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Variation in Aggressive Behavior in Sally Lightfoot Crabs (*Grapsus grapsus*) Relative to Age Class

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Variation in Aggressive Behavior in Sally Lightfoot Crabs (*Grapsus grapsus*) Relative to Age Class

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Introduction

Sally lightfoot crabs (*Grapsus grapsus*) are key organisms in the oceanic intertidal ecosystem of the Galápagos Islands, Ecuador. Their feeding behavior contributes to nutrient cycling and crabs acts as a food resource for other animals. Understanding how this species fits into this complex ecosystem is essential for ecosystem management.

Based on several days of behavioral observation, we studied crab aggressive behavior relative to age class and two different aspects; age class and distance to water, and degree of aggressiveness and outside influences (human activity and sea lion activity in vicinity of study region). We expected to observe a correlation between age and aggressiveness, age and distance to water and degree of outside influences and aggressiveness.



Figure 1. The location of the Galápagos Islands compared to the continent of South America

Methods

The study site was located along the rocky shoreline near Puerto Baquerizo Moreno, Isla San Cristóbal, Galápagos Islands, Ecuador (Figure 1). We utilized three locations and observed crab behavior on 28-24 July, 2018. Crab ages were determined by size and general color (adult, intermediate, and Juvenile; see Figure 5). Aggression was categorized as chasing or jabbing, regardless of age class. Distance to water was categorized by zones: dry (furthest from wave action), moist (mid-distance from wave action) and wet (at the site of wave action). All observations were carried out during one hour before and after low tide. Data was recorded in five minute intervals during the observation time periods. Chi-square goodness of fit analyses were used to determine significance.



Figure 5. Crab age classes based on phenotype; (l to r) adult, intermediate, and juvenile.

