Impacts of climatic and ecological variations on human user groups and implications for marine ecosystem-based management in Northern Peru

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Introduction

• The Piura region is a ‘transitional area’ between Peruvian upwelling system and equatorial waters

➢ strong oceanographic gradient, variability driven by El Niño Southern Oscillation (ENSO)

• Integrated coastal zone management (ICZM) process in Piura started 2003 (first in Peru)
Introduction

Aims of scoping study:

Identify
- marine resources/services and user groups,
- users‘ concerns and perceptions about the marine system,
- impacts of climatic and environmental variability,
- potential shifts under climate change

Methods:
- Personal interviews with marine stakeholders in Piura October-November 2017
- Analysis of the ICZM process in Piura up to 2017 (workshop protocols and reports) and participation in ‘Comités de Bahias‘ Nov/Dec 2017
Users & interactions
Fisheries

• Small-scale and artisanal fisheries extremely important for provision of livelihoods in coastal communities

• Paita: most important fishing port, fishmeal production and export

• Sechura Bay and along the North coast

• Local fisheries associations / gremios de pescadores
Fisheries (2)

- Strongly increasing landings in Piura in last 15 years

- Species:
  - Humboldt squid
  - Peruvian anchoveta
  - Scallops
  - Mahi-mahi (dolphinfish)
  - Tuna, bonito, chub mackerel…

Guevara-Carrasco & Bertrand 2017
Aquaculture

- Sechura has become the Latin American center of scallop aquaculture (bottom and hanging culture) => export
- Shrimp farming further east (Tumbes)
Coastal and marine tourism

- Beach tourism, national and international: Máncura and North coast, Colán,…
- Surf tourism
- Sports fishing (catch-and-release)
- Whale and turtle watching tours
Coastal and marine tourism (2)

• Some communities in the North actively pursue a transformation from fisheries to ecotourism: turtle tours, sports fishing, whale watching…
• … a path to more sustainable use of marine resources for coastal communities?

• Target species mostly migratory, highly variable and transboundary (unclear management/protection)
Fossil resources

- Offshore oil and gas drilling close to coast (in 5nm artesanal fisheries zone)
- Non-metallic mining (bentonite clay, limestone, marble) in coastal zones: runoffs into sea
- Licensed by national government to international companies

- Fear of pollution leads to conflicts with local communities and fisheries associations
Conservation

- High species diversity due to transitional area (mixing of tropical and upwelling communities)
- Near-coast islands: 32 bird species (endemic to Peru: Humboldt penguin, Red-legged cormorant...), sea lion colonies
- Endemic benthic invertebrates
- New marine reserve „Mar Pacífico Tropical“ decided in 2017, establishment pending
- Marine reserve actively supported by artisanal fishers’ associations in the North
Societal actors and uses of marine ecosystem

Fisheries
- Local consumption
- Fishmeal production
- Export
- Industrial fishers
  - Small-scale fishers
    - Squids
    - Bonito
    - Sharks
  - Processing
- Chub mackerel
- Mahi-mahi
- Tuna
- Sardine
- Scallop

Aquaculture
- Scallop culture

Tourism
- Beach tourism
- Sports fishing
- Diving
- Whale/turtle watching
- Sea lions
- Turtles

Fossil Resources
- Offshore oil & gas
- Mineral mining
- Pollution
- Use of space
ENSO and climate change impacts
Climatic variability and change

- Marked seasonal variability and ENSO variations
- Coastal El Niño (e.g. 2017): heavy impacts on infrastructure in Piura
- Current climate models project warming by 3-4°C until 2100 and the equatorial front moving south
ENSO impacts on user groups

**Fisheries:**
climate-related distributional shifts of target species during EN
- e.g. Peruvian anchoveta, Pacific sardine, Humboldt squid and demersal fish reduced / moving to cooler/deeper waters
- Increases in decapod shrimps, mahi-mahi, tunas (Yellowfin, Bigeye)

**Aquaculture:**
- During normal El Niño: Warm waters increase growth and production in scallops (*A. purpuratus*)
- Coastal El Niño 2017: Mass mortality of scallops
ENS0 impacts on user groups

**Tourism:**
- infrastructure damage and pollution of marine waters during strong EN events,
- mass mortality events in top-level predators such as sea lions and seabirds
- Turbid waters make diving impossible
- Immigration of typical tropical fish species after El Niño events
- Turtles and whales avoiding coastal waters during coastal El Niño events.
- Erosion or accretion of beaches and sandbanks
Stakeholder adaptation options to ENSO

- Fishers switch gear and target fish species (limited)
  - productivity not comparable
- Seafood processors can adapt to different products and buy raw products from different regions – still suffer losses (50% reduction in export in EN 1998)
- Economic diversification, temporary employment in other sectors (e.g. transport and restaurants)
- Aquaculture: move to other localities (limiting: protected waters and the supply of scallop seed from nearby hatcheries)
- Migration to other localities…
Challenges for Management
Challenges for management

• Reduction of pollution by
  o urban trash / plastic and wastewater
  o runoff from fishmeal and fish processing factories
  o disposal of engine oil from boats

• Improve fisheries licensing and control
  o Misdeclarations (anchovy for human consumption), double licensing
  o Destructive fishing practices (bottom trawling), contamination from boats, bycatch reduction
  o Overfishing / illegal entrance by industrial fleets into coastal zone,
  o Provision of environmental and climatic information to fishers
  o catch and by-catch of sharks, turtles and dolphins
Challenges for management (2)

- Mass mortality events of sea lions and seabirds, dead whale strandings: Food / pollution (noise) / fishermen??

- Mitigate conflicts for space and infrastructure through investment (e.g. jetties) and continue ICZM and increase participation

- Knowledge gaps: ecosystem shifts under climate change?
Climate change impacts: stakeholder concerns

- More frequent or stronger El Niño impacts
- Ecological shifts (more tropical/EN community, changes in productivity and movements of fish stocks to the south / deeper / offshore)
- Oxygen deficiency (benthic)
- Decreased primary productivity

- Terrestrial impacts (water scarcity, soil erosion...)


Climate change impacts

• Sea level rise:
  o Erosion of beaches and river mouths
  o Floodings damage coastal infrastructure
  o Loss of wetlands and mangroves

• Salinization of ground water and agricultural zones

• Potentially increasing conflicts among user groups?

Projected +1m until 2100
*GoRe Piura*
(Initial) conclusions / open questions

• The transition zone off the Piura coast has the highest biodiversity in Peru and higher productivity than tropical waters
• Overall impacts of EN and climate change on marine user groups are clearly negative
• Ecotourism as an adaptation option for coastal communities?
• Societally relevant knowledge gaps in climate and ecological projections
• Is societal adaptive capacity to cc increased by ENSO variability?
• Adaptation strategies: How to prepare for climate change and improve incorporation of environmental fluctuations in ecosystem-based management of marine areas in the Piura region?
Upcoming (hopefully)

'Humboldt-Tipping‘ project (2019-2021):
- End-to-end modeling (pelagic system)
- Trophic models for bay systems
- Stakeholder engagement and Social-Ecological System case studies in Piura/Sechura, Pisco/Paracas, Chimbote
- Governance analyses
Thank you!

contributors

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