Identifying future hotspots of conflict in marine capture fisheries

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Context

- Conflict can often be traced to unpredictable or unexpected events
- Climate change projected to fundamentally alter ecosystems around the world.
- Growing evidence that marine capture fisheries are already being affected by climate change (Cheung et al. 2013)
- But impacts will vary depending on the country's exposure to impacts of climate change, the sensitivity of its fisheries sector, and the inherent adaptive capacity (Allison et al. 2009)
- Overall, heavy fishing pressure reduces stability of catch levels under conditions of climate variability and change (Perry et al. 2010)

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Our question: Will climate change lead to more conflict and instability in marine capture fisheries around the world?

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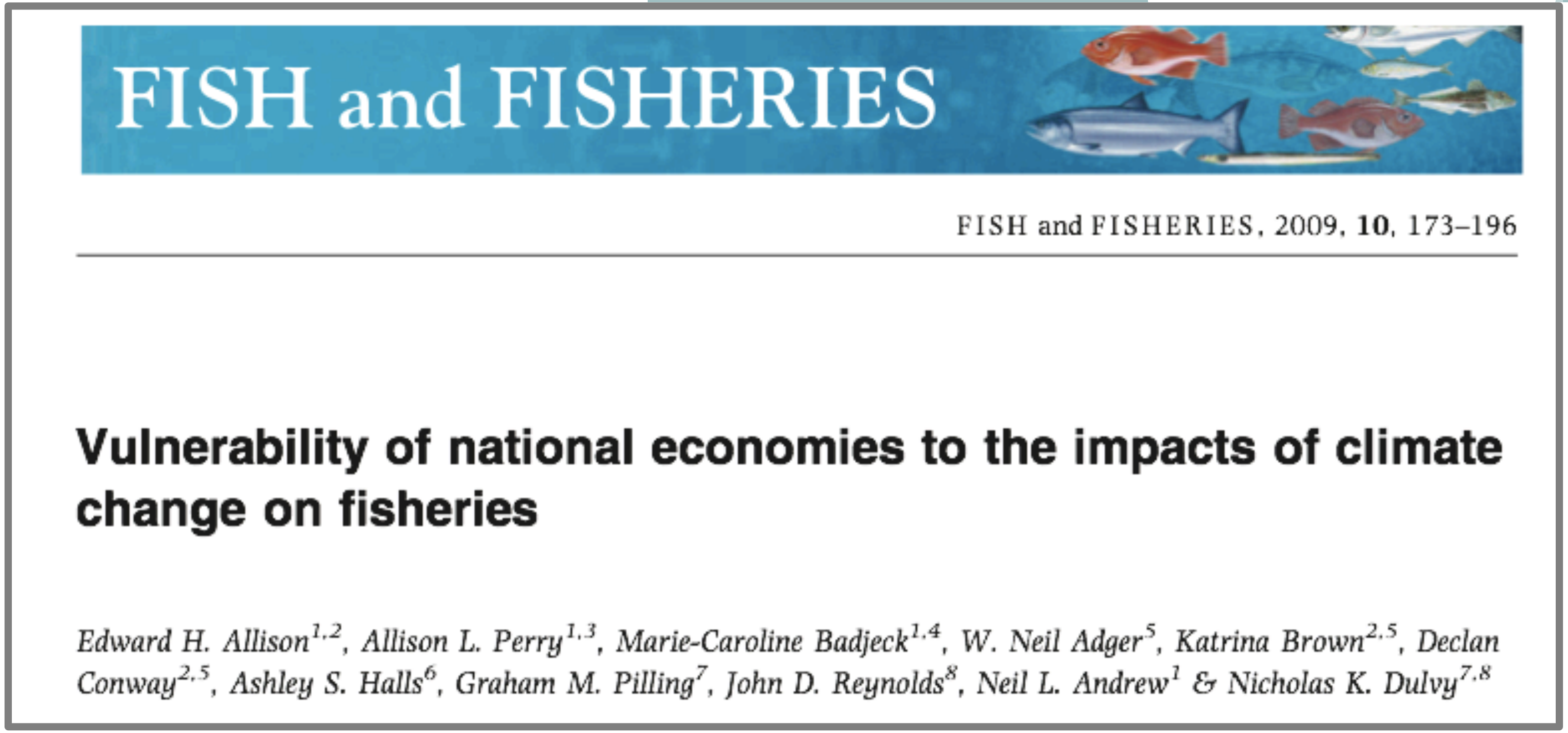
And if so, can future "hotspots" of conflict be identified so countermeasures can be taken?

