A SMARTer Approach to Collection of Catch Data for Conservation and Sustainability

Un Enfoque que Utiliza SMART para la Recopilación de Datos de Captura para la Conservación y la Sostenibilidad

Une Approche Utilisant SMART pour Collecter des Données de Capture pour la Conservation et la Durabilité

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EXTENDED ABSTRACT

Small-scale fisheries based around tropical reef ecosystems are critical to local livelihoods, food security, and export earnings in many developing nations (Andrew et al. 2007). However, the activities of small-scale fisheries are notoriously difficult to assess and manage given the existence of numerous landing sites, the dynamic multi-species, and multi-gear nature of extractions, and the limited quantity and/or quality of data needed for conventional stock assessment (Costello et al. 2012, Babcock et al. 2018). The recognition of these realities by governments and conservation organizations mandates improving data collection systems for successful biodiversity protection, sustainable fisheries, and poverty alleviation. Specifically, there is a clear need for simple and effective electronic systems to record catch at specific sites and transfer these data to a centralized repository for near real-time monitoring, analyses and subsequent management action and policy reform.

We examined the use of the open-source and customizable SMART (Spatial Monitoring And Reporting Tool) software application (http://smartconservationtools.org) that provides trained citizen technicians with simple, menu-driven fields to collect detailed fisheries data (species, size, gear, fishing area). This ongoing evaluation has already provided a clearer understanding of the nature and availability of fisheries products (fish and invertebrates) to households and local businesses within five of the largest coastal communities (Corozal, Caye Caulker, Belize City, Dangriga, Placencia) in Belize which access six of nine managed access fishing areas (Figure 1).

Preliminary data collections (Nov. 2017 – Sept. 2018) and analysis are based on 13,051 individually measured products composed of 4,161 queen conch, *Lobatus gigas* (32%), 680 spiny lobster, *Panulirus argus* (5%) and 8,210 scale fish (63%). Most landed conch meats (86%) were in market clean condition (N = 3605, mean = 114 g, legal minimum = 85g) with the majority landed in Dangriga (74%) from adjacent area 3 (71%). Spiny lobsters were largely landed as tails (75%, mean = 184 g, legal minimum = 114g) in Dangriga from area 3 (65%). A total of 63 species of fish from 23 families were landed from six managed access zones. Non-metric multi-dimensional scaling (Clarke and Gorley 2006) of abundance by species revealed substantial differences in landings between sites with Belize City and Dangriga being most similar and Corazol being most different with each site having a different top landed species (Figure 1). Fish community metrics, number of species, evenness and diversity also revealed differences between sites (Figure 1). Black-striped mojarra (*Eugerres plumieri*), exclusively landed in Corozal, was the most caught fish species overall (Figure 2). The top family of fish landed was Lutijanidae (snappers, 41%) with five of the top six landed fish species across Belize being snappers: gray snapper (*Lutjanus griseus*), lane snapper (*Lutjanus synagris*), yellowtail snapper (*Ocyurus chrysurus*), silk snapper (*Lutjanus vivanus*) and mutton snapper (*Lutjanus analis*) (Fig. 2). Great barracuda (*Sphyraena barracuda*) and carangidae (cravelle jack, *Caranx hippos*; horse-eyed jack, *Caranx latus*; greater amberjack *Seriola dumerili*) round out the top 10 species which comprise more than 68% of all fish landed. Nets are the most important gear (42%) used to capture fish overall followed by hook and line (36%), traps (15%) and spears (7%).

Invertivore-piscivores (e.g. mutton snapper) are the most (47%) landed trophic group followed by invertivores (e.g. lane snapper) (37%) and piscivores (e.g. great barracuda) (16%) (Randall 1967). Preliminary analysis indicates a number of species are overexploited based on high landings of immature sizes and low proportion of mature, optimal, and mega-spawners (Rochet and Trenkel 2003, Froese 2004, Hobday et al. 2011) (Figure 3). These data will be compared to ongoing catch data collections and previous analyses conducted by the Wildlife Conservation Society at Glover's reef and South-water caye marine reserves (Babcock et al. 2013, Tewfik et al. 2017, Babcock et al. 2018). The SMART based fisheries data collection system could be transferred to the national management authority integrated into existing enforcement patrols and supplement or replace fleet-wide hard-copy logbooks for formulation of future taxa, gear, temporal and spatial specific management actions.

