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Species Identification and Effect of Substrate on the Distribution of Fiddler Crabs, *Uca spp.* in Olango Island Wildlife Sanctuary, Cebu

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Abstract: Olango Island Wildlife Sanctuary is one of the areas in the Philippines that is teeming with fiddler crabs. However, to date no published studies have verified the identity of these populations. The fiddler crabs in the sanctuary were observed to be situated in a distinct location. Studies suggest that ecological factors such as substrate can play a main role in the distribution of fiddler crabs. This study aimed to identify the fiddler crabs, *Uca spp.* in Olango Island Wildlife Sanctuary, Cebu to the species level and describe the species distribution across sites with varying substrates. A total of 385 fiddler crabs were collected and accounted from four distinct sites. Discrete morphological characters and four morphometric measurements for *Uca* species were used for species identification. Type of substrate were observed and noted. Results revealed the presence of five fiddler crab species in the sanctuary namely, *Uca annulipes, Uca crassipes, Uca perplexa, Uca tetragonon,* and *Uca vocans*. Distribution of the five species appeared to be influenced by substrate type. *Uca crassipes* were abundant in the limestone areas with a little or no presence of sand while *Uca perplexa, Uca tetragonon and Uca vocans* were mostly seen in areas with high volume of sand and mud. Lastly, *Uca annulipes* were plentiful in the limestone areas with a low - moderate volume of sand. The investigation revealed that the distribution of the five species appeared to be influenced by the substrate type.

Key Words: fiddler crabs; *Uca;* substrate; distribution; olango island wildlife sanctuary

1. INTRODUCTION

Fiddler crabs are crustaceans that belong to the family Ocypodidae, genus *Uca*. They are the most dominant crabs in the tropical and subtropical intertidal mudflats and mangroves (Crane, 1975; Johnson, 2003). These tiny crabs have a morphologically distinct large claw in males and vary in different coloration. *Uca* species are widely studied because of its availability and their great number in a specific area (Crane, 1975).

Fiddler crabs serve as ecological engineers that changes the physical, chemical and biological being of mangrove communities (Thongtham and Kristensen, 2003; Kristensen and Holmer, 2001; Botto and Iribarne, 2000). This tiny crabs do not

have a direct measureable economic role. However, they are still important in the ecology of intertidal mudflats as they are often used as fishing bait and are the major food resource of marine organisms due to their numbers and biomass [Grimes et al., 1989].

Currently, there are 97 species that have been identified and described worldwide (Rosenberg, 2001). According to (Estampador, 1959), 19 species of fiddler crabs are present in the Philippines, but some unlisted species were found in Baybay, Leyte (Boregon and Evangelio, 2015) and in northern Luzon (Shih, 2012).

In the Philippines, one area that is teeming with fiddler crabs is the Olango Island Wildlife Sanctuary (OIWS) which is located on the west side of Mactan Island in Cebu. This is hailed as a wildlife protection site as it is one of the stop points of migratory birds around the world (Management Plan for Olango Wildlife Sanctuary, 1992). Migratory birds and other marine organisms feed on these crabs. These tiny crabs also contribute to the good soil oxygenation that is needed for a mangrove forest. However, to date no published work have verified the identity of the fiddler crab population in OIWS. The fiddler crabs in the sanctuary were also observed to be situated in a distinct location. Thus, this study aimed to identify the fiddler crabs, *Uca spp.* in Olango Island Wildlife Sanctuary, Cebu to the species level and describe the species distribution across sites with varying substrates.

2. METHODOLOGY

A. Site Description

Olango Island Wildlife Sanctuary is located approximately 4 km away from Mactan Island Cebu and approximately 15 km east of Cebu City. It is the first wetland of international importance for waterfowl in the Philippines (Management Plan for Olango Wildlife Sanctuary, 1992). Permit to study inside the OIWS was acquired from the Region VII's Department of Environment and Natural Resources.

B. Sampling Method

A total of four sites which are approximately 50 meters apart were used in this study. Three 50 - meter transect lines which were 10 meters apart were deployed to each site. Fiddler crabs were collected by hand with the aid of a shovel and a strainer. Type of substrate for each site were observed and noted. Collected crabs were put into labeled zip locks and were properly stored inside a freezer. Ice - kept collected crabs were transported to De La Salle University Zoology Laboratory for further morphological analysis.

C. Species Identification

Fiddler crabs in each site were identified to the species level using morphological characters set by (Shih et al., 2016) and four morphometric characters for *Uca* species set by (Crane, 1975). The morphometric measurements are as follow: the carapace length, carapace breadth, propodus length and dactyl length. All identified species were submitted to the Philippine National Museum for species ID verification.

