CLOCK CLIMATE ADAPTATION TO SHIFTING STOCKS

ADAPTING SMALL-SCALE FISHERIES TO THE IMPACTS OF CLIMATE CHANGE

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MOTIVATION

- Climate change is unevenly impacting marine species abundance and distribution, causing shifts in species ranges with poorly known consequences (Cooley et al., 2022).
- Scatter evidence exists on the adaptation strategies that fishing communities undertake, and largely missing empirical evidence for climate change coastal hotspots (Ilosvay et al., 2022).
- We expect that fisher's responses to climate change impacts in the fishing communities are driven by 1) their individual adaptive capacities (Cinner and Barnes, 2019); and 2) the degree of impact that the community faces (Ilosvay et al., 2022).
- The responses that we may observe in the fishing communities, understood as social-ecological systems (SES), will follow an adaptation pathway (Figure 1).
- Evidence is needed from existing fishing communities facing different levels of climate change impacts to understand what drives adaptation and transformation to climate change.

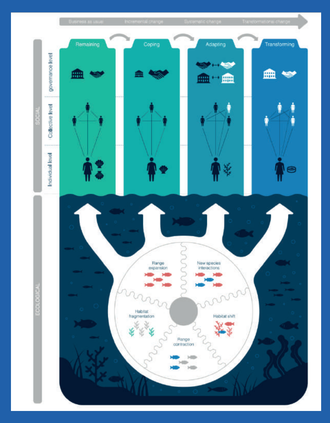

Figure 1. Adaptation pathway for fisheries social-ecological systems facing climate change.
The SES changes at the individual, collective and governance scale the higher the impacts following a pathway from remaining in the fishery (praying, keeping their customs), to coping with the impacts (fishing more/less, saving money), to adapting to the impacts (changing resources, location, gears), to transforming the system (expand their income sources, changing roles to trading/processing), to exiting the system.
Ojea et al., (2020)

CONTRIBUTION

Under the ERC funded project CLOCK: Climate Adaptation to shifting stocks, we develop three in depth case studies to understand what are the livelihood responses that can allow equitable and sustainable fishing livelihoods under climate change. Across the three case studies, we:

- Design a set of adaptive capacity indicators to understand communities' social resilience to climate change (based on Cinner and Barnes, 2019)
- Design a methodological approach, from case study approximation to building the local teams, to engaging with the fishers, surveying the communities and giving back the results to regional policy actors and the fishing communities.
- Test the adaptation pathways theory both with stated behavior on past experience and hypothetical scenarios.

A CASESTUDY APPROACH

Small scale fisheries in Nayarit (México)
- Formal and informal governance (self-governance)
- Low adaptive capacity (low accesto assets, high SSF dependence)
- Extreme impacts(50 % catch decrease in the last decade)

- Studied 6 communities along the coast of Nayarit between August and November 2021
- 453 semi-structured surveys in Spanish with three sections:
- a) environmental changes perception in the past ten years;
- b) responses to past environmental changes and to future impact scenarios; c) fishers' individual adaptive capacity
- Analyzed past responses with multinomial logistic mixed model
- Examined transformative responses to extreme future scenarios with survival analysis using a Mixed-effect proportional hazard model

Small scale fisheries in Galicia (Spain)
- Formal Governance (TURFs and fishing permits)
- Medium/high adaptive capacity (high access to assets, learning and organization)
- Moderate impacts (species mortality events and turnover)

- Studied 9 communities along the coast, with representation from inside bays and open ocean during June and July 2018
- 430 in person semi-structured interviews in Galician conducted with three sections: perceived impacts of climate change; 2) fishing habits;
- 3) responses to future climate scenarios; 4) adaptive capacities and other socioeconomic indicators.
- 80 (18.6 %) of fishers are women, mostly shellfish gatherers
- Analyzed adaptive capacities with social network analysis
- Examined drivers for adaptation and transformation responses with multinomial logistic mixed models

Coastal fisheries in Shikoku (Japan)
- Formal governance (local fishers and fisheries industry)
- High adaptive capacity (high access to assets, organization, and agency)
- Moderate impacts (species turn-over)

- Studied 25 communities along the tropicalization gradient in the Western Coast of Shikoku Island between January and March 2023
- 124 semi-structured surveys (oral and written) asking:
- a) environmental changes perception in the past 30 years;
- b) responses to past environmental changes; c) fishers' individual adaptive capacities.
- Analyzed the temperature gradient along the tropicalization of Shikoku's coast.
- Analyzed the role of exposure level and adaptive capacity in predicting fishers' responses with multinomial multinomial logistic mixed model.