And… any assessment of conflict potential requires a transdisciplinary approach drawing on both the social AND natural sciences.

First step: Assessing vulnerability

- Wanted to consider the issue globally
- Build on available resources and data if available
- No need to reinvent the wheel…

First step: Assessing vulnerability



FISH and FISHERIES

FISH and FISHERIES, 2009, **10**, 173–196

Vulnerability of national economies to the impacts of climate change on fisheries

Edward H. Allison[1,2], Allison L. Perry[1,3], Marie-Caroline Badjeck[1,4], W. Neil Adger[5], Katrina Brown[2,5], Declan Conway[2,5], Ashley S. Halls[6], Graham M. Pilling[7], John D. Reynolds[8], Neil L. Andrew[1] & Nicholas K. Dulvy[7,8]

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- Methodology: Exposure + Sensitivity - Adaptive Capacity = Vulnerability
- Based on a set of 10 main indicators

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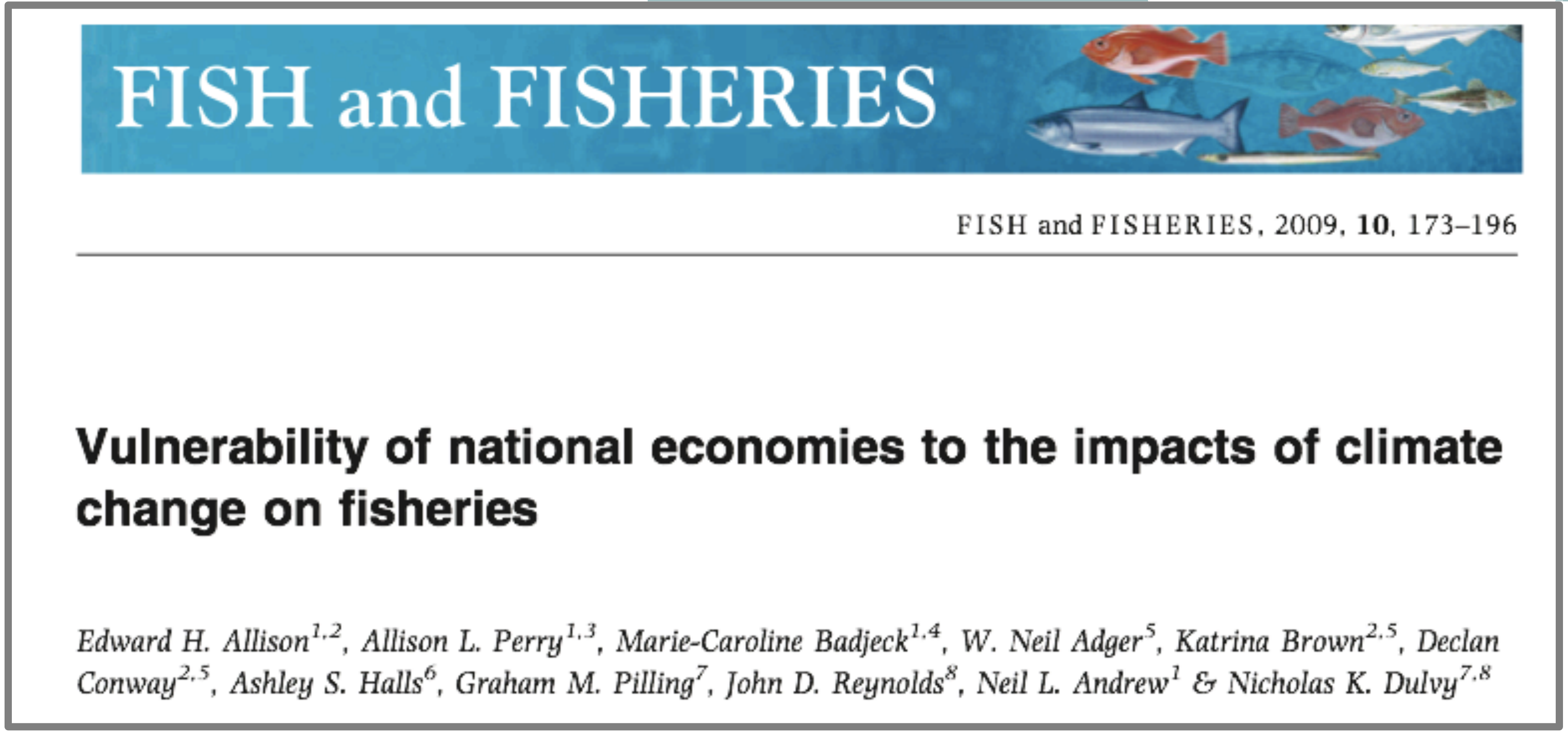

