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A Behavioral Study of Chacoan Peccaries (Catagonis wagneri) in a Zoo Environment

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A Behavioral Study of Chacoan Peccaries (*Catagonis wagneri*) in a Zoo Environment

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ABSTRACT: Found in the highly specialized area of the Gran Chaco, the Chacoan peccary (*Catagonis wagneri*) is an endangered animal threatened by industrial agriculture. In an attempt to save this species, three *C. wagneri* were brought to Central Florida Zoo where their health is monitored with great care in an attempt to possibly breed them in the future. While taking care of the other hooved animals, zookeepers are not able to give the peccaries their uninterrupted attention and have turned to help from the University of Central Florida to closely track if their behavior is indicative of a healthy, properly enriched captive peccary. By observing the activity patterns, type of encounters, and signs of stressful behavior in this aggregate of peccaries, it was hoped to be determined how well these peccaries have adapted to captivity with a newly introduced member, and how often they exhibit stressful behavior. Following the installation of the dividing fence, there was a decrease in aggressive behavior between the new and established peccaries, and an increase in the number of positive encounters such as mutual scenting and body rubbing. The eventual decline of aggressive behavior can be attributed to the increased exposure the fence created which allowed for agonistic behavior, such as charging and teeth chattering, to be executed in a safe manner. Socialization was progressively improved between the three as a new hierarchy was developed, eventually leading to group scenting and days where all members of the aggregate rested near each other.

KEYWORDS: chacoan peccary; *catagonis wagneri*; mixed aggregate; hierarchy; endangered

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Introduction

Life history

Once thought to be extinct by western scientists, the Chacoan peccary, *Catagonus wagneri*, was rediscovered in the 1970's. A member of the order Artiodactyla, or even-toed ungulates, peccaries are a "New World pig" that have four surviving species. These include the collared (*Pecari tajacu*), white-lipped (*Tayassu pecari*), the giant (*Pecari maximus*), and the Chacoan (Roosmalen et al, 2007). *C. wagneri* is characterized by a mixed coloration of various shades of gray-brown, black, and white. It has bristly fur, with a dark mid-dorsal line running down the back and light-colored band across the shoulders, similar to the *P. tajacu*. While *P. tajacu* and *C. wagneri* may share their looks, *C. wagneri* is larger and heavier than the other species. When comparing between sexes, there are no significant morphological differences, and so behavior is used to distinguish between male and female. Similar to *P. tajacu*, *C. wagneri* can be found in large herd groups with a rough social hierarchy (Sowls 1997). However, in areas where hunting and deforestation are high, they can be known locally as solitario in places such as Bolivia where they are often loan travelers.

Environment

Chacoan peccaries are endemic to the Gran Chaco, a region of hot, arid forest in Paraguay, Argentina, and Bolivia. Typical characteristics of this environment include a dense shrub layer, bromeliads with stiff, spiny leaves, and cacti (Gasparri and Grau 2009). The peccary diet includes cacti, bromeliad roots, fruits, or seed, though *C. wagneri* are the least likely to forage for roots and tubers (Taber et al., 1991). Beyond their daily feeding, in order to get more nutrients, peccaries have been known to lick mineral rich soil from ant mounds to ingest more minerals such as calcium and magnesium (Sowls, 1997). Their natural habitat is in the areas of low rainfall, high temperature, and the driest conditions in the Gran Chaco. Despite the constant high temperatures, peccaries are considered diurnal animals that stay active from dawn until dusk most of the year. In the summer months, when the core area temperature is at a maximum, they have been known to take midday breaks. During the high heat of the day, *C. wagneri* will undergo a short period of inactivity, and this can mean delaying foraging until later in the day in order to save energy (Taber et al., 1993).

Social Dynamics

Although other species of peccaries can maintain group sizes between five to twenty, *C. wagneri* stay in groups around one to ten, consisting of both sexes and all ages. In the wild, constant hunting has pushed group sizes even lower to one to four (Altrichter & Boaglio, 2004). These larger group sizes were beneficial for predator avoidance as well as increased foraging success. To communicate with each other, peccaries will make various sounds like grunting or chattering their teeth. *C. wagneri* vocalizations are considered to be less precise compared to *T. peccari*, and teeth chattering is less commonly associated with *C. wagneri* compared to others. When it comes to aggression, there is also a split in opinion if *C. wagneri* maintains a dominance hierarchy like other peccaries, since few researchers have been able to observe a sufficient number of marked animals for a long enough time. In a study on *P. tajacu* in intensive breeding programs, small groups showed stable dominance behavior and formed hierarchies, but the dominant leads were female (Suleima et al., 2016). In a zoo in Zurich, hand reared *C. wagneri* were seldom afraid of people, and it was determined that larger animals were above smaller ones, and females were above males (Sowls, 1997).

