Caught in a pickle? Assessing the historical management and examining future opportunities for the Galápagos sea cucumber fishery

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MScSM
Master of Science in Sustainability Management

Sea cucumber facts

- Sea cucumbers are Invertebrates found in all marine environments across the globe (Anderson et al., 2010; O'Loughlin et al., 2011).
- They help maintain ecosystem health by aiding bioturbation, enhancing benthic biota productivity, and increasing seawater alkalinity, among other functions (Shiell & Knott, 2010; Schneider et al., 2011; Purcell et al., 2016; Williamson et al., 2021).
- In 2020, a reported 43 000 tonnes of sea cucumbers were fished in over 70 countries, comprising 9% of total marine capture production (FAO, 2022).
- Sea cucumbers have been traded in Asian Pacific markets for over a thousand years (Aydin et al., 2011).
- Over 81% of global sea cucumber fisheries have experienced population declines due to overfishing (Anderson et al., 2010).

Research question

Is there evidence that the Galápagos sea cucumber fishery can be managed sustainably and, if so, how?

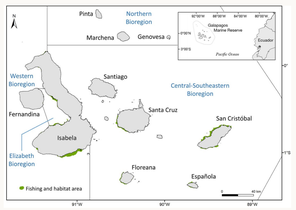

Figure 1. Map of the Galápagos Marine Reserve indicating the fishing and habitat area of *I. fuscus*, the only sea cucumber species in the Galápagos. [From Ramírez-González et al. 2020b].

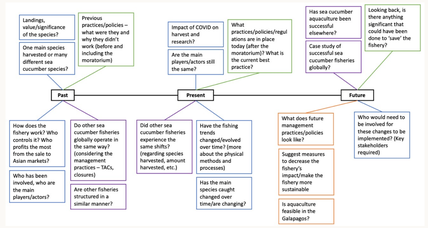

Figure 2. A graphical representation of preliminary questions and topics I planned to include in the interviews. Blue boxes represent questions and issues about the structure of the fishery, green boxes to the management of the Galápagos fishery, purple boxes denote questions about other sea cucumber fisheries globally, and orange to future opportunities for the Galápagos fishery.

Methodology

- Literature review:
  - Base search terms: "sea cucumber Galápagos" and "sea cucumber management"
  - Keywords relating to ecology: "ecological impact," "overharvesting," "overfishing," and "sustainable"
  - Keywords relating to management: "regulation," "monitoring," "economy," "social," and "challenge"
- Semi-structured interviews:
  - Dr. Jorge Ramírez-González: Fisheries Interdisciplinary Research Project Lead at the Charles Darwin Foundation
  - Dr. Arliene Rogers: Professor at the University of Belize, researched Belizean sea cucumbers for over 12 years
  - Dr. Luis Felaco: Sea cucumber aquaculture company owner

Galápagos sea cucumber fishery

- This fishery is one of the oldest of its kind in South America (Toral-Granda, 2008).
- Only harvests the sea cucumber species *Isostichopus fuscus*
  - This species is listed as engendered on the IUCN Red List with a population reduction of over 80% (Mercier et al., 2013).
- Sea cucumbers occupy a unique ecologic, social, and economic role in the archipelago.

Historic & current management

- 1991: Fishery relocated to Canal Bolívar with just over 100 fishers (Shepherd et al., 2004).
- 1994: Fishing season was closed early as fishing grew out of control (Powell & Gibbs, 1995).
- 1994-1999: The fishery becomes illegal (Shepherd et al., 2004).
- 1998: The 'Special Law for the Conservation and Sustainable Development of the Province of Galápagos' was adopted (Hoyman & McCall, 2013).
- 1999: Fishery reopened after training workshops and a TAC and minimum size limits were imposed (Shepherd et al., 2004).
- 2008: A population density traffic light system was introduced (Ramírez-González et al., 2020a).
  - Density ≥ 11 sea cucumbers/100 m^2 → population healthy or recovering, the fishery can open
  - Density ≤ 11 sea cucumbers/100 m^2 → critical status, the fishery is closed
- 2008-2010: Fishery closed due to low population densities.
- 2011: Population densities were acceptable, fishery was opened.
- 2012-2014: Fishery closed due to low population densities.
- 2015: Population densities were acceptable, fishery was opened.
- 2016-2021: Moratorium issued on sea cucumber fishery.
- 2021: Fishery reopened but promptly closed after two weeks as TAC had been reached (Ortiz, 2022; Viteri Mejía et al., 2022).
- Overall, the fishery's former management practices were insufficient in preventing overexploitation.

Comparison to other fisheries

- Campeche Bank, Mexico
  - The fishery's regional and social similarity to the Galápagos allowed for more direct comparisons of management strategies and their effectiveness.
- Queensland, Australia
  - The fishery's location in a developed, high-income country provided insights into how management strategies can differ based on resource availability and political context.

Figure 3. Image of the brown sea cucumber, *Isostichopus fuscus*. Photo credit: Carmelo López Abad

Shortcomings & future opportunities

- The overcalculation of former catch quotas was largely due to overestimations in local sea cucumber species growth rate and population distributions.
- Overfishing was at also driven by political pressure → the high price of sea cucumbers resulted in setting the fishing quota at unstainable levels.
- The Galápagos can consider incorporating a more collaborative, bottom-up approach to fisheries management.
  - Long-term case studies from various Latin American small-scale fisheries indicate that this approach has produced positive effects for fisheries.
- Exploring low-technology aquaculture in combination with stock enhancements can also provide a solution for declining fisheries and contribute to restoring local populations.
  - However, careful attention must be paid to unintended or unanticipated social and environmental impacts.

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