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But…

Limitations

Includes marine fisheries AND inland fisheries

- 7 of the 20 most vulnerable countries on the resulting index are land-locked
- Marine fisheries roughly 7 times as productive as inland fisheries
- Calculation of vulnerability could be quite different for marine and inland fisheries

We disaggregate data, and focus exclusively on marine capture fisheries

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Limitations

Selection of exposure indicator(s)

- Relies entirely on projected air surface temperature change to 2050 (A1F1 and B2 scenarios)

- “For countries with marine fisheries, an obvious choice would be changes in SST, but there is no equivalent for inland waters…” (Allison et al. 2009)

We use projected change in SST and salinity *(multi-model ensemble means under RCP 4.5)*

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Selection of adaptive capacity indicator(s)

- Indicators: healthy life expectancy, literacy rate, school enrolment rate, governance level, total GDP
- Effective at capturing broad adaptive capacity to any type of vulnerability (e.g. climate change, economic crisis, outbreak of disease, etc.)
- But lack connection to fisheries sector (although the exposure and sensitivity are closely tied to fisheries)

We made various adjustments

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Found very high correlation between “literacy rate” and “school enrolment rate” (Spearman’s ρ = 0.97), so removed “school enrolment rate”

We made various adjustments

Added: “Subsidies to fisheries sector as a proportion of total landings” *(cushion in case of crisis; proxy for government’s willingness to intervene/support)*

Added: “Proportion of industrial fishing to small-scale fishing”
(industrial fishing has greater adaptive capacity due to mobility and flexibility)

And…

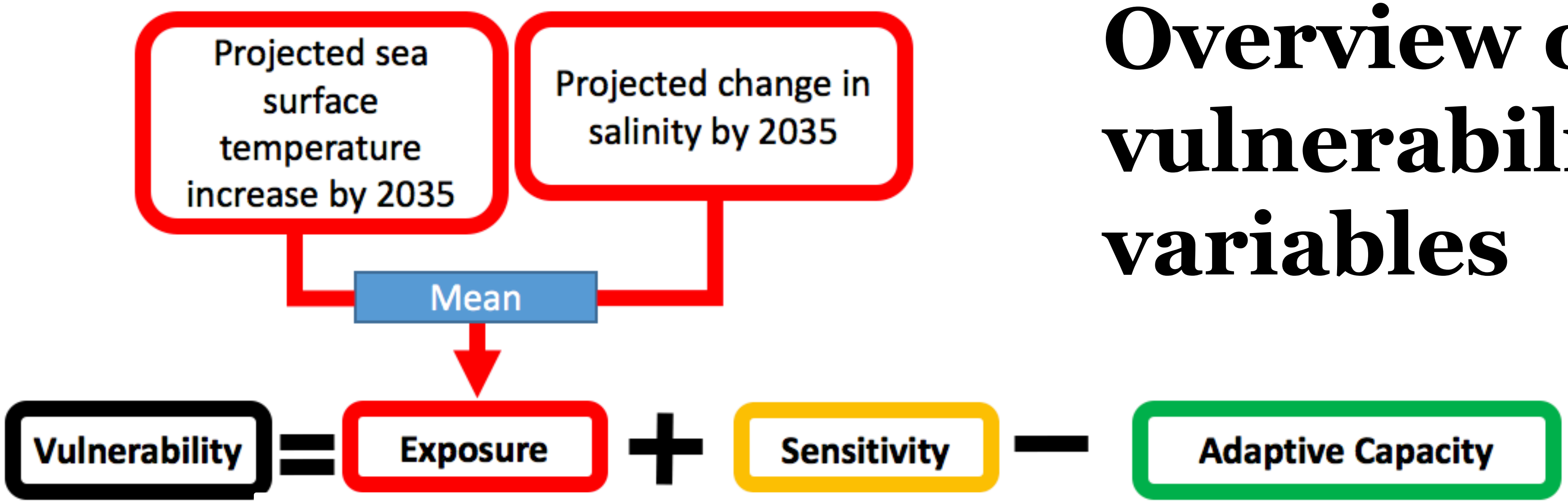
Updated all indicators that were retained (original index based on data up to 2001)