Territoriality

Since peccaries are from dense forests, they have difficulty using their vision to keep in touch with herd members. Their small eyes and poor eyesight are offset by their well-developed olfactory and auditory senses (Sowls, 1997). When it comes to marking their territory, recognizing individuals, or spraying in defense, peccaries have a series of scent glands on their backs. These glands can also be used for mutual rubbing, a behavior where peccaries rub their cheeks on the glands of another. The territory of a peccary, specifically the core area, is often associated with cacti patches. Peccaries can run for long lengths of time, which can be for territorial reasons or predator avoidance (Taber et al., 1993).

Identification

Central Florida Zoo (CFZ) is home to an aggregate

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of three *C. wagneri*: Agave, Tammy, and Harvey. At the time of this study, Agave and Tammy were sixteen years old, and the newest addition was three-year-old Harvey. Both females, Agave and Tammy, formed their own herd after the eldest female peccary passed away four years ago, leaving them alone in the enclosure together. Initially, it was difficult to differentiate between the two females because morphologically they are very similar. As can be seen in Table 1, while there was a slight difference in how dark they were compared to each other, clips in their ears and scars on their faces were used as key identification. The clips on their ears were hard to see at a long distance, so facial scars and behavior were utilized more heavily. Agave was injured on May 11th, 2019, which resulted in a small scar below her right eye near her nose, in addition to a hole on the upper part of her left ear. Tammy had a scar on the bridge of her nose, as well as a hole in the lower part of her left ear (see Table 1). Altogether, behavioral differences were the main way to differentiate between both female peccaries. Harvey was always kept separate from Agave and Tammy, so he did not need a physical marker to set him apart.

Objective

As the *C. wagneri's* habitat continues to be diminished, the opportunity to document its behavior becomes rarer, forcing some zoologists to compare what little they know about *C. wagneri* to *T. peccari* or *P. tajacu*. Animal behavior is an important factor to consider when housing endangered animals, especially when a new member is added to an already established dynamic. While breeding is the ideal end goal, peccaries cannot be forced into a herd as interfamilial aggression can occur.

While the peccaries will not have the adequate amount of space to travel for such a mobile species, their behavioral health will be monitored by observing their level of activity and the positive interactions between peccaries. Monitored positive interactions include mutual scenting, wallowing, and resting together. Peccaries are skittish animals, so remaining active, e.g., patrolling the fence of their enclosure and interacting with their daily enrichment, will indicate that they are comfortable with their environment. Creating the right environment is vital for a stress-free transition to keeping all three peccaries in the same enclosure. The purpose of this study was to observe the behavior of three *C. wagneri* and determine if they were behaving as they would in their natural environment. With the introduction of a male member in their enclosure, the changes in the dynamic between the two female peccaries was evaluated with the hopes of breeding them in the future. If the peccaries are provided enough enrichment to keep them stimulated and able to go on throughout the day with their natural behaviors, then there will be a better chance for them to become comfortable and engage in positive group behavior, leading to the formation of a herd. The purpose of this study was to follow the interactions in a mixed aggregate of *C. wagneri*. With the introduction of the new male to this aggregate of peccaries, agonistic behavior needed to be followed in order to prevent unnecessary stress or harm while becoming acclimated. While the peccaries are unlikely to breed after missing their breeding period, eventually there is the hope to breed the peccaries, and maintaining a stress-free environment is key to the continuing success of this endangered species.

Name	Identifying Characteristics
Harvey	Part in fur on forehead, always separated from Agave and Tammy.
Agave	Hole in upper left ear, scar near right eye, most likely to instigate an encounter with Harvey.
Tammy	Hole in lower left ear, scar on nose.

Table 1: Identification charts for the aggregate of peccaries; differentiating between a species with no sexual dimorphism.

