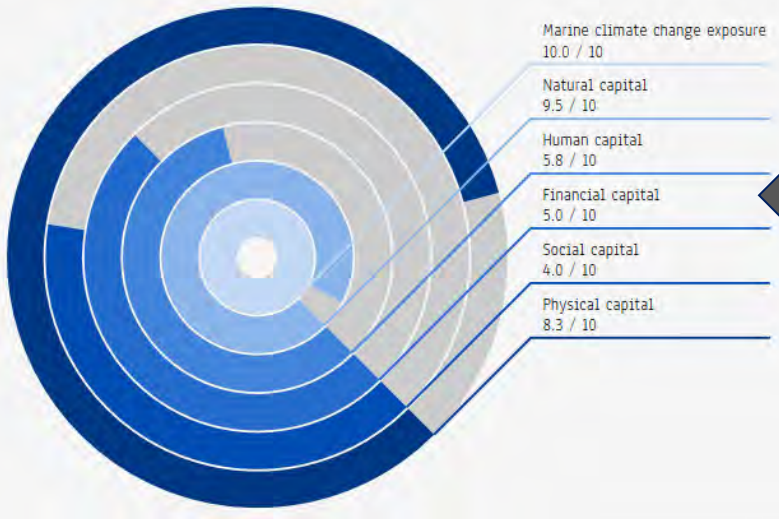
COASTAL

Your Climate Change Blueprint

Your Climate Change assessment is below.

Your overall score: 7.12 / 10

Your community has a high vulnerability to climate change. According to the information provided, improving and increasing the resources available within your community (i.e. capitals) is critical to ensure the community can cope with future changes.



For each region a prediction of the ocean temperature change was calculated and is shown in the map. From the map you can deduce if a temperature change is predicted in your region. Please indicate if ocean warming is predicted in your area.

Queensland

Age dependency (<19 and >65 as a percentage of 20-64 year olds)

A high age dependency ratio means that there is a high proportion of young and/or older people in the community. People who fall in this age group are more reliant on community services (including schools etc). A higher age dependency ratio means lower financial capital. On average the age dependency ratio in Australia is 55.1% (2011 census).

Region	Average weekly rent
Australian average	55.120%
Queensland	45.010%
Your region	45.01%

Average weekly rent

A lower median weekly rent means that there are likely to be more resources available to other goods and services. A lower average rent therefore increases financial capital. On average, median rent in Australia is 282/week (2011 census).

Region	Average weekly rent
Australian average	\$282
Queensland	\$300
Your region	\$300

Your Climate Change Blueprint

Marine species at risk

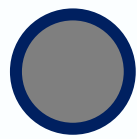
Different marine species will face different risks from climate change according to factors specific to climate impacts occurring in the area and the lifecycle of the species. The risk to marine fishery species face due to climate change has been assessed for each state using information from species-specific social, economic and governance metrics such as socio-recreational values and the level of government administration required were evaluated. Sensitivities to climate change from the risk assessment on key fishery species in south-eastern Australia were used. This work thoroughly reviewed literature and completed species profiles to underpin the ecological risk analyses. This 'screening' assessed the impact of p (e.g. rainfall, wind, temperature) on abundance, distribution and timing of life cycle event approach has been adopted in western Australia (Caputi et al. in prep) and tropical Australia (in prep) and this information has been included here. The biological species sensitivities social and governance information has been used to estimate the proportion of species at risk.

The marine species in your region are likely to be affected by the climate driven changes. Species at risk was created.

Barramundi
Lates niloticus

Yes, this fish is in my area

What is next



Australia wide socio-ecological vulnerability comparison
(currently in progress)



Refine the measures for adaptation and exposure
(e.g. including personal, occupational, and institutional flexibility. Also more refined measures of economic, social, historical and cultural dependence on fishing)



Compare socio-ecological vulnerability for southern hemisphere hotspot countries
(using standardised & culturally appropriate survey – See James Howards talk today)



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Identify and prioritise adaptation options
(based on local and larger scale needs)

COASTAL CLIMATE BLUEPRINT

- Home
- About the research
- Blueprint information >
- Information on local impacts >
- Case studies >
- Create a Blueprint
- History of Australian fishing
- References
- Contact Us

Is your coastal community prepared for the effects of climate change in the marine environment?
Test if you are prepared with our online climate change blueprint tool

CREATE A BLUEPRINT

- Marine Impacts
- Community Impacts
- Climate Impacts

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**Obrigado
Thank you**

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