

# Extreme climatic effects on a co-managed small-scale spiny lobster fishery:

Implications in revenues and quasi-profits  
distribution and cooperative responses to climatic  
challenge

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# Resilience

The ability of socio-ecological systems (such as fishery systems) to:

- cope with disturbances,
- adapt to change
- and
- retain the same function, structure, identity and feedbacks

(Folke et al. 2002; Walker et al., 2006)

Resilience analysis should consider its socio-economic dimensions, such as distributional effects issues

(Adger *et al.*, 2002; Potete & Ostrom, 2004; Martin & Sunley, 2014)

# Distributional effects

It involves the implications related to how the benefits (and the costs) of a management action spreads among individuals, groups or even communities

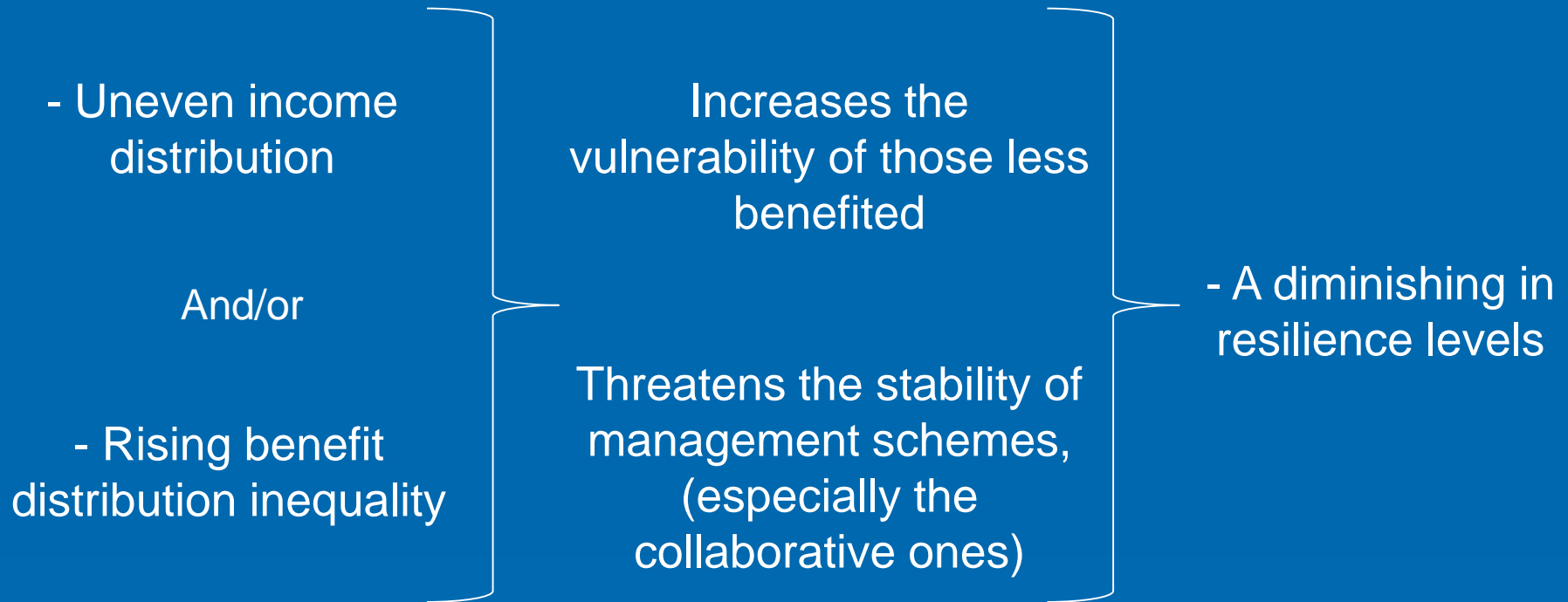
(Clay *et al.*, 2014)

Concerns about distributional effects: its inherent equity or inequity can affect the acceptability, the possible success and the outcomes of management systems

(Guyader & Thébaud, 2001; Sumaila, 2010).



# Distributional effects and resilience



(Nash, 1953; Balland & Plateau, 1999; Agrawal, 2001; Adger *et al.*, 2002)

# Small-scale fisheries SSFs

- Subject to high susceptibility to climatic and oceanographic variability (Chavez *et al.*, 2003).
- Securing sustainable SSFs involves (among others factors) :
  - Recognize and take into account the differential impact of natural disasters (such as extreme climate effects ).
  - Support an equitable distribution of the benefits yielded from the fishing activity

(FAO, 2014)



# Research Questions

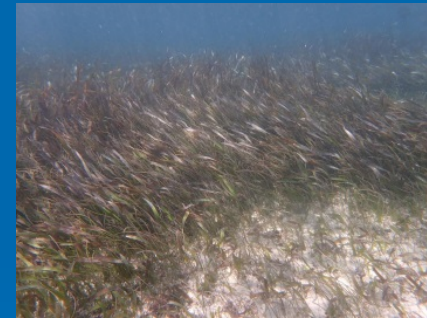
- How benefits are distributed among the members of a small scale fishing cooperative that has proved being sustainable over time?
- What strategies were adopted by fishers to cope with the effects of an extreme climatic event?
- What were the results of those strategies in terms of:
  - catches
  - quasi-profits
  - distribution effects

# Materials and Methods: Fishery geographic area

## Ecological characteristics



- Sian Ka'an Biosphere Reserve
- Shallow karst bay
- 740 km<sup>2</sup>
- Extensive sea grasses



- Important influence of continental freshwater
- Reef barrier outside the bay
- Reef lagoon at the bay «mouth»

Arellano-Méndez, et al., 2010;  
Medina, 2011.

