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Using Low Level Aerial Imagery to Asses Fiddler Crab (*Uca pugnax*) Populations in Salt Marshes

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This project explored and assessed the use of low-level aerial imagery on populations of fiddler crabs *Uca pugnax* in a variety of salt marsh habitats. Data was collected from both Pleasant Point (6/27, 7/12) and Banca Back (7/18) marshes located in Branford, CT. The objective of the experiment was to 1) see if low level aerial imagery could accurately assess fiddler crab populations within the variety of habitats on the salt marsh, 2) how do distributions and abundances of fiddler crabs differ from previously recorded data, and 3) do the results suggest that there has been a change in the distribution and abundance of fiddler crabs on salt marshes that can be related to global change phenomena such as sea level rise. In order to complete objective two and three I first had to make sure that flight paths from the UAV (unmanned aerial vehicle) did not affect the behavior or disturb crab populations on the salt marsh. By gradually reducing the altitude of the drone from 15 m and recording crabs with both on ground (GoPro) and UAV video footage. The height at which crabs were found to be disturbed was ~5 m. So 10 m flight plans were developed using the apps DroneDeploy and Pix4D to capture pictures along a grid providing overlap to create orthomosaics. Orthomosaics were created using the program Agisoft that was exported into both tiffs and a reduced jpeg files. The reduced jpegs were used in ImageJ to assess patches within the area sampled by classifying individual pixels by color and separating them from the original image providing the area, perimeter and ID number to each patch. The TIFF files were placed into ArcMap where distribution of the crabs across each area sampled could be calculated.

UAV images accurately and efficiently assessed fiddler crabs within patches and did so in a noninvasive approach. Flight plans at 10 meters were found to be optimal in terms of flight time, total area processed, low interference with crab behavior, and ability to accurately count crab populations. At a 10 m flight altitude it was possible to fly a 307 m^2- 7,228 m^2 area in about 10-20 minutes and with just one UAV battery. Within these areas patch occupancy was found to be approximately 80% for all areas sampled representing a significant habitat for crab populations. Crab density within all patches was found to be higher than previously recorded values (Zajac, *in preparation*) ~19 crabs/m^2 (6/27), ~26 crabs/m^2 (7/12) and ~16 crabs/m^2 (7/18). The increases in these values may be due to the noninvasive approach the UAV provides; traditional sample methods require the individual to walk over their sample area which may scare off crabs. The distribution of crabs in bare patches showed primarily random distributions except for the Banca Back (7/18/18) area closest to the main tidal creek. This could have been due to preferential settlement of larvae on bank edges and the accessibility of the tidal bank compared to settlement within the high marsh.