D. Statistical Analysis

Principal component analysis was conducted to verify if the four morphometric parameters (carapace length, carapace breadth, propodus, and dactyl) have the same patterns for both similar coloration and the same species. This test was conducted for each male and female group considering the sexual dimorphism of fiddler crabs.

3. RESULTS AND DISCUSSION

A. Species Identification

A total of 385 fiddler crabs were collected and accounted from four distinct sites. Results of species identification showed the presence of five fiddler crab species in the sanctuary namely, *Uca annulipes, Uca crassipes, Uca perplexa, Uca tetragonon,* and *Uca vocans*, as seen in figure 1.

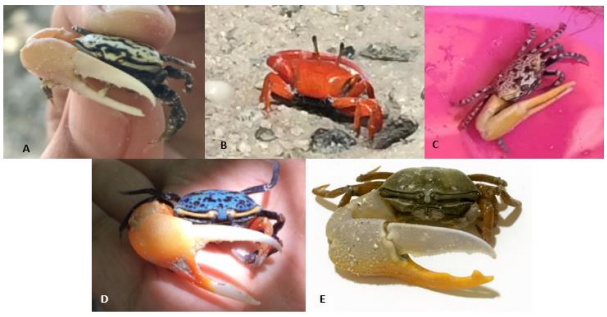

Figure 1. A. *Uca annulipes, Male B. Uca crassipes, Male C. Uca perplexa, Male D. Uca tetragonon, Male* and E. *Uca vocans, Male*

Principal component analysis revealed a pattern of clustering for the same coloration and for the same species in both male and female fiddler crabs as shown in figure 2 for males and figure 3 for females.

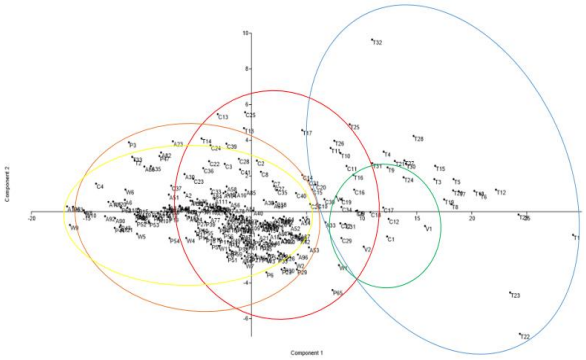

Figure 2. Principal component analysis score plot of OIWS's male fiddler crabs

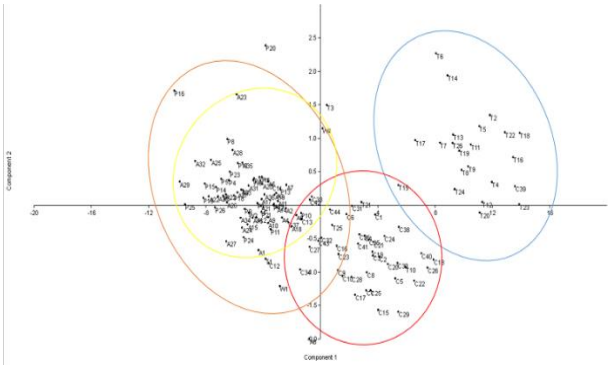

Figure 3. Principal component analysis score plot of OIWS's female fiddler crabs

All identified species in this study were included in the combined list of identified Philippine fiddler crabs of Estampador (1959), Shih (2012), and Boregon and Evangelio (2015). Nonetheless, Olango Island Wildlife Sanctuary, Mactan, Cebu should be included in the updated list of *Uca annulipes, Uca crassipes, Uca perplexa, Uca tetragonon,* and *Uca vocans* place of distribution in the Philippines.

Color differences in fiddler crabs are one of the characters that is being used for species identification as these tiny crabs vary in color worldwide. Yet, coloration alone is not enough to verify the identity of fiddler crab species. Other morphological characteristics and its morphometric measurements should be involved in the identification process (Crane, 1975). This is because color variation may be caused by intrinsic factors such as foraging behavior, reproductive behavior, and social behavior while others may be caused by extrinsic factors such as but are not limited to, water salinity, temperature, availability of nutrients and oxygen (Macintosh, 1982 and Bezerra et al., 2006). Therefore, color cues should be handled with caution unless one is an expert with the species and its sympatric associates (Crane, 1975).

