Comprehensive Assessment of Coastal Fisheries Responses to Extreme Climate Events

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Extreme Climate Events

Introduction

Rapid great extreme weather event increase climate change implicated

- Geophysical disasters
- Climate related (hydro-meteorological) disasters
- Economic damage

EM-DAT International Disaster Database,
Center for Research on Epidemiology of Disasters,
University of Louvain.

Graph showing number of disasters and economic damage from 1950 to 2010.
Definitions:

- A disturbance event is considered an Extreme Climate Event (ECE) if there is both a statistically rare climatic event and extreme ecological response.

- Extreme responses cross critical thresholds where community structure and ecosystem function move outside their normal bounds.

Extreme Climate Events

R Santos et al. (2016) Ecosphere
Introduction

Climate Change and Fisheries

Widespread impacts attributed to climate change based on the available scientific literature since the AR4

*Reports mostly on commercial landings and infrastructure.

Effects on recreational fisheries overlooked
Fisheries Resilient or Prone to Collapse?

South Florida Recreational Fisheries

• FL - Highest number of recreational anglers, the most dollars spent on fishing in the US, and the highest quality of fishing worldwide

• Total economic impact (Fedler, 2013)
  • $5.2 billion- statewide saltwater angling
Questions

Fisheries Resilient or Prone to Collapse? South Florida Recreational Fisheries

Q1: How are the catch structure trajectories from baseline conditions?
   - Gradual or Stable
   - Abrupt or Reversible

Q2: What is the temporal dynamic (inter-year) of catch structure change?
   - Abrupt changes after ECEs?
   - Distinct spatial rxn to ECEs?
Fisheries Resilient or Prone to Collapse?

Adopt community ecology concepts

- Assess speed and direction of community changes
- Responses to disturbances
- Trajectories of community change ≈ Resilience

Methods

Lamothe et al. (2019) Ecosphere (fig); Caceres et al. (2019); Ecol Monog; Bagchi et al. (2017) Ecol Appl
Fisheries Resilient or Prone to Collapse?

Adopt community ecology concepts

Methods

Lamothe et al. (2019) Ecosphere (fig - up); Caceres et al. (2019) (fig – down); Ecol Monog; Bagchi et al. (2017) Ecol Appl (fig – down)
**Fishery-Dependent Data (FDD)**

- Fishing reports submitted by fishing guides to Everglades National Park:
  - 1986 to 2017
  - Useful for stock and ES assessments
  - Events: Hurricanes, Seagrass Die-off, Cold Spells
  - CPUE in 6 Fishing Areas
    - Merged into 4: (1) Inner Florida Bay/ (2) Outer Florida Bay/ (4, 5) West Inner/West Outer (3, 6)

- We sum catch and effort across the months, and created average annual CPUE value
- We analyzed the catch structure based on a Bray-Curtis dissimilarity matrix of the average annual CPUE
Study Domain

Recreational Fisheries in ENP

Materials & Methods

Top 20 species

- Spotted seatrout
- Red drum
- Snook
- Crevalle jack
- Gray snapper
- Tarpon
- Ladyfish
- Sheepshead
- Black drum
- Bonefish
- Spanish mackerel
- Goliath grouper
- Blacktip shark
- Florida pompano
- Lemon shark
- Tripletail
- Bluefish
- Bonnethead
- Garfish
- Sea catfish

Total Count

- Spotted seatrout: 85,949
- Red drum: 76,081
- Snook: 70,334
- Crevalle jack: 36,866
- Gray snapper: 34,406
- Tarpon: 31,901
- Ladyfish: 26,824
- Sheepshead: 11,470
- Black drum: 9,822
- Bonefish: 6,247
- Spanish mackerel: 6,025
- Goliath grouper: 4,226
- Blacktip shark: 4,217
- Florida pompano: 4,126
- Lemon shark: 3,937
- Tripletail: 2,664
- Bluefish: 2,504
- Bonnethead: 2,133
- Garfish: 1,998
- Sea catfish: 1,882
Species Occurrence

Most species caught across all fishing areas

Results

Species richness consistency was spatially dependent:

- $S'$ relatively consistent across years in the “outer” fishing areas
- More variable at the “Inner” fishing areas
Results: ordination space of the catch
Results:

*Stable* displacement from initial conditions

- **Inner Florida Bay**
- **Outer Florida Bay**
- **West Inner**
- **West Outer**

*Stable*
Results

Geometric analysis

Similar catch structure temporal dynamics

Catch structure more similar than others

The least of abrupt changes in West Outer

However, magnitude of change similar across periods
Q1: How are the catch structure trajectories from baseline conditions?
  - Stable?

Catch vs Effort

Anglers vs Guides

Effects of data transformation and distance matrix
Q2: How is the temporal (inter-year) dynamic of catch structure change?

- Overall, consistent magnitude of change across periods
- Spatially explicit, limited responses to ECEs?
  - legacy/confounded effects

- Importance of species specific responses
  - Breakpoint analysis
  - Event coincidence analysis
Thank You!

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