KEYWORDS: Small-scale fisheries, Belize, livelihoods

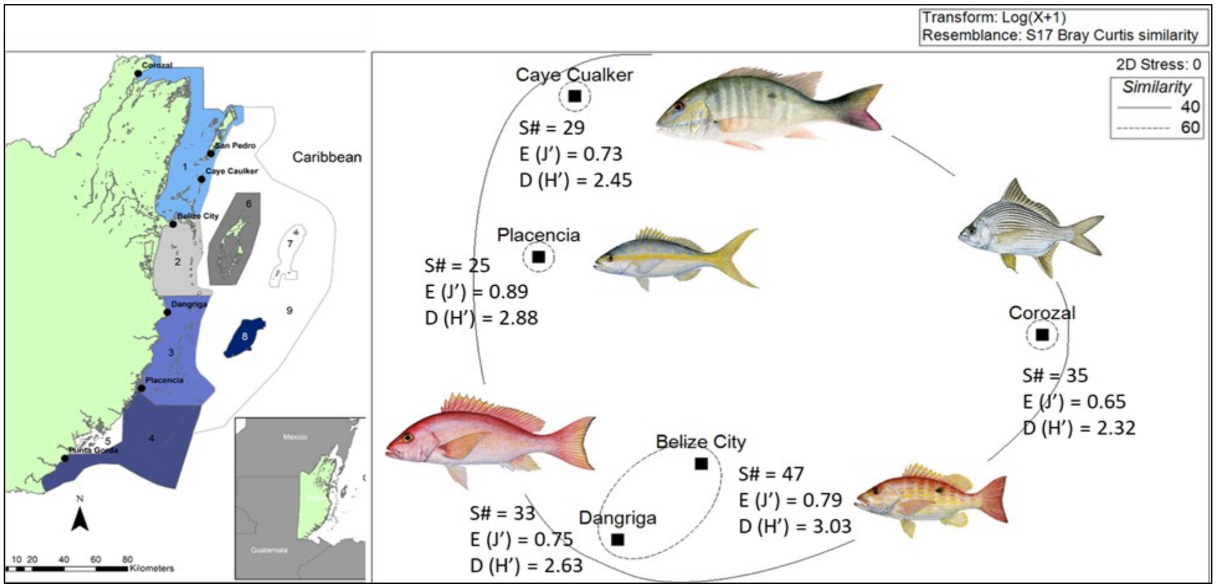

Figure 1. Multi-dimensional scaling plot and similarity contours of fish species abundance with associated fish community metrics (S# = number of species, E (J') = evenness, D (H') = Shannon diversity). Top landed species for each landing site displayed: lane snapper (Belize City); mutton snapper (Caye Caulker); black-stripped mojarra, (Corozal); silk snapper (Dangriga), yellowtail snapper (Placencia). Gray snapper was the second most landed fish overall and at Corozal. Map displays managed access fishing zones and major coastal communities in Belize.