Were able to expand from 132 to 147 national economies

Overview of vulnerability index variables

Vulnerability = Exposure + Sensitivity − Adaptive Capacity

Overview of vulnerability index variables



Projected sea surface temperature increase by 2035

Projected change in salinity by 2035

Mean

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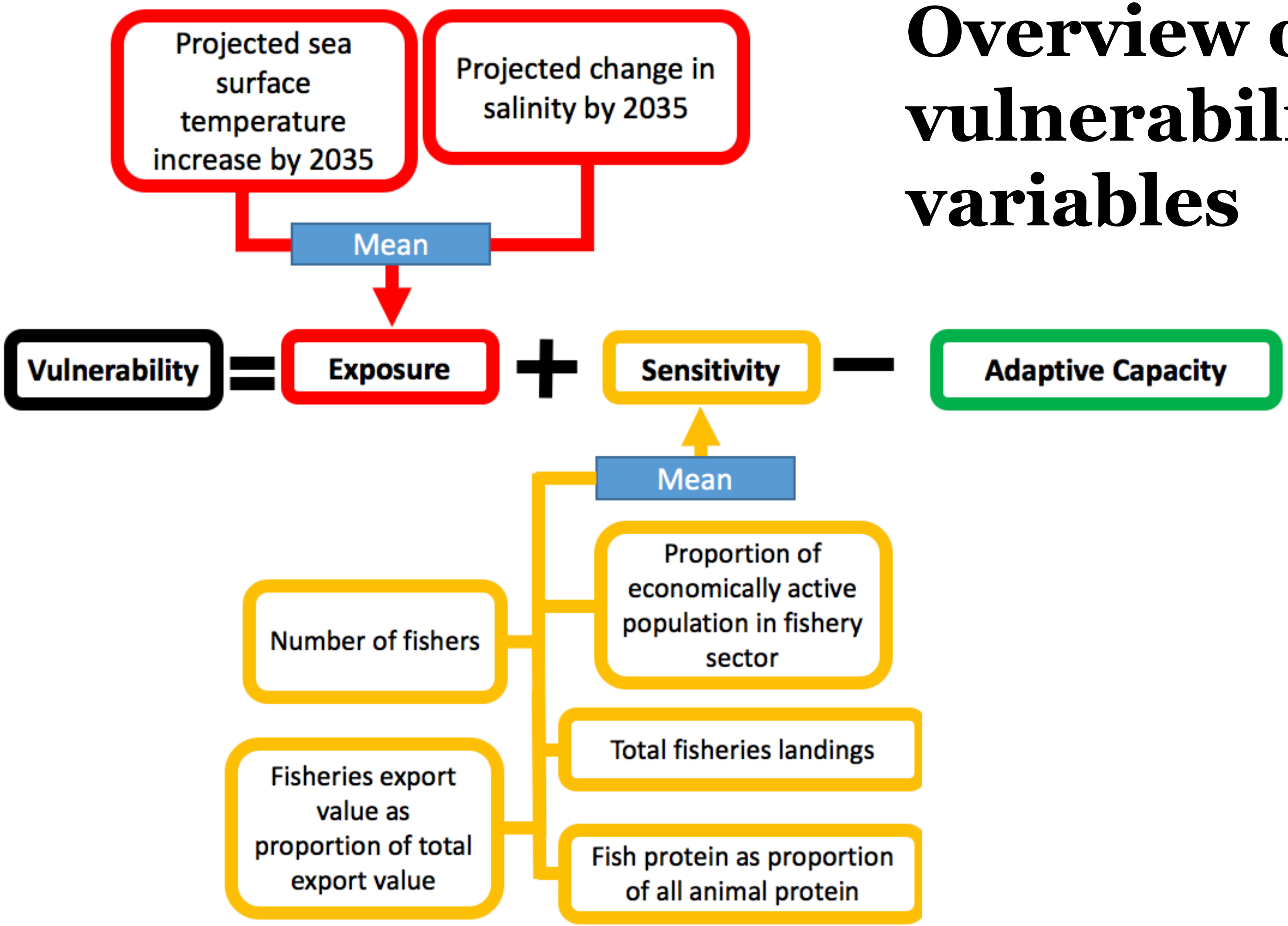
Overview of vulnerability index variables



