Spatial-Temporal Movement Patterns of Juvenile Atlantic Tarpon (*Megalops atlanticus)* in Brewers Bay, St. Thomas, US Virgin Islands

Patrones Espacial-Temporales del Movimiento del Sábalo Atlántico Juvenil (*Megalops atlanticus*) en la Bahía de Brewers, St. Thomas de las Islas Vírgenes de los EE.UU.

Schémas de Mouvements Spatio-Temporels des Jeunes Tarpons de l'Atlantique (*Megalops atlanticus*) dans la Baie Brewers, St. Thomas du les ÎLes Vierges Américaines

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EXTENDED ABSTRACT

Understanding how animals move across time and space provides information on various aspects of animals including their different behaviors (i.e., foraging, resting, breeding), ontogenetic shifts, habitat use, species interactions, species growth and survival, population distribution/abundance and biodiversity (Dingle and Drake 2007, Danylchuck et al. 2011; Pittman et al. 2014). At a local scale fish utilize small areas known as "home ranges" whereby they partake in daily activities; such as feeding, resting and breeding. Within a home range, fish select core areas that are used for specific purposes such as feeding and resting (Pittman and McAlpine 2003). These home ranges can comprise of different benthic (i.e coral reefs, seagrass beds and sand patches) and pelagic habitats, as well as mangroves, lagoons and estuaries. Home ranges can be influenced by diel/crepuscular periods, seasonal changes or ontogenetic shifts (Powell 2000, Pittman and McAlpine 2003, Hitt et al. 2011a). Atlantic tarpon (*Megalops atlanticus*) are highly mobile fish important to recreational fisheries along the Atlantic Ocean, especially the Gulf of Mexico and the Caribbean Islands (Ault 2008; Hammerschlag et al. 2012, Luo and Ault 2012). Little is known about small-scale movements or space use of juvenile tarpon in Caribbean ecosystems. This study aims to fulfill those gaps using acoustic telemetry in Brewers Bay, St. Thomas, US Virgin Islands.

Fourteen Atlantic tarpon ranging in size from 61cm to 95cm fork length (FL) were passively tracked (VEMCO V13 or V13P acoustic transmitters) to identify their vertical movement and home range, during diel, crepuscular and seasonal periods. Tarpon were passively tracked by acoustic receivers (n= 43) that were strategically moored throughout Brewers Bay, St. Thomas, US Virgin Islands. Acoustic data was downloaded every 6 months and were processed using VUE and R. Using 30-minute intervals the average position (latitude and longitude) for each fish were calculated to provide Center of Activity (COA) points (Simpfendorfer et al. 2002, Duffing Romero 2018). Based on COA location points, home range size and location was calculated using Minimum convex polygons (100% MCP) and Kernel utilization distribution (50% & 95% KUD). MCPs provide information on the extent of the area used by an individual, while KUDs the space utilized within a home range based on highest detection density. Theses spatial analyses were calculated and plotted using R (adehabitat package) and ArcGIS. Moreover, distance (m) and time (s) moved between COA relocation points for each fish were calculated to elucidate their diel rate of movement (ROM) patterns. Lastly, 3 tarpon had depth transmitters for which we binned their depth measurements into hourly and monthly periods and applied boxplots to elucidate their vertical movement patterns.

From September 2015 to May 2017 only four tarpon showed greater than 80% residency time within Brewers Bay. The average home range size for all Atlantic tarpon was 0.603 km^2 (range = 0.109 - 1.349km^2). Tarpon primarily had their home range along the waters of the airport runway and the lagoon (Figure 1). During the day tarpon primarily utilized the waters around the St. Thomas airport runway and at night seemed to rest in a small lagoon. Tarpon had significantly higher rate of movement (ROM) during crepuscular periods than diel periods ($p < 0.0005$); however, ROM was higher during the day than at night. High ROM during crepuscular periods and day indicate that tarpon are foraging or participating in other behaviors; while lower ROM at night indicates that tarpon are resting. Monthly home range size varied significantly among each tarpon (R^2 0.4311, $p = 0.001$). Tarpon showed home range expansion primarily during the months of April, September and October, indicating that they may be following food sources or avoiding high fluctuations of water temperatures. Tarpon were typically found in waters < 18 m, but occasionally moved to depths up to 25 m; whereby they primarily stayed in shallower depths (< 10m) at night and utilized broader ranges of the water column during the day. Similarly, tarpon showed extended vertical movement to deeper waters in the months of January and from July - October. Our results illustrate clear movement patterns (both horizontal and vertical) of juvenile Atlantic tarpon in Brewers Bay across time and space. These results provide baseline data that will be important to efficiently monitor and evaluate responses to changing water and habitat quality that can inform management plans for the species.