6 ADAPTIVE CAPACITY DOMAINS

1000 IN PERSON SURVEYS CONDUCTED

120+ TARGET FISHS SPECIES

7 MANAGEMENT SYSTEMS

10 RESULTS WORKSHOPS

ADAPTIVE CAPACITIES

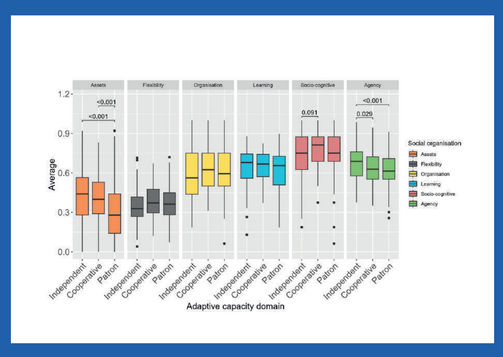

Fig. 2. Adaptive capacities in Nayarit coastal fisheries. Fishers have in general low adaptive capacity, especially the economic and material assets, the flexibility to change fishing practices/species, and the agency to respond to environmental changes. We also see that fishers under Patron-client relationships are related to lower adaptive capacity (Elkin et al., 2023).

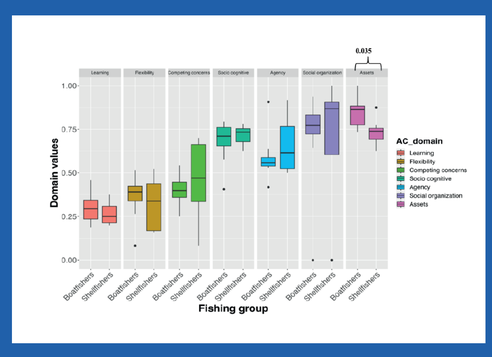

Fig. 3. Adaptive capacities in Galician artisanal fisheries.
Fishers have in general medium adaptive capacity, with some categories rising high scores, such as the economic and material assets, the social Organization, knowledge of the system (Socio-Cognitive) and the Agency to take action. However some adaptive capacities have low scores, Learning, Flexibility (due to the permit system) and Competing Concerns (inequality).

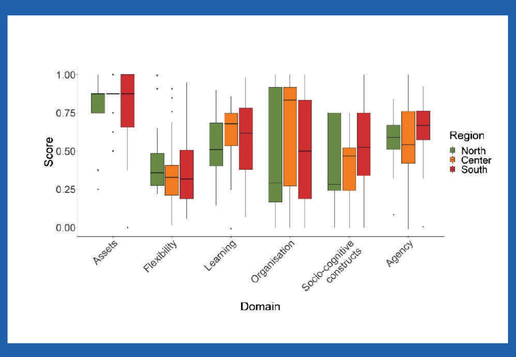

Fig. 4. Adaptive capacities in Shikoku's coastal artisanal fisheries.
Adaptive capacity is high for most of the adaptive capacity domains, however it varies across the latitudinal gradient. Assets, Learning, Organization and Agency are high in this system. However flexibility is low for all regional due to the FCA system
of permits and areas. Socio-cognitive constructs are low for the northern region (less aware of climate change).