Projected sea surface temperature increase by 2035

Projected change in salinity by 2035

Mean

Vulnerability = **Exposure** + **Sensitivity** − **Adaptive Capacity**

Mean

Proportion of economically active population in fishery sector

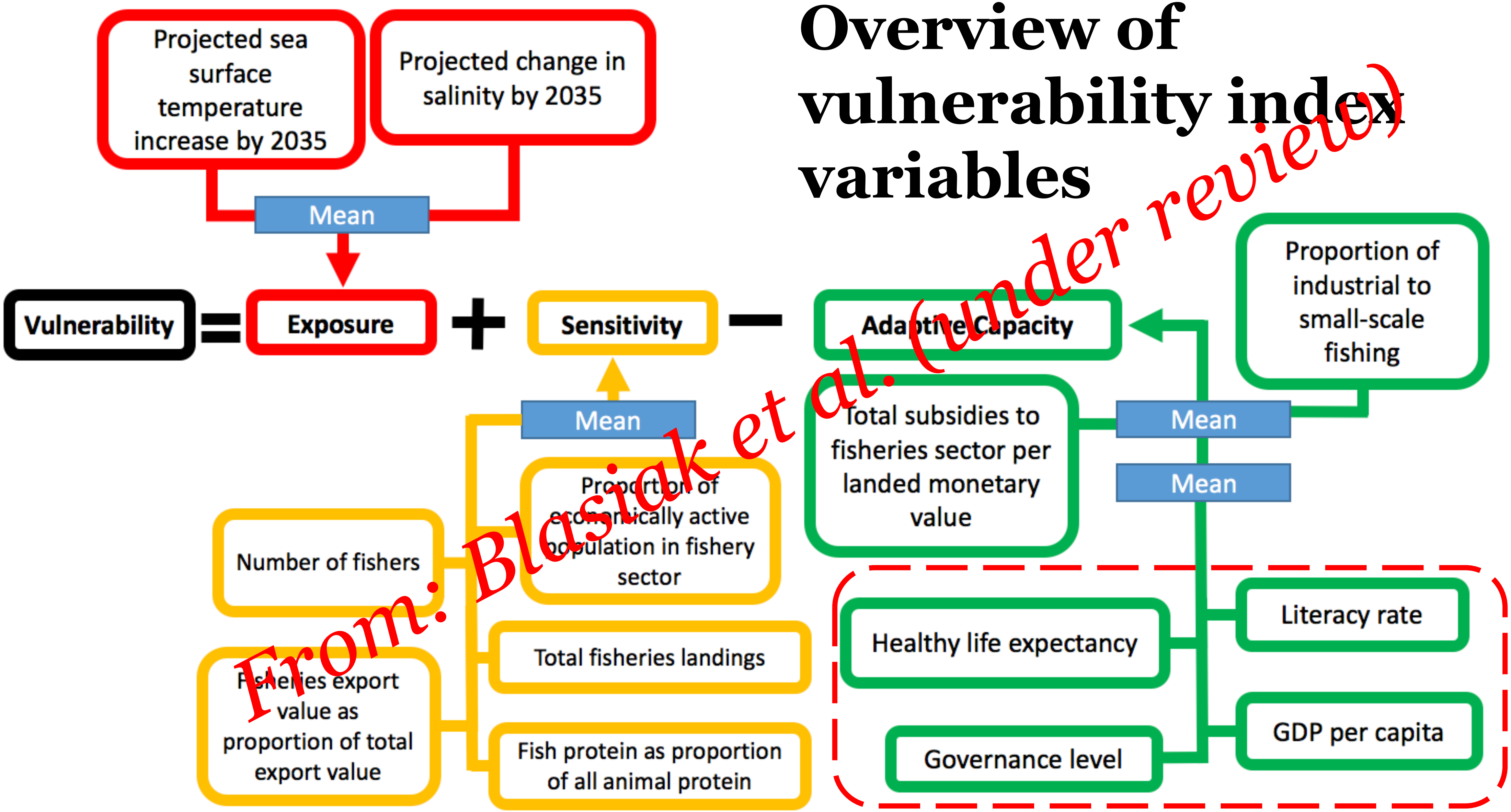
Number of fishers

Total fisheries landings

Fisheries export value as proportion of total export value

Fish protein as proportion of all animal protein

Overview of vulnerability index variables



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Vulnerability = **Exposure** + **Sensitivity** − **Adaptive Capacity**

Mean

Number of fishers

Proportion of economically active population in fishery sector

Total fisheries landings

Fisheries export value as proportion of total export value

Fish protein as proportion of all animal protein

Proportion of industrial to small-scale fishing

Total subsidies to fisheries sector per landed monetary value

Mean

Mean

Healthy life expectancy

Literacy rate

GDP per capita

Governance level

From: Blasiak et al. (under review)

So what do we get?

Allison et al. 2009	
1	Angola
2	DR Congo
3	Russian Federation
4	Mauritania
5	Senegal
6	Mali
7	Sierra Leone
8	Mozambique
9	Niger
10	Peru
11	Morocco
12	Bangladesh
13	Zambia
14	Ukraine
15	Malawi

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Updated/revised index	
1	Kiribati
2	Micronesia
3	Solomon Islands
4	Maldives
5	Tuvalu
6	Haiti
7	Sierra Leone
8	China
9	Seychelles
10	Indonesia
11	Guinea-Bissau
12	Cote d’Ivoire
13	Sao Tome e Principe
14	Senegal
15	Ghana

From: Blasiak et al. (under review)

LDCs and OECD

Comparing level of development and exposure/ sensitivity/ adaptive capacity

	Least Developed Countries (LDCs)				Organization for Economic Cooperation and Development (OECD) member states			
	E	S	AC	V	E	S	AC	V
1st Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2nd Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3rd Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4th Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

From: Blasiak et al. (under review)