# Socio-economic context of the fishing Community



- Punta Allen
- $\approx$  500 inhabitants
- Main source of income:



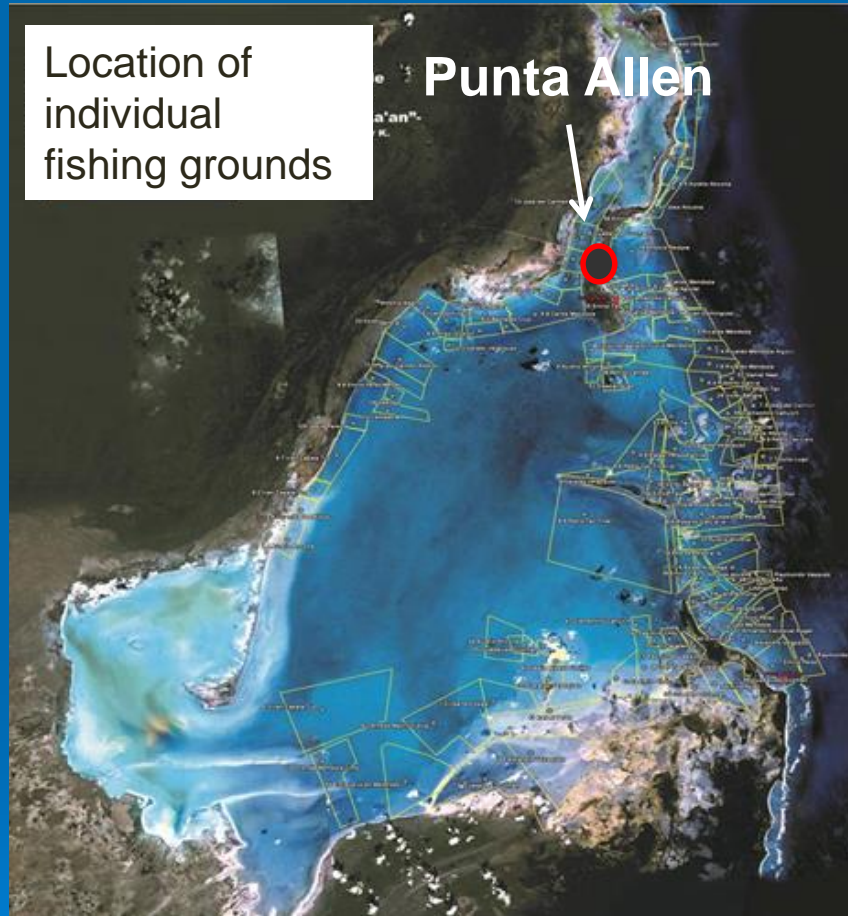
Spiny lobster *Panulirus argus* fishery



INEGI, 2010  
Velez, et al., 2014



# Fishery organization and co-management (TURF)



(Modified from Cooper, L. and Mendoza, M. com pers. and Kooper, L.)

## Fishery management & regulation

### Government

- Closed season
- Minimum size
- No capture of BF
- Limit to HP

### Cooperative

- Forbidden: SCUBA  
Hooka  
Traps/nets
- Individual Transferable  
Grounds

Individual Fishing Grounds: 120

- Certified by MSC (2012)

