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)
Context

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?

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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

- Constructed index of 132 national economies
- Methodology: Exposure + Sensitivity - Adaptive Capacity = Vulnerability
- Based on a set of 10 main indicators
First step: Assessing vulnerability

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


- Constructed index of 132 national economies
- Methodology: Exposure + Sensitivity - Adaptive
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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
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We disaggregate data, and focus exclusively on marine capture fisheries
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)
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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)
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We made various adjustments
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Found very high correlation between “literacy rate” and “school enrolment rate” (Spearman’s $\rho = 0.97$), 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

Vulnerability = Exposure + Sensitivity - Adaptive Capacity
Overview of vulnerability index variables

Vulnerability = Exposure + Sensitivity

- Exposure:
  - Projected sea surface temperature increase by 2035
  - Projected change in salinity by 2035

- Sensitivity:
  - Proportion of economically active population in fishery sector
  - Total fisheries landings
  - Fish protein as proportion of all animal protein

- Adaptive Capacity:
  - Mean

- Vulnerability:
  - Number of fishers
Overview of vulnerability index variables

Vulnerability = Exposure + Sensitivity

Projected sea surface temperature increase by 2035
Projected change in salinity by 2035

Exposure
- Number of fishers
- Fisheries export value as proportion of total export value
- Total fisheries landings
- Proportion of economically active population in fishery sector
- Fish protein as proportion of all animal protein

Sensitivity
- Mean
- Total subsidies to fisheries sector per landed monetary value

Adaptive Capacity
- Proportion of industrial to small-scale fishing
- Healthy life expectancy
- Governance level
- GDP per capita
- Literacy rate

From: Blasjak et al. (Under review)
So what do we get?

<table>
<thead>
<tr>
<th>Allison et al. 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Angola</td>
</tr>
<tr>
<td>2 DR Congo</td>
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<tr>
<td>3 Russian Federation</td>
</tr>
<tr>
<td>4 Mauritania</td>
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<tr>
<td>5 Senegal</td>
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<td>6 Mali</td>
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<td>7 Sierra Leone</td>
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<td>8 Mozambique</td>
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<td>9 Niger</td>
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<td>10 Peru</td>
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<td>11 Morocco</td>
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<td>12 Bangladesh</td>
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<td>13 Zambia</td>
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<td>14 Ukraine</td>
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<tr>
<td>15 Malawi</td>
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</tbody>
</table>
So what do we get?

<table>
<thead>
<tr>
<th>Allison et al. 2009</th>
<th>Updated/revised index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Angola</td>
<td>1 Kiribati</td>
</tr>
<tr>
<td>2 DR Congo</td>
<td>2 Micronesia</td>
</tr>
<tr>
<td>3 Russian Federation</td>
<td>3 Solomon Islands</td>
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<td>4 Mauritania</td>
<td>4 Maldives</td>
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<td>5 Senegal</td>
<td>5 Tuvalu</td>
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<td>6 Mali</td>
<td>6 Haiti</td>
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<td>7 Sierra Leone</td>
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<td>8 Mozambique</td>
<td>8 China</td>
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<td>9 Niger</td>
<td>9 Seychelles</td>
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<td>10 Peru</td>
<td>10 Indonesia</td>
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<td>11 Morocco</td>
<td>11 Guinea-Bissau</td>
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<td>12 Bangladesh</td>
<td>12 Cote d’Ivoire</td>
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<td>13 Zambia</td>
<td>13 Sao Tome e Principe</td>
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<td>14 Ukraine</td>
<td>14 Senegal</td>
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<td>15 Malawi</td>
<td>15 Ghana</td>
</tr>
</tbody>
</table>

From: Blasiak et al. (under review)
Comparing level of development and exposure/ sensitivity/ adaptive capacity

<table>
<thead>
<tr>
<th>Quartile</th>
<th>Least Developed Countries (LDCs)</th>
<th>Organization for Economic Cooperation and Development (OECD) member states</th>
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</thead>
<tbody>
<tr>
<td>1st Quartile</td>
<td>E</td>
<td>S</td>
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<tr>
<td>2nd Quartile</td>
<td>E</td>
<td>S</td>
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<tr>
<td>3rd Quartile</td>
<td>E</td>
<td>S</td>
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<tr>
<td>4th Quartile</td>
<td>E</td>
<td>S</td>
</tr>
</tbody>
</table>

From: Blasiak et al. (under review)
Geographical distribution of vulnerability

<table>
<thead>
<tr>
<th></th>
<th>Africa</th>
<th>Asia</th>
<th>Europe</th>
<th>North and Central America</th>
<th>Oceania</th>
<th>South America</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Quartile</td>
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<td>2nd Quartile</td>
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<td>3rd Quartile</td>
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<td>4th Quartile</td>
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<td>Totals</td>
<td>38</td>
<td>34</td>
<td>29</td>
<td>24</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

From: Blasich et al. (under review)
Vulnerability and contribution to climate change and LDCs

From: Blasiak et al. (under review)
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)
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
Thank you!

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