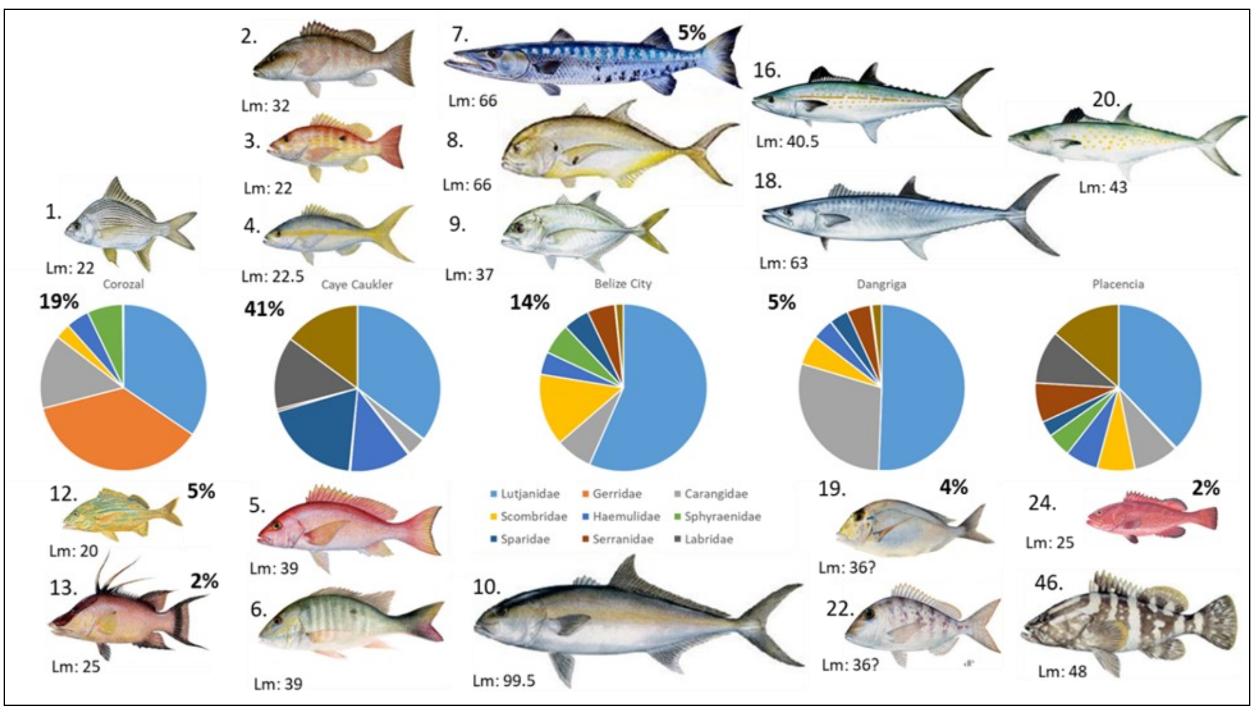

Figure 2. Principle fish families (% abundance) and top species within families (# ranked overall, Lm = size of maturity in cm) identified in all community landings data across Belize (N = 8210). Lutijanidae (41%) (2. gray, *Lutjanus griseus* 3. lane, *Lutjanus synagris* 4. yellowtail, Ocyurus chrysurus 5. silk, *Lutjanus vivanus* 6. Mutton, *Lutjanus analis*), Gerridae (19%) (1. Black-striped mojarra, *Eugerres plumieri*), Carangidae (14%) (8. cravelle jack, *Caranx hippos* 9. horse-eyed jack, *Caranx latus* 10. greater amberjack, *Seriola dumerili*), Sphyraenidae (5%) (7. Great barracuda, *Sphyraena barracuda*), Haemulidae (5%) (12. blue-striped grunt, *Haemulon sciurus*), Sparidae (19. pluma porgy, *Calamus pennatula* 22. jolt-head porgy, *Calamus bajonado*), Labridae (2%) (13. Hogfish, *Lachnolaimus maximus*) Scrombidae (5%) (16. cero, *Scomberomorus regalis* 18. king mackerel, *Scomberomorus cavalla* 20. Spanish mackerel, *Scomberomorus maculatus*), Serranidae (2%) (24. red hind, *Epinephelus guttatus* 46. Nassau grouper, *Epinephelus striatus*). Lm values from fishbase.org, Babcock et al. 2018 and associated sources.