Sosa-Cordero, et al., 2008  
McKay, et al., 2014

# Artificial shelter use in the fishery



Artificial shelters:  $\approx 27,000$

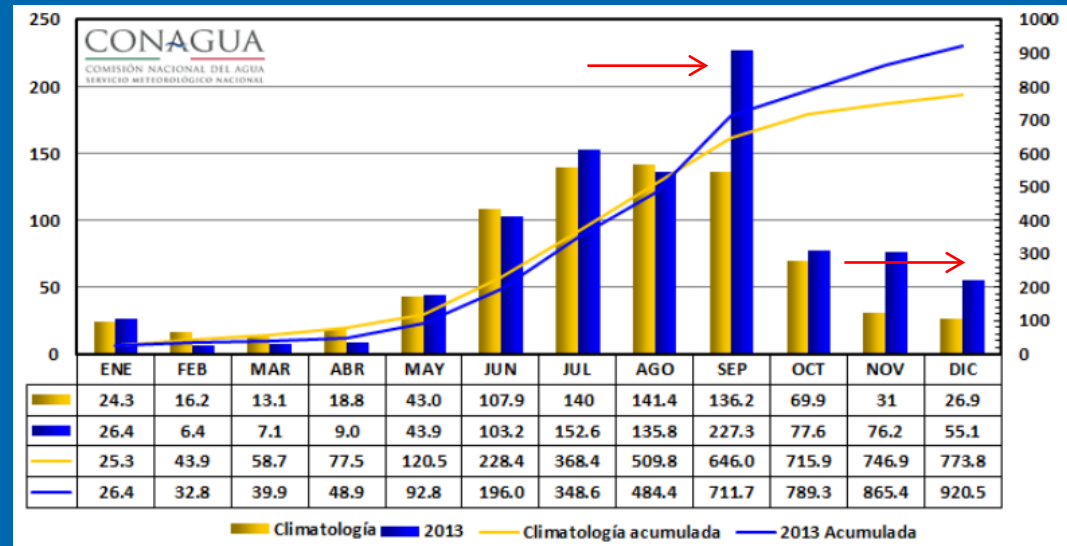
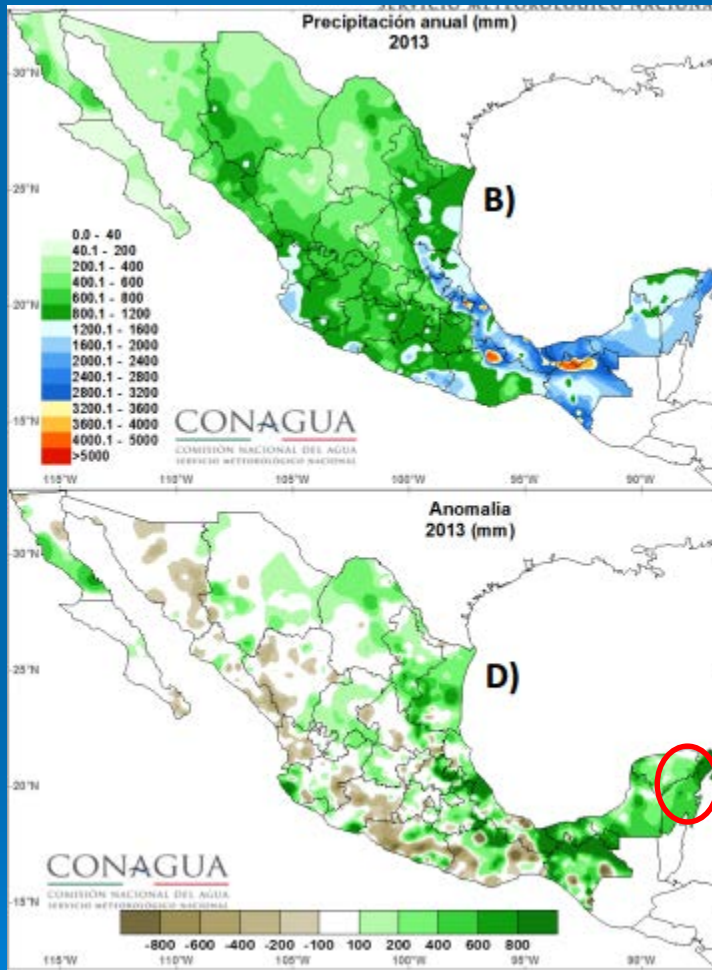
Headley, et al., 2016 (in progress)



# Fishing and harvest operation



# Extreme climatic event



2013 the rainiest year since 1941  
in the zone ( > 25-50 %)

\*Heavy rains continued up to  
2014

Meteorological National Service. 2014



# Method: Data collection

Interviews to fishers (semi-structured questionnaires)



Fishing logbooks and cooperative's records



# Fishing benefits

quasi-profit of variable costs  $qp$

Fishing trip revenues

Fishing trip costs

## Price and cost parameters

### Incomes

Tail price	25.72	US\$/kg
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Whole price	14.79	US\$/kg
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### Costs