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Materials and Methods

From May to July 2019, *C. wagneri* were observed eight hours a week at the Central Florida Zoo in Sanford, Florida. The activities were sorted into foraging, standing, sitting, walking, and other encounters. A positive, negative, or null value was given to each encounter. If there were no encounters, a zero was assigned for that day. Negative behavior, such as teeth chattering or charging the gate, was assigned a value of -1. Positive behavior, such as mutual snout rubbing, and scenting, was assigned a value of +1. Multiple positive or negative encounters in a row would be totaled. The behavior was not totaled for days that alternated between positive and negative behavior in order to get a clearer picture of the alternating behaviors throughout the day.

Visual observations were typically made in four-hour blocks, with most observation time taking place from ten in the morning to two in the afternoon. The peccary behavior was recorded in a notebook that was then compiled into a Microsoft Excel sheet. Observations were organized into these six categories: time, place, name, activity type, length, and additional notes.

For Agave and Tammy, the peccary enclosure has been their home for the last five years. Harvey arrived at the zoo in spring, a couple of months before this observational period started. Due to the aggressive behavior displayed by all three, Harvey was kept apart from Agave and Tammy. Figure 1 shows the outdoor yard of the enclosure that is separated into two different areas, a smaller area that leads to the back and the larger section that takes up a majority of the viewing area from the front.
The smaller area contains the mud pit, a shade cover, two large plants, and logs. The larger area contains the hut, an enclosed area for when it rains, a large tree, a variety of plants, logs, and a water mister to help the peccaries regulate their temperature. To the left of the enclosure there is the warthog exhibit, and to the right there is an empty plot before the cougar exhibit.

The daily diet of this aggregate of peccaries typically consisted of lettuce, sweet potatoes, grains, seeds, and the occasional apples. In addition to the water gained from the lettuce, a rubber water bucket was filled each morning and kept along the back wall. They were fed three times a day, once in the morning, again in the afternoon, and lastly in the evening before the zoo closed. The midday snack was used to provide necessary care to the peccaries such as weighing them, giving them medicine, and helping them become more comfortable with their handlers. With the exception of the enclosed area under the hut, the entire exhibit was open to the elements. Temperatures ranged between 28oC and 36oC, with a small rain shower typically occurring in the late afternoon.

Figure 1: Peccary enclosure taken from the front right corner, viewing the hut, the back tree, and the shade cover from left to right.

Results

Observations

Since peccaries are not sexually dimorphic and thus have no physical defining characteristics between the sexes, their behavior was the easiest way to differentiate between them from a distance. Foraging included time spent eating at designated feeding stations, time spent looking for food that was randomly distributed in the enclosure, and time spent rooting around plants. The "other" category includes behaviors that didn't neatly fit in the previous five, and include activities like wallowing, defecating, running, or drinking.

Figure 3 analyzes how much time of the peccary's day was spent on the six different activity categories. Harvey spent 61.48% of his time foraging, while Agave and Tammy spent only 13.69% and 14.39% respectively.

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Figure 2: Diagram of the peccary enclosure viewed from the top down

While patrolling, the peccaries would stand for short periods of time (<3 minutes). This amounted to 18.15% of Harvey's time, 23.63% of Agave's time, and 15.23% of Tammy's time. A majority of Agave and Tammy's day were spent sitting and resting. Agave spent 42.13% of her time sitting, and Tammy spent 62.57% of her time sitting. Harvey sat for far less of his day, only spending 13.67% of his time sitting. Harvey spent 12.86% of his day walking, similar to Agave's 14.78%. While Tammy would be sitting, Agave would walk along the perimeter or stand, looking at the middle fence, or standing directly next to Harvey as he foraged. Tammy only spent 4.60% walking around. Regarding the "other" category, Harvey spent 1.90% of his day doing the other activities, Agave spent 1.18% of her day, and Tammy spent 1.44%. Harvey and Agave spent similar proportions of their day in encounters, with Harvey spending 5.61% of his day in encounters, and Agave spending 4.58% of her time in encounters. Tammy, who is known to be skittish, only spent 1.77% of her days in encounters with the other peccaries. Despite the fact that she caused the most aggressive encounters between all three of them, especially as Harvey and Agave would scent each other, Tammy's encounters added up to 1.83% of her time.