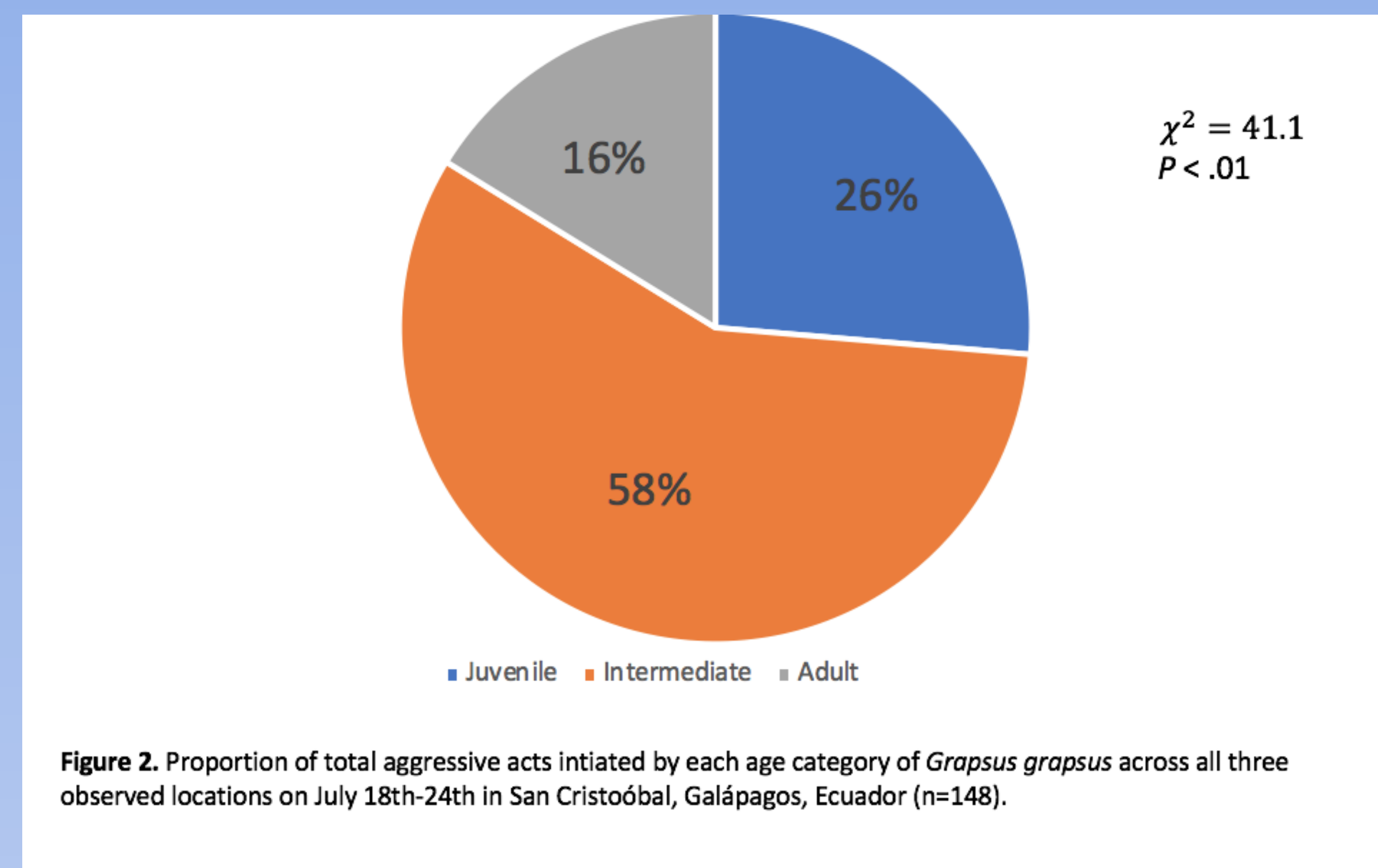


Figure 2. Proportion of total aggressive acts initiated by each age category of *Grapsus grapsus* across all three observed locations on July 18th-24th in San Cristóbal, Galápagos, Ecuador (n=148).