Gas	1.00	US\$/kg
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Engine Oil	6.43	US\$/kg
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Exchange rate (April 2015)		
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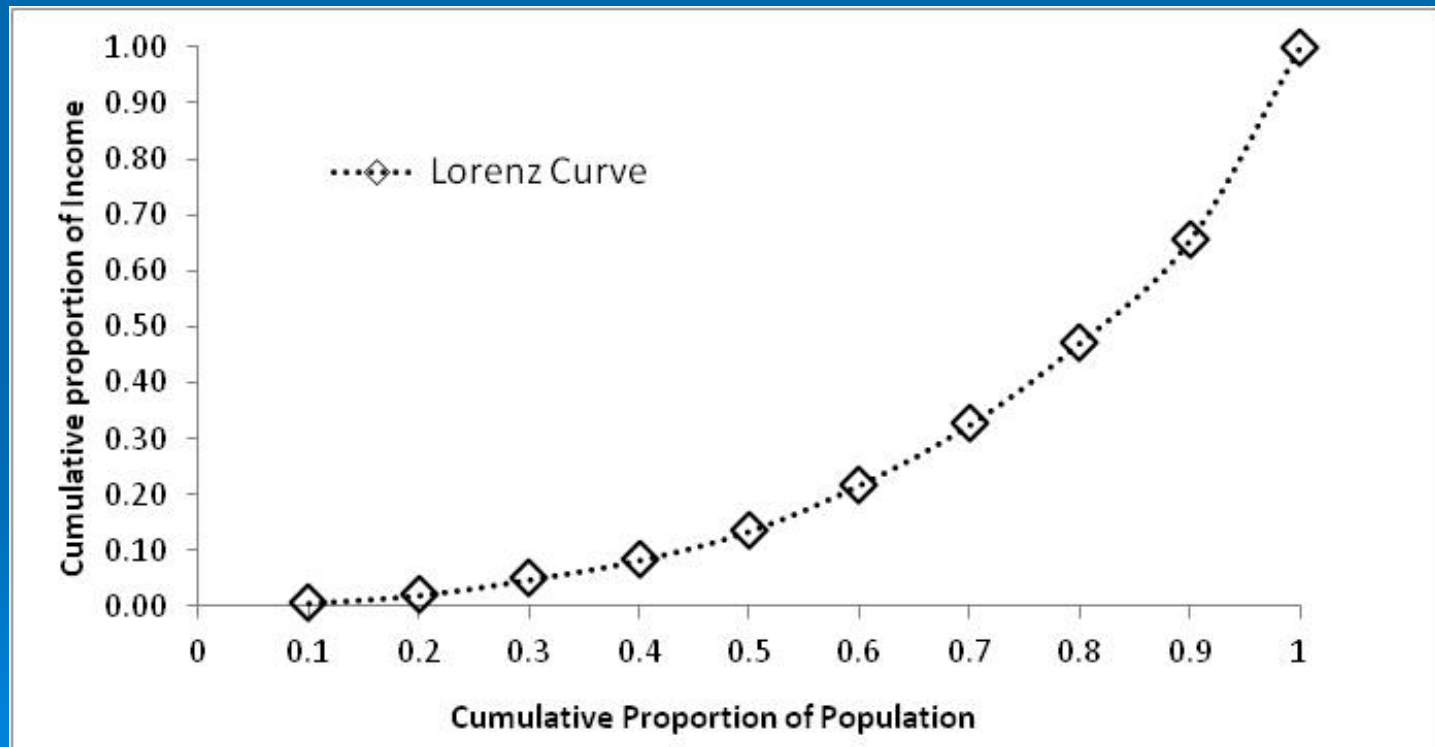
15.55	US\$/kg
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# Measuring benefits distribution

## Lorenz curves

- Cumulative proportion of population ranked by income level
- Range (0,1)
- Unit less