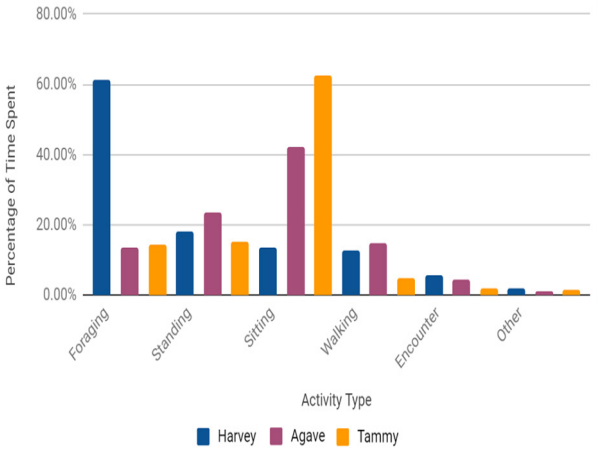

Figure 3: Percentage of time Harvey, Agave, and Tammy spent doing various activities.

Encounters

Agonistic behavior happened daily both before and after the middle fence was installed on May 30th, 2019. Each gate along the back wall has a mesh wire that allows for interactions, but each time there was an encounter at these gates, all members of the aggregate would bristle and vocalize. Since not all encounters were aggressive, agonistic behavior can better describe the daily interactions in which all three peccaries were involved. The types of behavior counted under agonistic encounters are teeth chattering, grunting vocalizations, charging, and bristling. In Figure 3, the total interactions were broken down into who was involved in each encounter.

As can be seen in Figure 4, Harvey and Agave had the greatest number of encounters at 84, while Harvey and Tammy only had 10. Agave and Tammy had 21 encounters, and all together, all three peccaries got into an encounter together 28 times. These add up to a total of 144 encounters over the observation period.

Harvey and Agave had 84 total encounters, the most over the observation period (see Figure 5). Of those 84 times, three days had no instances, and there were 19 negative and 65 positive encounters. After the gate was built May 30th, 2019, there was an influx of encounters that decreased as the study went on. Once the gate was built, Tammy had space to distance herself, allowing Harvey and Agave to acclimate themselves, resulting in the activity spike June 6th, 7th, and 10th 2019.

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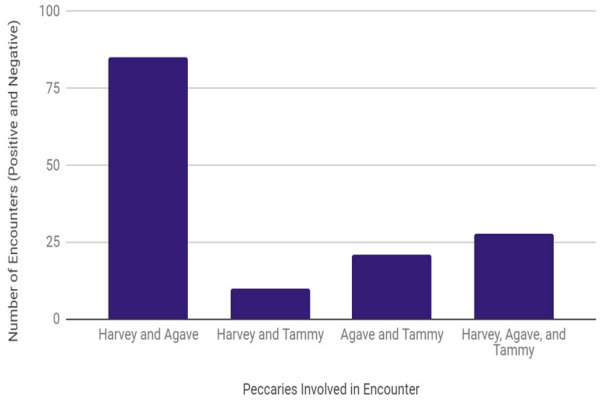

Figure 4: The number of encounters among the aggregate broken down into the individuals involved.

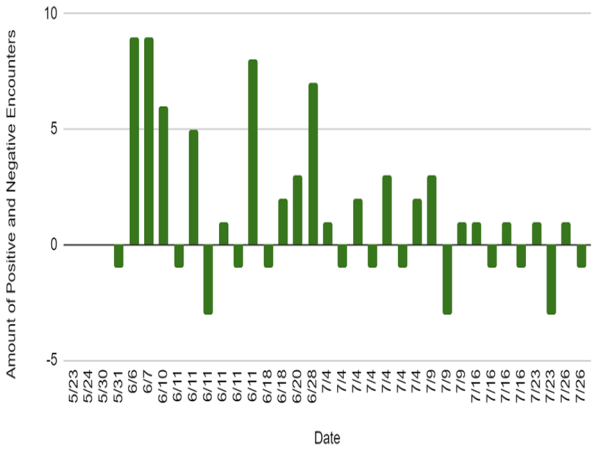

Figure 5: The amount of positive and negative encounters between Harvey and Agave.