B. Species Distribution Across Sites

A total of four sites were used in this study, as seen in figure 4.

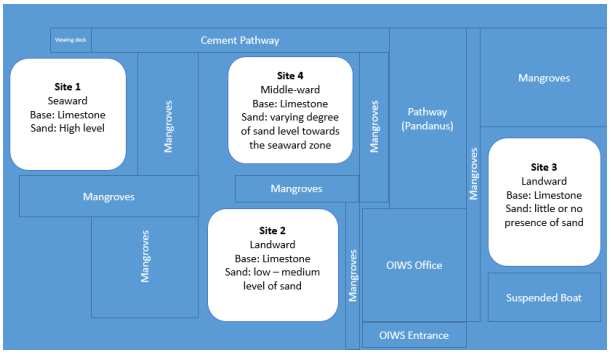

Figure 4. Map of Sampling Site in OIWS

Site 1, an area near the seaward zone, consisted of high level of sand and mud. On the other hand, Site 2, an area near the landward zone,

was composed of limestone with a low – medium level of sand. Site 3 was also near the landward zone. However, it was observed to have a substrate of limestone with little or no presence of sand. Lastly, Site 4 is in the middle zone where the substrate is still composed of limestone but with a varying degree of sand level towards the seaward zone.

The distribution of the five species appeared to be correlated to the substrate type as showed in figure 5. *Uca crassipes* were abundant in limestone areas with a little or no presence of sand in site 3 and 4. While, *Uca vocans* were mostly seen in areas with high volume of sand that appears to be muddy such as observed in site 1. Moreover, *Uca tetragonon* were observed to prefer high volume of sand such as observed in site 1 and in the near seaward zone of site 4. *Uca perplexa* were observed to inhabit all sites with sand but mostly abundant in sandy parts of Site 1 and site 3. Lastly, *Uca annulipes* were plentiful in the limestone areas with a low to moderate volume of sand part in sites 2 and 3.

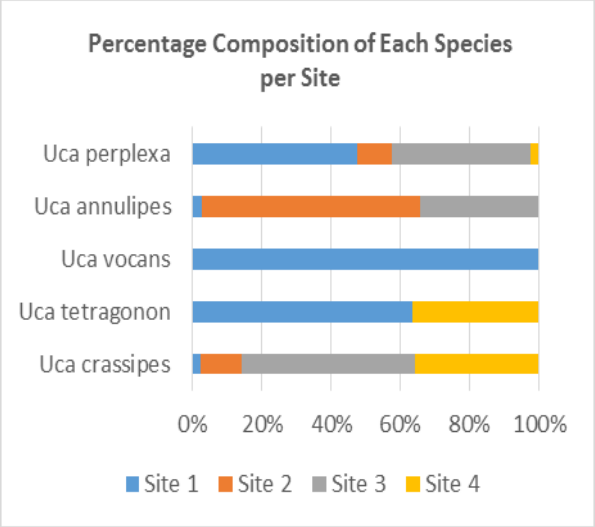

Figure 5. Percentage Composition of Each Species per Site

A study suggests that ecological factors such as ocean currents can affect species distribution of *Uca* (Shih, 2012). However, according to MacIntosh (1989), salinity and the types of substrate are the most essential ecological factors that can affect the spatial distribution of many species of fiddler crabs. The result for *Uca perplexa* in this study were synonymous to the result of Boregon and Evagelio (2015). Whereby *Uca perplexa* prefer a substrate with high volume of sand. Spatial distribution across sight may be caused by the feeding behavior of fiddler crabs which some species prefer smaller grains of sand while others prefer larger grains (Boregon and Evangelio, 2015, and Crane, 1975). This spatial distribution behavior of substrate preference were also observed in other decapod crustaceans such as in *Alpheus glaber, Calocaris macandreae, Processa canaliculata* and *Solenocera membranacea (Rufino et al., 2006).*

4. CONCLUSION

Five fiddler crab species were identified in Olango Island Wildlife Sanctuary, Cebu. They are namely, *Uca annulipes, Uca crassipes, Uca perplexa, Uca tetragonon,* and *Uca vocans*. The investigation revealed that the distribution of the five species appeared to be influenced by the substrate type. Furthermore, ambiguous individuals that were not identified by morphological characters and morphometric measurements should be subjected to molecular analysis. In addition, substrate analysis should be conducted to further understand the relationship of the substrate composition and spatial distribution of fiddler crabs. Moreover, addition of other ecological factors such as temperature, pH, salinity, and vegetation should also be considered.

5. ACKNOWLEDGEMENT

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