KEYWORDS: Atlantic tarpon, home range, acoustic telemetry

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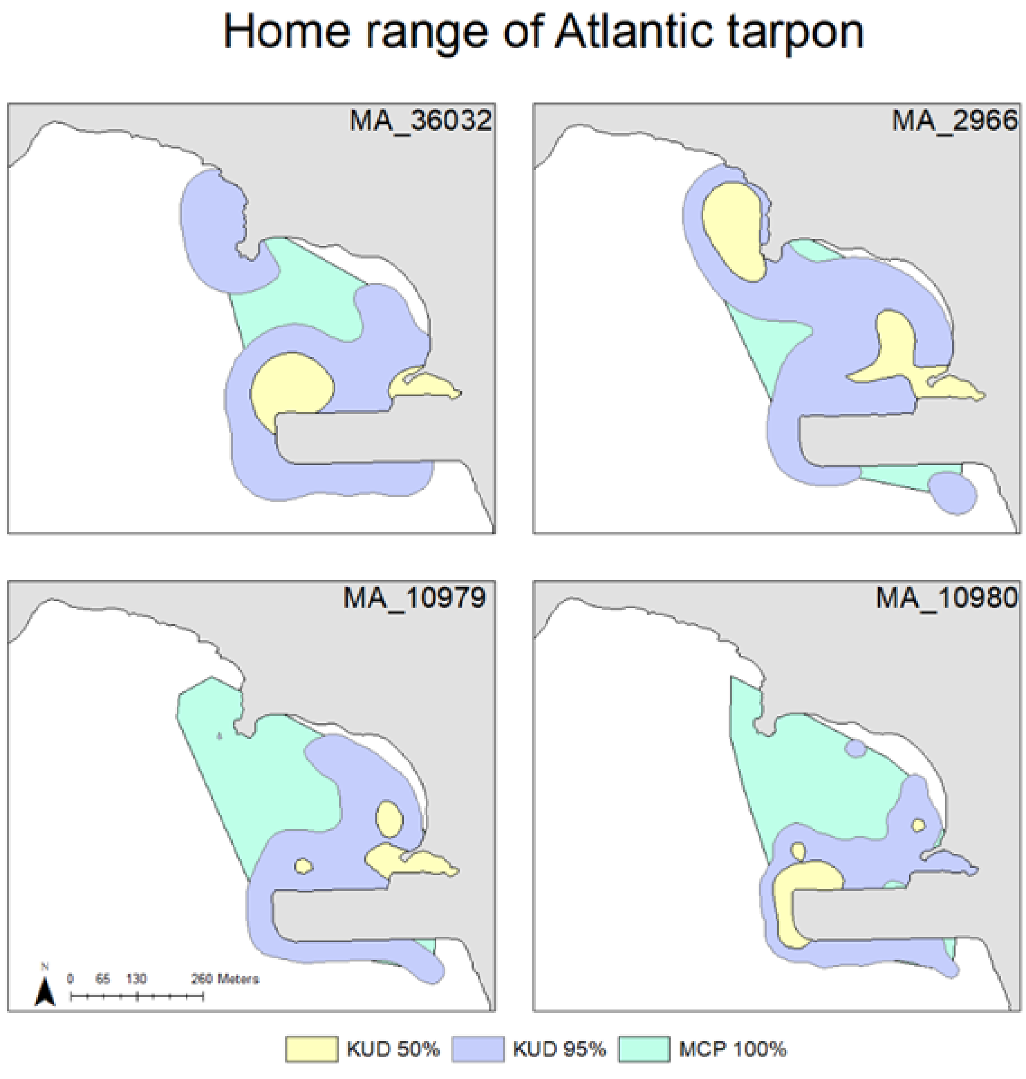

Figure 1. Representation of the home range for each Atlantic tarpon based on kernel utilization distribution (50% and 95%) and minimum convex polygon (100%) analyses (Duffing Romero 2018).