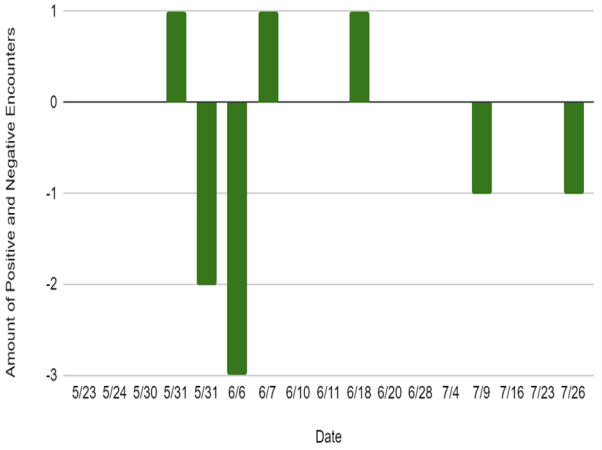

Figure 6: The amount of positive and negative encounters between Harvey and Tammy.

When the encounter involved Harvey and Tammy, there were only 10 distinct encounters. Of the ten, seven were negative and three were positive. Even the positive encounters would end with Harvey retreating from Tammy, so negative trend (see Figure 6) shows an accurate depiction of their relationship.

Agave and Tammy had mainly positive interactions (see Figure 7) where they would scent each other throughout the day, especially after a stressful encounter with Harvey. The negative encounter between Agave and Tammy always involved food and happened when Tammy would get too close to Agave while foraging, such as on June 28th and July 4th, 2019. Only once did Tammy snap at Agave, which happened when Agave startled Tammy sitting under the back tree on July 23rd, 2019.

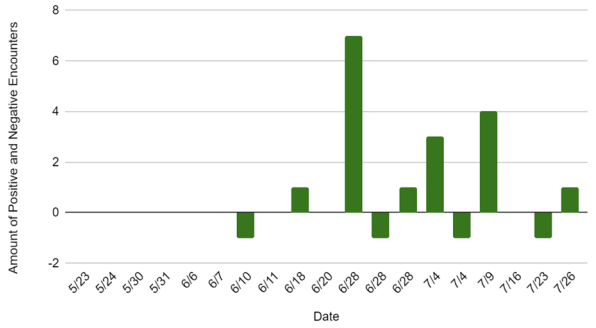

Figure 7: The amount of positive and negative encounters between Agave and Tammy.

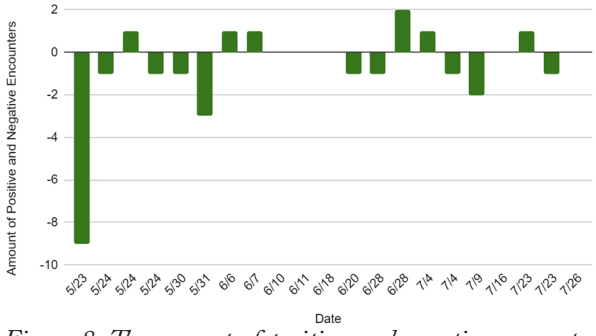

Figure 8: The amount of positive and negative encounters between Harvey, Agave, and Tammy.

Between the three peccaries, out of the 28 encounters as a group, 7 were positive, and 21 were negative (see Figure 8). A majority of these negative encounters happened before the gate was installed. Once the gate was installed, Tammy could choose to go in the back area to avoid a confrontation. There were no encounters as a group for a stretch of three days on June 10th, 11th, and 18th, 2019. Towards the end of

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the study, on July 16th and 26th, 2019, there were no group encounters. One notable date is June 28th, 2019, where for the first time ever, all three peccaries sat in close proximity to each other.

Conclusion

Social behavior

When in the larger part of the enclosure, Harvey would often spend his time walking the middle fence, possibly in an attempt to have an encounter with Agave. As Harvey would come into contact with Agave, the reactions were mixed, with some bristling and teeth chattering. Harvey would approach the middle fence regularly, standing across from Agave. Once Agave approached Harvey and smelled his face briefly, she would rub her snout on him until he grunted and walked away. While their interactions were not always all positive, the fact that they were happening in the first place indicates room for improvement in future social interactions. Within the short time frame in which this study took place, Harvey had already shown improvement in his comfort in being sniffed by both females (see Figures 5 and 6).