Mapping vulnerability

Geographical distribution of vulnerability

	Africa	Asia	Europe	North and Central America	Oceania	South America
1st Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2nd Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3rd Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4th Quartile	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Totals	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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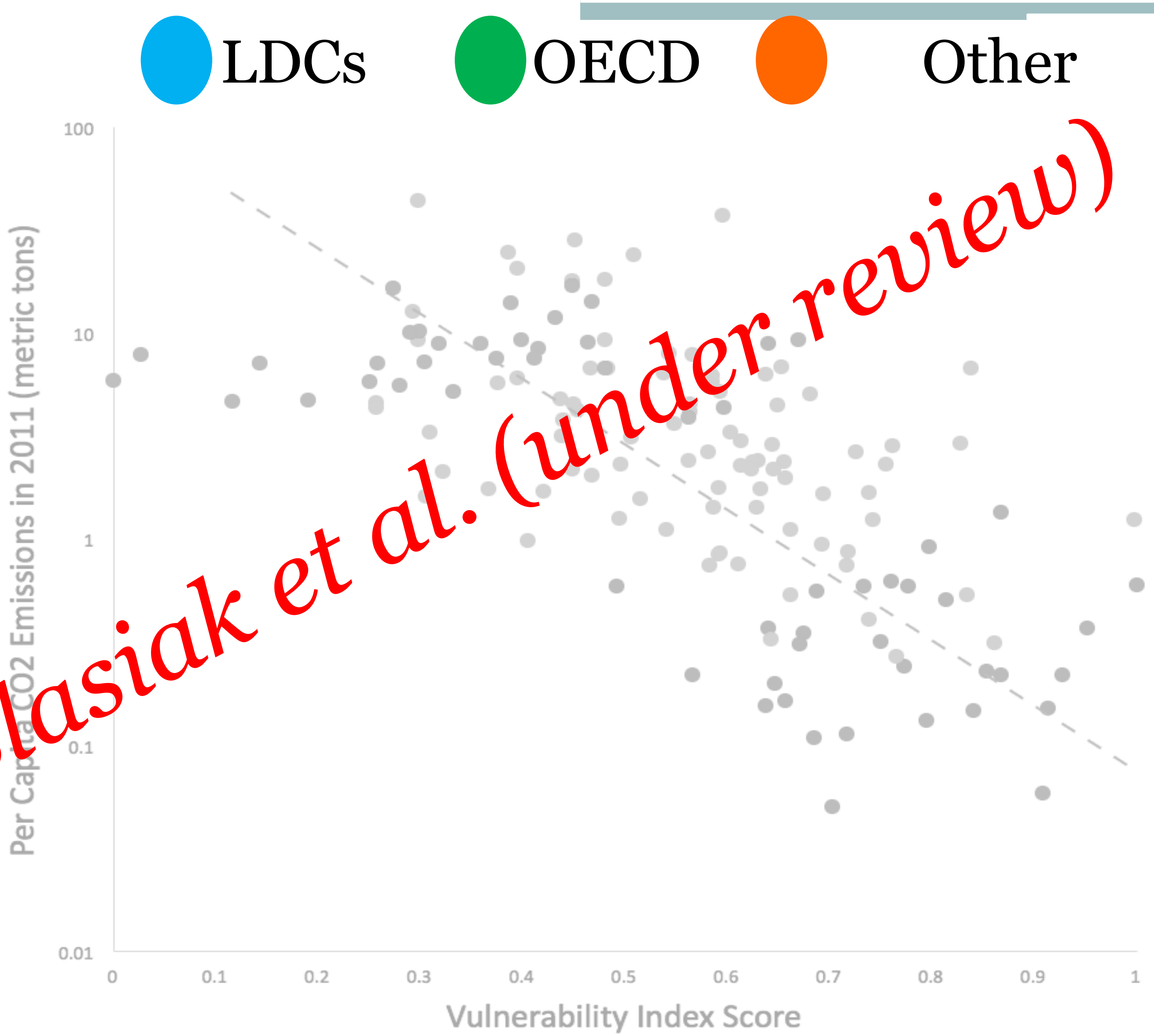
Vulnerability and contribution to climate change



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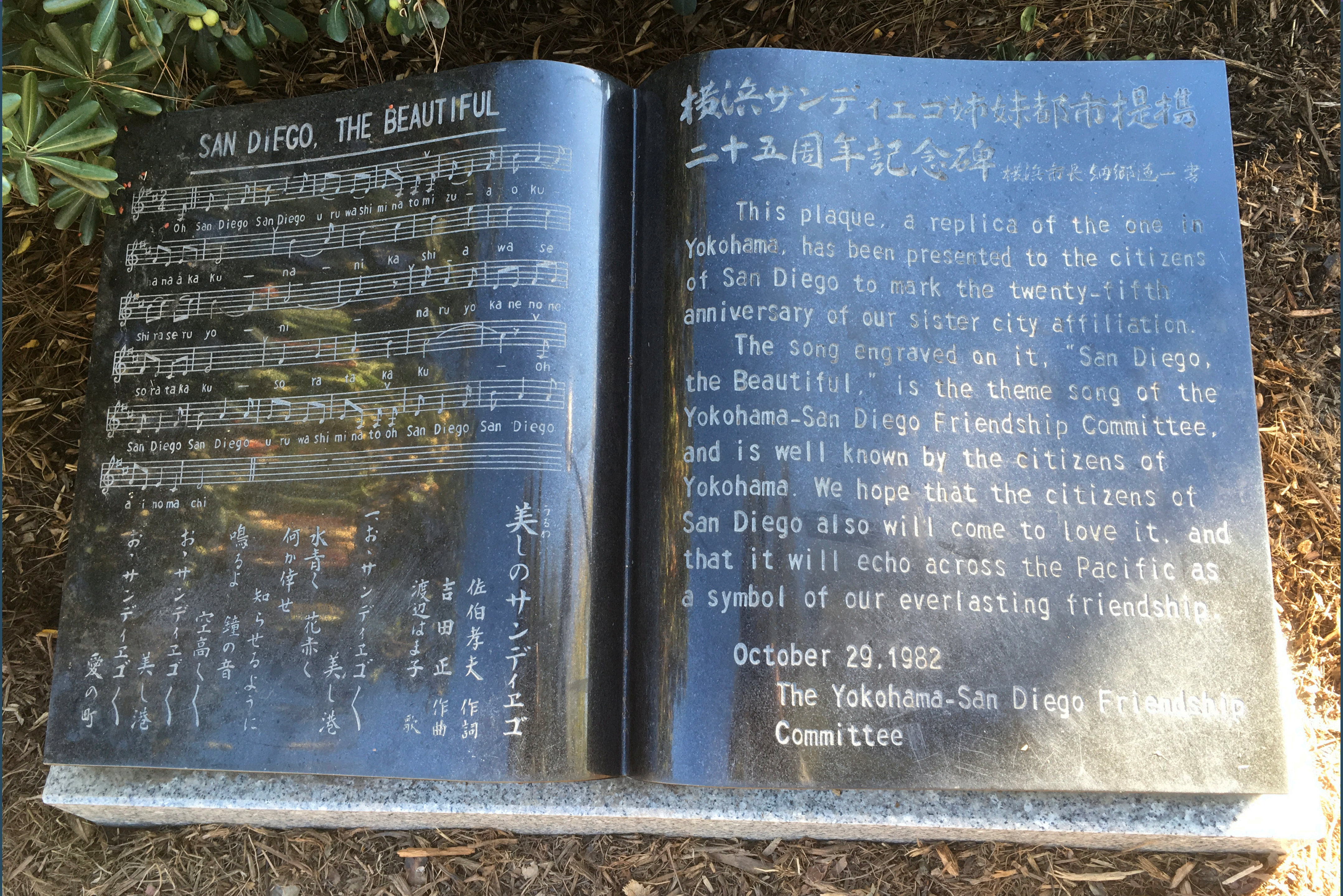
Conclusions