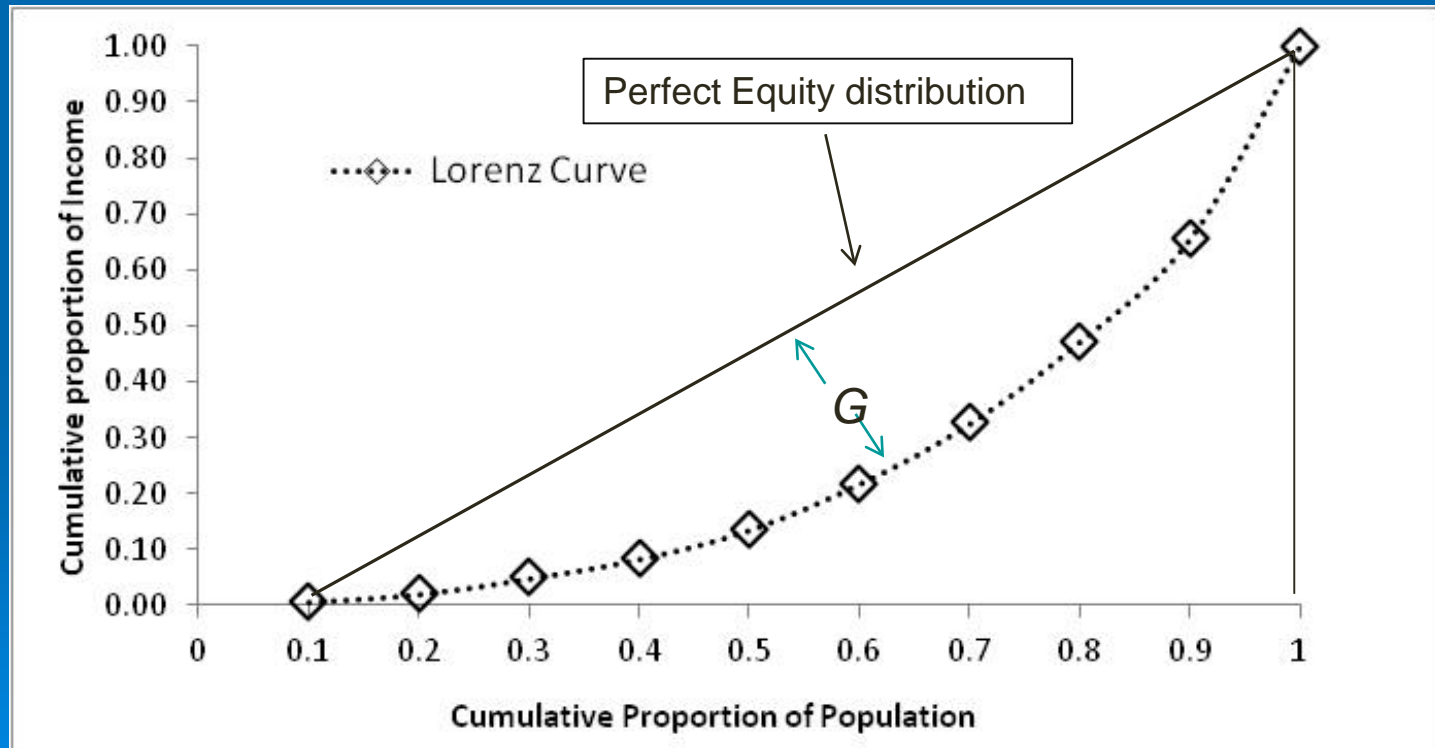


# Measuring benefits distribution

Gini inequity index  $G$  (0,1):

The extent in which an income distribution differs from Perfect Equity

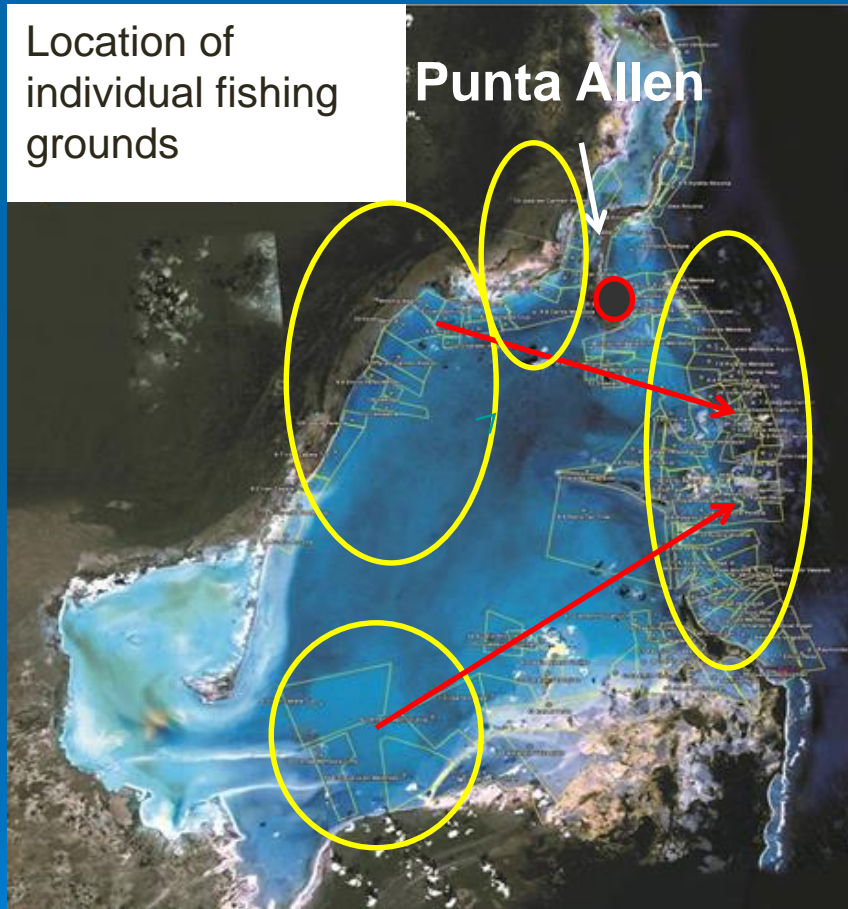
The area between uniform and a singular Lorenz curve.



(Gini, 1912; Blackwood & Lynch, 1994)



# Results: Perceptions of fishermen on climate uncertainty



In exceptional rainy years, lobsters  
“run away”