ADAPTATION AND TRANSFORMATION RESPONSES | Some examples

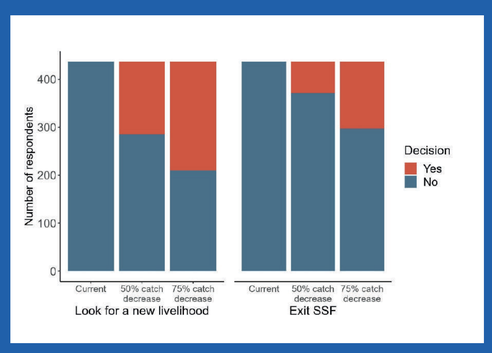

Fig. 5. Responses to climate change in Nayarit
Results on transformation reponses show that fishers are not likely to engage in a new livelihood when catches decrease up to 50%, however if decreases amount to 75% of catches, half fishers would engage in livelihood alternatives. A low number of fishers consider exiting the fishery when impacts rise, even with 75% decrease, only 25% of fishers exit which points to a high dependence and attachment to fishing. (Ilosvay et al., under review).

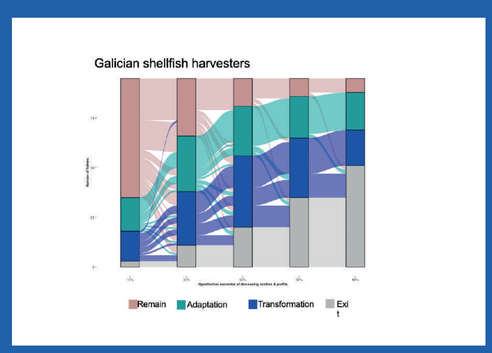

Fig. 6. Adaptation pathway in Galicia
SSF. Figure shows results for the shellfish harvesters in Galicia, managed under a Territorial User Rights for Fisheries and composed mainly by women (90%). Each column is a level of impact scenario, and colors show the types of responses. Flows show the number of fishers that transit from one response to other over senarios of increasing catches. Fishers follow the coping to adapting and transforming scenarios when impacts grow. Even at the 90% scenario, some fishers remain, showing the most vulnerable individuals.

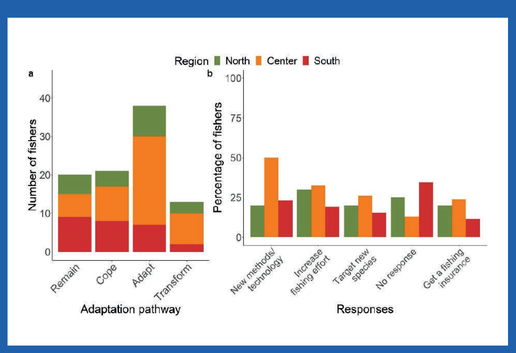

Fig. 7. Adaptive responses in Shikoku's coastal artisanal fisheries.
We find that most fishers in Shikoku have adapted to the impacts of climate change (a) by changing fishing technology (b) and targeting new species. However this is true for the northern and center regions, less affected by climate change.
The southern region reports mainly remaining and coping responses, including no responses (remain) (b).

KEY FINDINGS

- We find that adaptive capacities and adaptation responses are largely tied to the organization and management system of the fishery
- Importance of patron-client relationships in Mexico, that limit some important adaptive capacities
- Territorial rights and formal permits are lowering the Flexibility domain in Japan and Galicia
- We find that, in general, fishers follow the adaptation pathway, from remaining and coping to transforming and exiting when impacts increase
- However we identify vulnerable individuals/groups that are not able to respond to the impacts of climate change (i.e. independent fishers in Nayarit or net fishers in Galicia).
- Hotspots with high Adaptive Capacity like Japan have a possibly already transformed their fishing systems, so we mainly find remaining coping strategies
- Understanding how adaptive capacities influence adaptation responses can help us design adaptive management interventions to help SSF communities respond to climate change

PROJECT MATERIALS

VIDEOS OF THE SSF

Galician fishers' perceptions

Nayarit fishes perceptions

4 DOCTORAL THESES

Diego Salgueiro-Otero, Galician fishers

Alba Aguión, Galician fishers

Iratxe Rubio, Basque fisheries

3 CASE STUDY FLYERS

6 MASTER THESES

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