When Agave would sit for long periods of time it was always with Tammy, indicating that this was used to build social bonding. Sitting together is a herd behavior that provides protection and security, and is uncommon for other forest dwelling even-toed ungulates (Walther, 1971). Social behavior between Agave and Tammy was shown via scenting, body rubbing, snout rubbing, and sitting together. Since peccaries are highly olfactory animals, scenting is used as a social experience to build companionship and bond. The most common times where Agave and Tammy would scent each other were after an encounter, while walking past the middle fence, and after wallowing. When Tammy was not sitting, she was either standing before sitting down or foraging. Tammy and Agave had similar activity levels, which reflects how their days were spent before the introduction of Harvey and the fence.

Foraging

The foraging category includes the time spent in designated feeding areas, foraging across the enclosure, and rooting near plants. Under the hut the peccaries were observed licking dirt, possibly in an attempt to ingest minerals (Sowls, 1997) or eat ants with the hay in the dirt. After the midday heat, Harvey would spend the rest of the day rooting through the dirt by the plants, or under the hut. When plants were placed in the enclosure, he would stop and eat the leaves before moving on to forage by the plants. Harvey was the peccary that spent most of his daily time foraging, and he was the only peccary to root for food daily. This may be because he is still a growing juvenile peccary, while the females are both fully grown adults.

On the other hand, Agave and Tammy would walk past food on particularly hot days, waiting until later in the day to continue foraging. For the females, foraging was not their main priority, and they almost never rooted around the plants, except before sitting down or wallowing. When it came to aggressive food interactions, Agave was the one to bristle and vocalize at Tammy if she was too close to her or the food Agave intended on eating. Harvey would not show signs of agonistic behavior specifically when another peccary was near, but he would grunt while eating. This may have been because his feeding station was in the front right corner with a significant amount of daily foot traffic.

Enrichment

Enrichment is an important step to provide the peccaries with a healthy, stimulating lifestyle. At the Central Florida Zoo, enrichment for the peccaries was not a rigidly defined process. While logs and plant fronds were placed throughout the area, other forms of enrichment came from toys or clothes with new smells that were rubbed around the enclosure. Harvey was the only peccary to engage with plant fronds and brown paper bags, and even then, his engagement was primarily with enrichment that was food related. The logs could be rearranged to create a new environment for the peccaries, but the introduction of the fence provided them with new smells, creating the daily enrichment needed until the peccaries became acclimated. While Agave and Tammy would not spend much time foraging around the newly moved logs, they would still investigate the new position when first let into the front of the exhibit. This is important in order to keep the peccaries mentally engaged in addition to being physically active.

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Other

Some other behavior not included in the total breakdown of peccary activity levels included wallowing, running, defecating, scenting, and drinking. These activities often took less than a minute and did not fit in with the other five categories they participated in daily. Wallowing was the most common "other" behavior. Agave and Tammy always chose the wallowing pond, while Harvey chose the dust in front of the middle gate. At times, the two females would take turns rooting and digging through the pond before wallowing in it. After taking turns wallowing, Agave would sprint around for less than a minute before both females would then go to the left fence and scent it. Another way the peccaries scented around their home range, was by walking up to the middle fence and scent it at the start of the day. These instances happened without the presence of the opposing peccary, so scenting was a territorial way to mark objects within the home range.

The use of scat to define boundaries was a common occurrence that only increased as all three peccaries were allowed into the enclosure at the same time. Initially, the front left corner bordering the warthog exhibit was the only area all three peccaries would use. This established their territory next to the warthogs, as well as allowed them to share their scents and mingle. However, after the fence was built, Harvey, Agave, and Tammy defecated near areas of high use. Agave and Tammy both defecated near the shade cover's plant, even when they chose to sit near that plant for the rest of the day. In another instance, Harvey chose to make the right gate his new scat corner, despite his constant travel to the back area. Both days that they chose to defecate away from the front right corner scat station were also days that there was an agonistic encounter, and the defecating peccary was not allowed to travel to the typical front left scat corner. This suggests that scat stations were used as a boundary marker to minimize future negative encounters.

Agonistic Behavior

Despite previous research suggesting charging and teeth chattering are uncommon in *C. wagneri*, both agonistic behaviors were seen in encounters between all three peccaries. Charging was a behavior seen the least, and teeth chattering was mainly used as a warning signal in place of charging the fence. This disconnect in previous research may be due to the fact that studies are conducted in the wild where *C. wagneri* are few and far between. On the contrary, at the zoo, the peccaries were forced to exist in overlapping territories. Combined with the different levels of comfort with being handled by the zookeepers, this further complicated daily encounters and the developing herd dynamic. With time, agonistic fighting is expected to decrease as the peccaries become accustomed to each other's scents.