Usefulness of revised index

- Helps to identify priority countries for climate finance, capacity building, etc.
- Individual exposure, sensitivity and adaptive capacity indices can be used to identify potential regional leaders
- Can be used to investigate potential correlation between conflict (past/emerging) and exposure/vulnerability/etc.
- Early identification of conflict hotspots could help with conflict mitigation or avoidance

Final thoughts… **thanks PICES!**

- Overlay map of vulnerability with location of straddling, shared and highly migratory stocks
- Create "scenarios" for different types of (non-)cooperative fisheries policies
- Recalculate the index with different RCP multi-model ensembles (e.g. RCP 8.5)
- Make all our data available (e.g. website allowing any user to recalculate values based on different weighting of the variables)


Oh San Diego San Diego u ru wa shi mi na to mi zu — a o ku
ha na a ka ku — na — ni ka shi a wa se
shi ra se ru yo — ni — na ru yo ka ne no ne
so ra ta ka ku — so ra ta ka ku — oh
San Diego San Diego u ru wa shi mi na to oh San Diego San Diego
a i no ma chi

SAN DIEGO, THE BEAUTIFUL

美しのサンディエゴ
佐伯孝夫 作詞
吉田正 作曲
渡辺はま子 歌
一、お、サンディエゴ 美し港
水青く 花赤く
何か倖せ 知らせるように
鳴るよ 鐘の音
空高く
お、サンディエゴ 美し港
お、サンディエゴ 愛の町

横浜サンディエゴ姉妹都市提携
二十五周年記念碑

横浜市長 細郷道一 書

This plaque, a replica of the one in Yokohama, has been presented to the citizens of San Diego to mark the twenty-fifth anniversary of our sister city affiliation.

The song engraved on it, "San Diego, the Beautiful," is the theme song of the Yokohama-San Diego Friendship Committee, and is well known by the citizens of Yokohama. We hope that the citizens of San Diego also will come to love it, and that it will echo across the Pacific as a symbol of our everlasting friendship.

October 29, 1982
The Yokohama-San Diego Friendship Committee

SAN DIEGO, THE BEAUTIFUL
Oh San Diego San Diego u ru wa shi mi na to mi zu – a o ku
ha na a ka ku – na – ni ka shi a wa se
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PICES

Thank you!

東京大学 THE UNIVERSITY OF TOKYO

NEOPS
New Ocean Paradigm on Its Biogeochemistry, Ecosystem and Sustainable Use

UNITED NATIONS UNIVERSITY

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