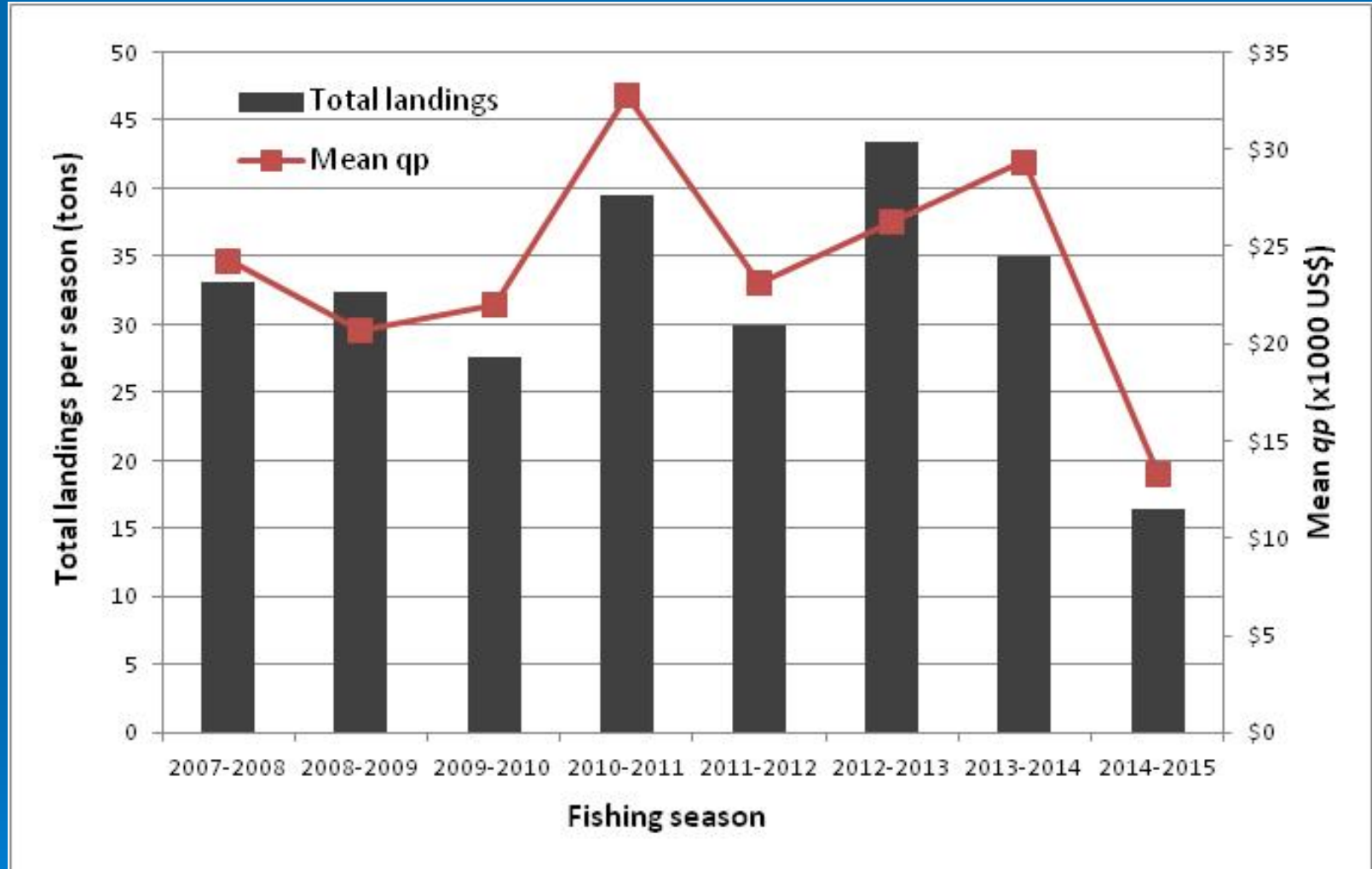
Reduction of catch per fishing  
trip

Higher risk of breaking self-  
imposed regulations

Co-management system  
could be in jeopardy

(Modified from Cooper, L. and Mendoza, M. com  
pers. and Kooper, L.)