On the rare occasion, if Agave followed Harvey too closely as he walked, he would respond with a brief whirl in place while vocalizing. Harvey and Agave had more positive social behaviors than negative ones, and instances like these only occurred on July 16th and 26th, 2019 (see Figure 5). Other out of character aggression was displayed by Tammy with Agave, where Tammy barked at Agave for surprising her while sleeping at the end of the day, on July 23rd, 2019 (see Figure 7). These instances were atypical, and did not represent the group dynamic.

Tammy is considered a skittish peccary (CFZ Zookeepers) and is less likely to get into an encounter with Harvey, but when they did confront one another, it was aggressive. While food was the main trigger for Agave and Harvey, Tammy would charge, bite, and vocalize when she felt her territory was invaded. For the first two weeks after the middle fence was built, whenever Harvey attempted to make contact with Agave, Tammy would disrupt the encounter. After the encounter between Harvey and Agave would end, Tammy would pace the spot where the encounter occurred, possibly in an attempt to establish dominance. Overtime, Tammy became more likely to avoid an encounter with Harvey, and their negative interactions decreased. There were few select times, such as on June 23rd and August 23rd, 2019 (see Figure 6), that all three of them were resting in close proximity, but their positive interactions were limited to allowing the other to sniff.

Despite Harvey's attempts to initiate positive social interactions between the three peccaries, Agave and Tammy have been the only peccaries to lay together close enough to touch. Harvey would often attempt to lay next to Agave as she lay with Tammy, but Tammy would become agitated and disrupt those attempts. After chattering her teeth and attempting to chase Harvey away from the middle gate, Tammy

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would retreat to the back area, panting. Although the aggregate of *C. wagneri* saw an initial increase in agonistic behavior, there was eventually a decline as all three slowly became accustomed to each other. Before the fence was erected, Harvey would lay by the gate that divided the holding area to the viewing area in the front, but Agave and Tammy would chatter and charge the gate. By the end of this study, all three *C. wagneri* would lay within one body length of each other, with only the fence to divide Harvey from Agave and Tammy.

Implications

The Chacoan peccaries at CFZ do not show the high amount of walking that is indicated by earlier research (Taber et al, 1993), but they do maintain some form of hierarchy within the aggregate. While this hierarchy isn't proof of a healthy living environment, it can be used to measure how close they are to accomplishing a balanced herd dynamic with limited interfamilial aggression. At the cost of halving the peccaries' habitat, the middle fence was built in order to acclimate the peccaries, allowing for positive encounters to occur with the hope of removing the gate in the future. This resulted in pacing and agonistic fighting that may have been caused by the introduction of a new member and a loss of free space occurring simultaneously. Once the peccaries are no longer an injury risk to each other, the fence removal will allow them to closer mimic their wild behavior, in addition to potentially continuing this species' survival.

Dominance behavior did not occur regularly, but it still occurred between all three peccaries. Since Harvey was starting as a new member of the aggregate, he was at the receiving end of almost all agonistic threats. The apparent dynamic at CFZ supports the idea that *C. wagneri* have similar herd dynamics to *P. tajacu*, which is important when trying to monitor what the CFZ's herd dynamic may look like in the future. The peccaries at the zoo have food and no predators, so the main benefit in building a herd is the social bonding. Before the middle fence was built, Agave and Tammy performed the same activities together. Once the gate allowed all of them to be out at once, Tammy became more skittish, and Agave spent time apart from Tammy to interact with and sometimes scent Harvey. Perhaps their days would more accurately reflect the large amounts of walking and foraging done by wild peccaries if the constant encounters didn't disrupt how their daily life functioned. This does not guarantee that they are close to becoming a cohesive herd, but it indicates a promising increase in positive social behaviors.

To further benefit this species, future research will identify methods to reduce agonistic encounters between peccaries. By combining the acclimation process with daily enrichment, peccaries could become more comfortable around each other. Additionally, once negative interactions have decreased to the point that the peccaries are not a physical danger to one another, the removal of the fence may aid the peccaries in building a herd dynamic. Once all three peccaries can complete their daily behaviors together, such as patrolling or defecating together, it will further reinforce the positive aspects of a healthy herd dynamic.

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