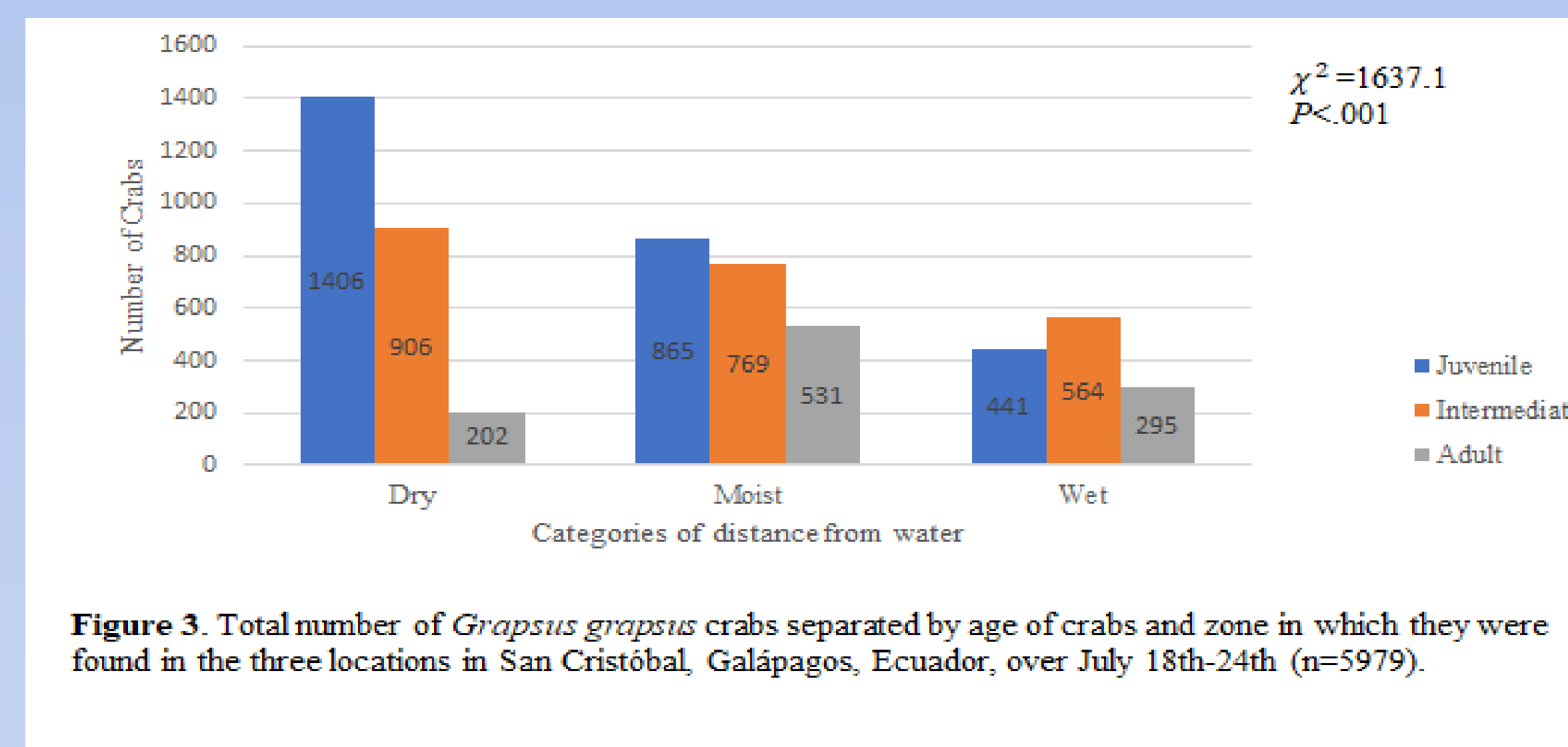


Figure 3. Total number of *Grapsus grapsus* crabs separated by age of crabs and zone in which they were found in the three locations in San Cristóbal, Galápagos, Ecuador, over July 18th-24th (n=5979).