# Results: Time series of catches and $qp$ (2007 – 2015)



-Season 2014-2015: Production and  $qp$  dropped by 50 %

# Collective and individual actions

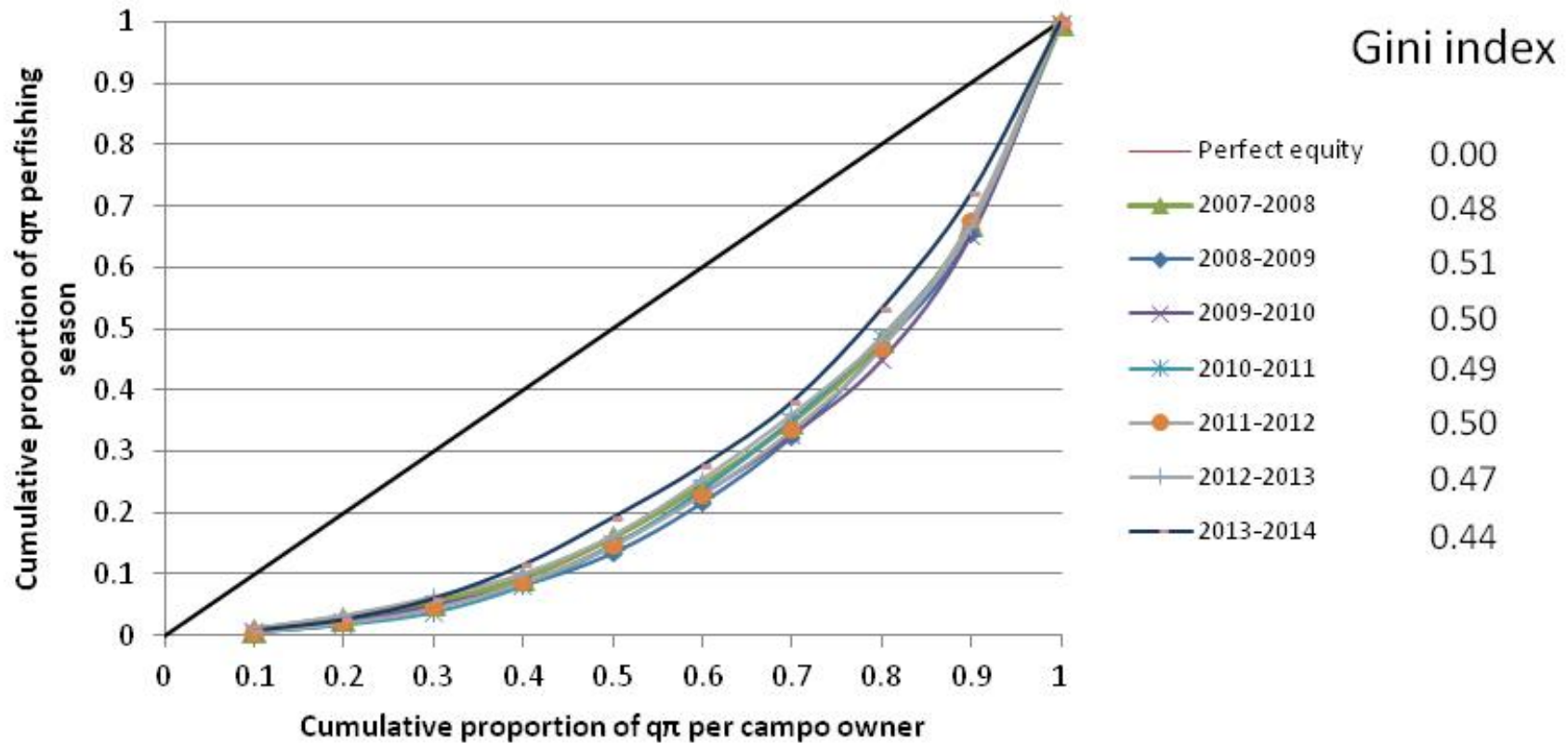
- Community agreed strategy

- Scheduling “no-fishing days” (up to three weeks per month), looking to achieve higher catches per trip
- Allowing fishermen with the most affected fishing areas collaborating with fishermen whose fishing areas were less affected

- Individual strategies

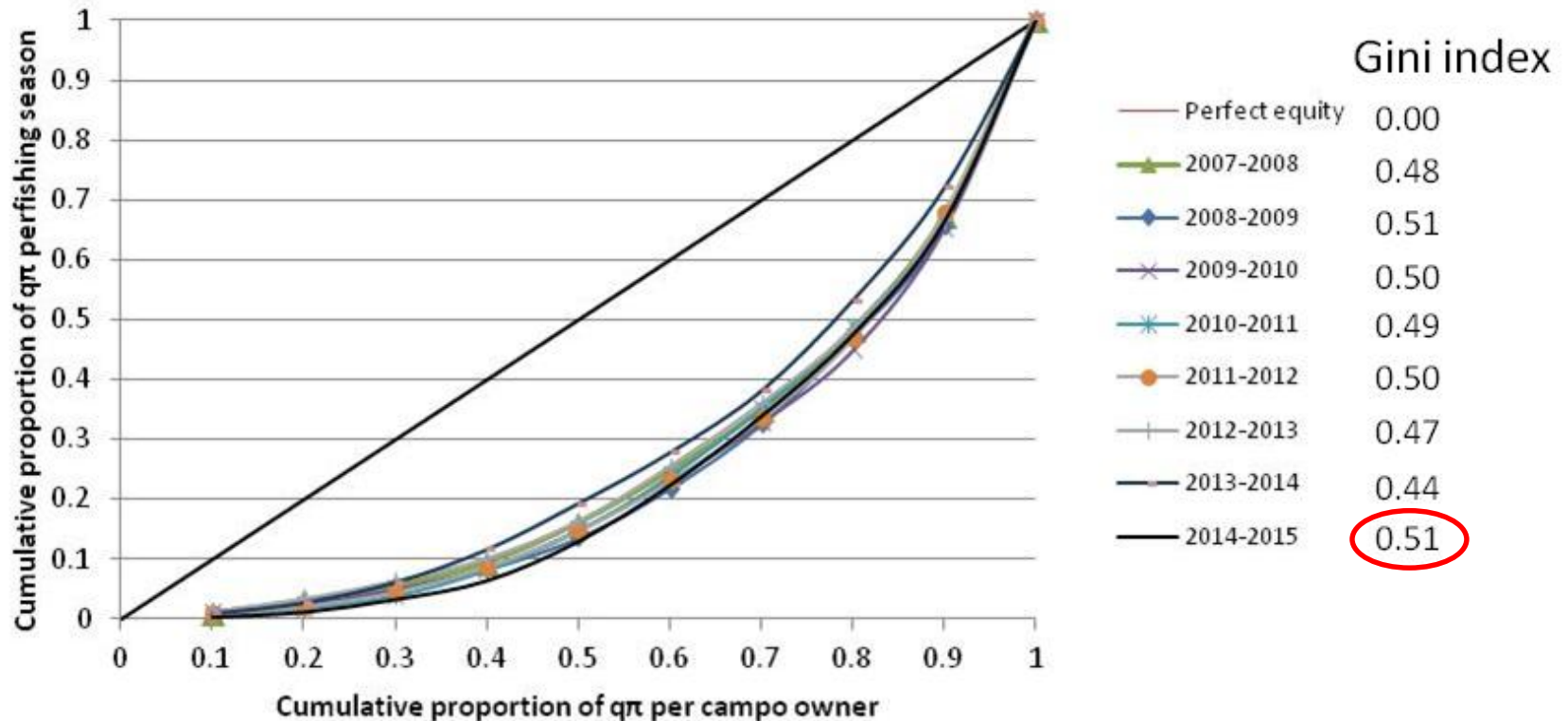
- Alternative livelihoods: working in recreational fly-fishing and eco-tourism guides
- Targeting less-value species: finfish and sharks, among others