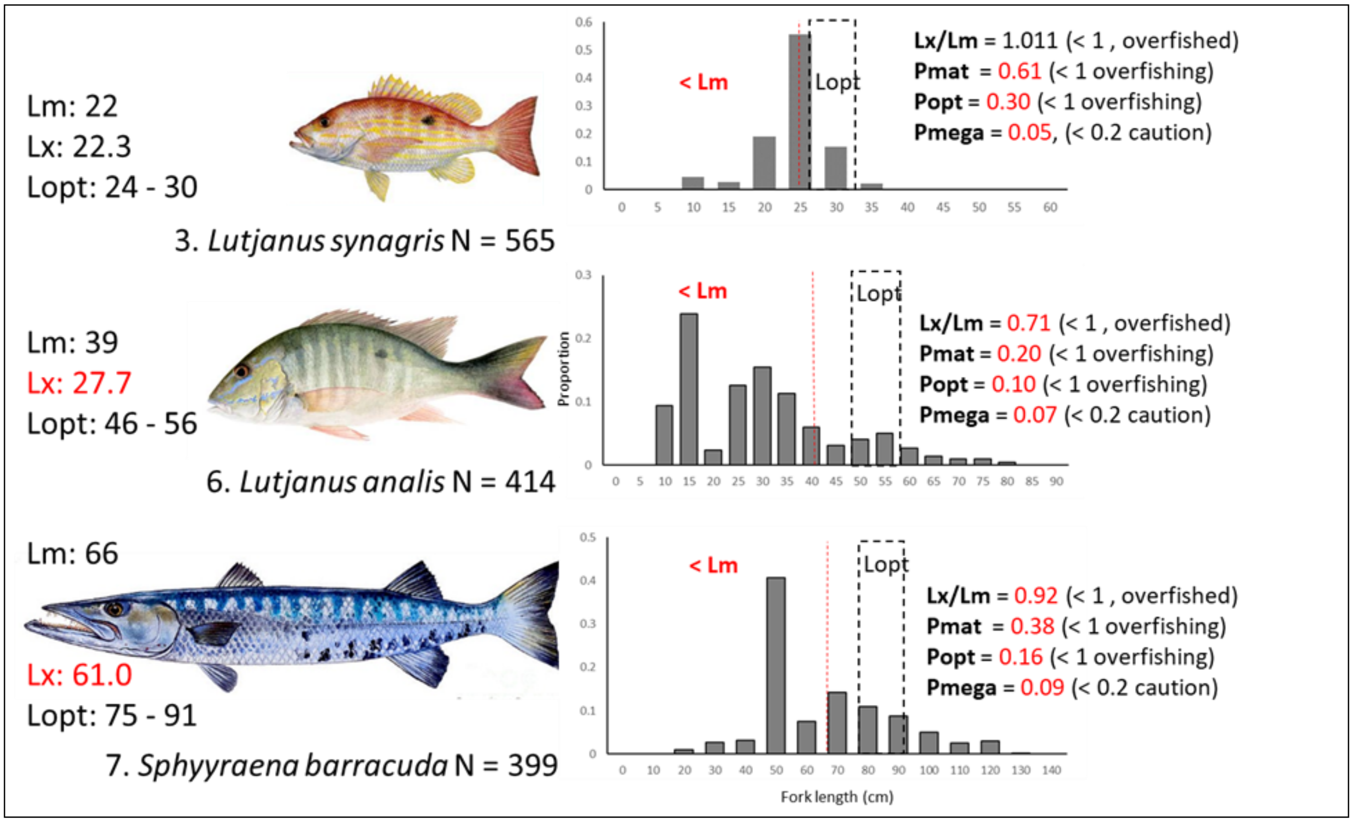

Figure 3. Fork length frequency distributions (proportions) and status based on length based population metrics for an invertivore (e.g. lane snapper, *Lutjanus synagris*), ivertivore-piscivore (e.g. mutton snapper, *Lutjanus analis*) and piscivore (e.g. barracuda, *Sphyyraena barracuda*). Lm = size at maturity (red dashed line, see Fig. 2 for sources), Lx = mean size in this study, Lx/Lm (Rochet and Trenkel 2003, Hobday et al. 2011), Pmat = proportion mature (> Lm), Popt = proportion optimal size (±10%, black dashed polygon) and Pmega = proportion megaspawener (1.1 x max optimal size) (Froese 2004).

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