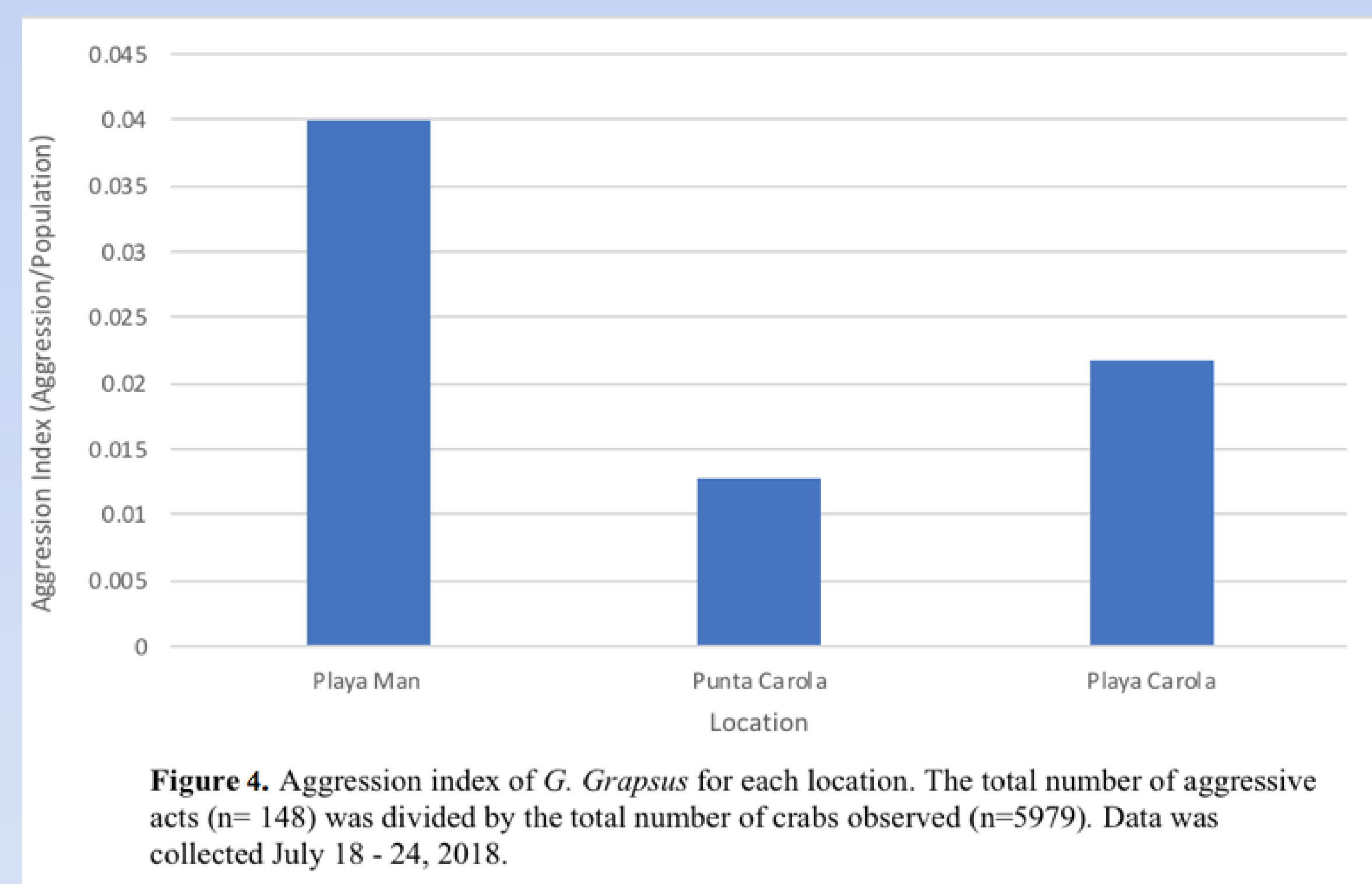


Figure 4. Aggression index of *G. Grapsus* for each location. The total number of aggressive acts (n= 148) was divided by the total number of crabs observed (n=5979). Data was collected July 18 - 24, 2018.

Results

Age vs Aggression

A total of 148 acts of aggression were observed between the three locations. As seen in Figure 2, intermediate aged crabs displayed 58% of the acts of aggression, being significantly higher than the other age groups ($P < 0.01$, $\chi^2 = 41.1$)

Age vs Distance from Water

In the dry zone, juvenile aged crabs were observed significantly more often than both other age groups. In the moist and wet zones, the age groups were more equally distributed (Figure 3).

Aggression vs Activity Level of Outside Factors

A total of 91, 34, and 23 acts of aggression were observed among the 2281, 2646, and 1052 crabs at Playa Man, Punta Carola, and Playa Carola, respectively. The aggression index shows the largest proportion of aggressive acts among the crabs at Playa Man. Playa Man was observed to have the highest level of activity by outside factors (Figure 4).

Discussion

Our results suggests that intermediate crabs were more aggressive than other age categories, displaying 58% of the total acts of aggression (Figure 2). This could be attributed to their competition for food resources with other age groups.

We predicted that we would observe a higher frequency of adult crabs in the wet zone – our data did not support this prediction (Figure 3). A possible explanation for this is that adults may only be active in wet zones when feeding, then return to zones further from water and more protected from the elements.

It was predicted that crabs on beaches with higher activity levels would display fewer acts of aggression since activity would cause them to scatter, thus engaging in less acts of aggression. Results show the most acts of aggression at Playa Man, the beach with the highest activity level by outside factors (Figure 4). This data does not support our hypothesis. These crabs are in an environment frequently disturbed by outside factors, such as humans and sea lions, so they may appear more hostile to other crabs, and therefore engage in more acts of aggression.

In the crabs, hormonal changes may attribute to the intermediate crabs being significantly more aggressive than juveniles or adults (Figure 2). More research on this topic would be valuable to explain behaviors among a variety of species. Further research on mating season, gender, and food availability and quality could be done to provide better explanation for these results.

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