# Distribution benefitts: Lorenz Curve and Gini index (2007-2014)



$$\overline{G} = 0.48 \pm 0.22 (p=0.05)$$

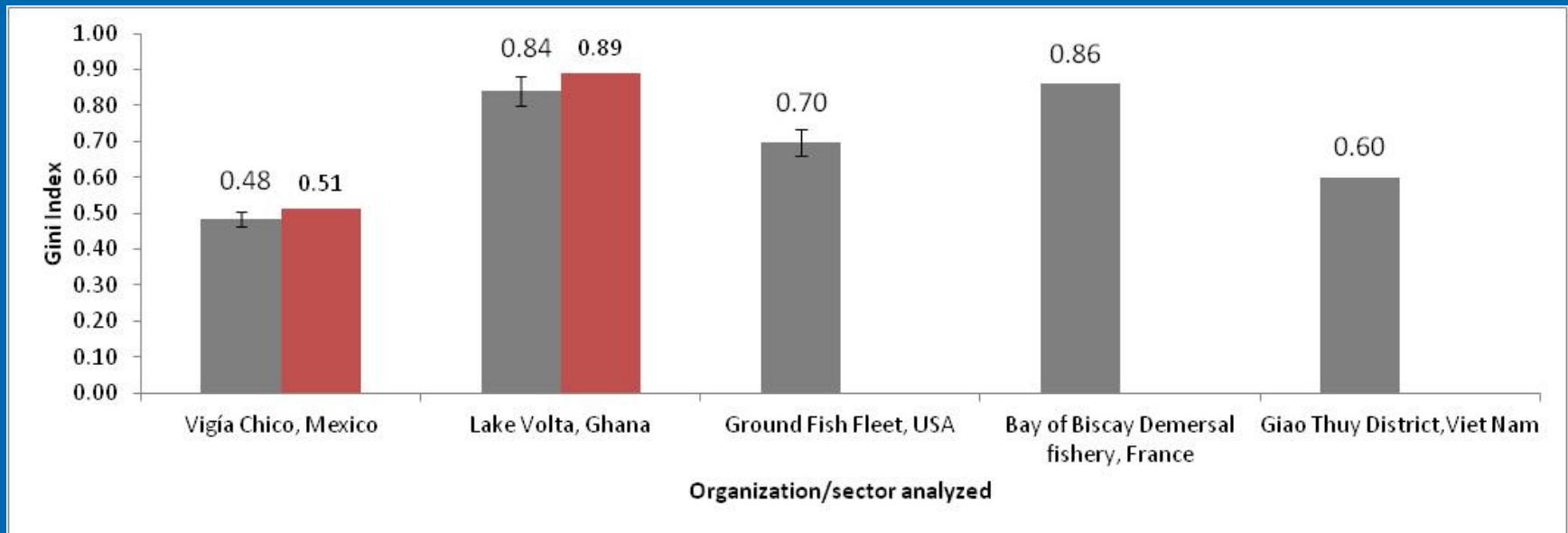
# Distribution benefitts: Lorenz Curve and Gini index (2007-2015)



Gini index did not have a significant change

$$G = 0.48 \pm 0.22 (p=0.05)$$

# Comparing Punta Allen's Gini index with other fishing communities and industries



(Adger *et al.*, 2002; Béné & Obirih-Opareh *et al.*, 2009; Clay *et al.*, 2014; Bellanger *et al.*, 2016)

# Final remarks

- The extreme climatic episode during rainy season 2013-2014 caused a drop in catches and quasi-profits of about 50 %.
- Co-manage system of Punta Allen lobster fishery demonstrated being capable of dealing with this climatic episode
- Based on the Gini index, community agreements allowed the fishermen to maintain an equitable distribution of benefits, even under adverse conditions with distributional effects.
- Solidarity among the peers strengthened the social resilience of lobster fishers in Punta Allen.

# Thanks



**Community Conservation**  
Research Network



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