

**Burrowing Habits, Habitat Selections, and Behaviors of Four Common
Dominican Land Crabs; *Guinotia dentata*, *Gecarcinus lateralis*,
Gecarcinus ruricola, and *Cardisoma guanhumi***

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Burrowing Habits, Habitat Selections, and Behaviors of Four Common Dominican Land Crabs; *Guinotia dentata*, *Gecarcinus lateralis*, *Gecarcinus ruricola*, and *Cardisoma guanhumi*

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Phylum Arthropoda

Order Decapoda

Suborder Reptantia

Section Anomura

Family Gecarcinidae

- *Cardisoma guanhumi* (Latreille) – White or Swamp Crab
- *Gecarcinus lateralis* (Fremenville) – Touloulou
- *Gecarcinus ruricola* (Linnaeus) – Black Crab

Family Psueodothelphusidae

Subfamily Psuedothelphusinae

- *Guinotia dentata* (Latreille) – Cyrique

Abstract

Dominica is home to several significant social, cultural, and ecologically important terrestrial decapods which are poorly understood. These terrestrial crabs rely on burrows which they dig into the ground for protection from predators and the elements. This study focuses upon four species' (*Guinotia dentata*, *Gecarcinus lateralis*, *Gecarcinus ruricola*, and *Cardisoma guanhumi*) unique behaviors and habits that relate to burrowing and habitat selection.

Introduction

Dominica is home to twenty documented species of crabs, several of which are well adapted to terrestrial life (Chace and Hobbs, 1969). Some terrestrial species, especially the two species of *Gecarcinus*, are an important food source for local Dominicans. Two popular local dishes, “Crab-back” and “Calilou Soup” can be made from the meat of the terrestrial crabs. “Calilou Soup” (coconut milk, boiled crab, seasoning, and dasheen leaves boiled with fat pork or bacon stock) is considered by many to be one of the most delectable dishes of Dominican cuisine. Many Dominicans procure these creatures at night after heavy rains that follow a dry spell. Groups of Dominicans may gather with torches and gunny sacks in the evening and night and walk the roadways, coastal areas, and clearings to capture several different species after these rains, when the crabs out of their burrows and wandering the land. Other than their role of being an important food source for the island, terrestrial crabs play an important role as scavengers (Chace & Hobbs). One crab, *Gecarcinus lateralis*, is even used in traditional island medicine to help earaches (James, 2004).

Terrestrial Crabs of Dominica are poorly understood creatures. They spend the majority of their lives in dens and burrows underground. Their main periods of activity are at night, often leaving their burrows only on nights following heavy rains. The narrow windows of time when they can be observed in the wild make terrestrial crabs difficult to observe and understand. As burrow dwelling is such an important and significant part of the life history and survival of land crabs, this study focused on increasing the understanding of the unique burrowing habits, burrow habitat selections, and other burrow-related behaviors of four common culturally, socially, and ecological important species of terrestrial decapods that dwell in Dominica: *Guinotia dentata*, *Gecarcinus lateralis*, *Gecarcinus ruricola*, and *Cardisoma guanhumi*.

Biological Adaptations of Terrestrial Crabs

There are approximately 1000 species of true crabs in section Brachyura. Most live in the sea on or near the bottom (Headstrom, 1979). However, some species have developed adaptations that have enabled them to live out of the water. In these species, the shell covering the gills is considerably inflated and lined with a thick membrane richly supplied with blood vessels. This membrane allows them to use atmospheric oxygen in a way similar to the lungs of mammals. Those that dig deep burrows have modified gills that absorb and retain moisture from damp sand. Terrestrial forms are found in tropical and subtropical regions and still must return to the sea to reproduce and allow larval crabs to develop (Headstrom, 1979).

Materials and Methods

This study required multiple observation sites around the island of Dominica to gather data and photographs of the different habitats and burrows of each of the species in their natural environment. To observe burrowing activities of each species a terrarium microhabitat was constructed at the Archbold Research Station. Ideally, the terrariums should be placed indoors in dark cool room with low volume of human traffic. This will increase the chances of observing crab activity as they are rather cautious in the presence of light and seem to be able to sense vibrations, especially those associated with human footsteps. Due to limited space in the laboratory, terrariums were placed on the north side of dining hall under the shade of the veranda.

Soil was collected at the research station and dumped into the terrarium, with deepest soil on one side, with depths tapering off to low flat area at the other side. Soil was compacted with the use of a brick to prevent burrows from collapsing. Several stones were either semi-buried or placed on top of the soil, as most crab burrows were observed underneath the protection of

large rocks in a natural setting. It was beneficial to place flat rocks in the corners of the terrarium to keep the crabs from burrowing there, where glass prevented proper tunneling and resulted in the excavations of large open holes rather than burrows. A small container of water should be included to allow crabs access to water. Most of the crabs are both strong and agile and can escape the terrarium if the top is in a reachable distance. They have the capability of a vertical climb at least a distance equivalent to the length of their longest clawed limb fully extended to the furthest outstretched walking leg. The highest level of soil allowable in the terrarium should leave enough space to the top of the terrarium to accommodate this length and an additional 5 to 10 cm to accommodate for soil accumulation near the terrarium walls from burrowing activity. Since these crabs are mainly nocturnal and photosensitive, even a typical flashlight can spook them. A dim light, preferably green, red, or black should be set up in the observation area to allow proper observation without alarming them. White lights were mainly used because of convenience and were detrimental to observations as crabs were often inactive or spooked by the light.

Care should be used when capturing crabs as legs and pinchers can easily be removed or knocked off with rough handling. Attempts to pull a crab from its burrow by hand should be avoided as they can strongly anchor themselves inside and it is nearly impossible to remove them unharmed and with all appendages still attached. *Guinotia dentata* specimens were obtained at the Archbold Research Station. Large adults were obtained at night in the Check Hall River during dry weather using a flashlight to spot them in the water and a dip-net to capture them. Mid-sized adults were captured by hand along trails and around the buildings of the station following heavy rains. The presence of large yellow claws with straight sharply pointed fingers is a useful characteristic for identifying *Guinotia* when in its burrow. *Gecarcinus ruricola* specimens were captured at Cabrits National Park. They were captured by hand after uncovering them underneath rotting logs and large rocks along the trails up both East and West Cabrit. The dark purple/red coloration of carapace and most of the body is a good indication for identifying these crabs in their burrow. *Gecarcinus lateralis* specimens were obtained at Champagne Beach. Attempts to dig them out their burrows failed due to the steep slope and deep burrows. Specimens were obtained by hand capture after overturning stones along the

trail. *Cardisoma guanhumi* colonies were observed at Batali Beach, Castle Bruce Beach at St. David's Bay, and the Cabrits Swamp. However, no specimens were *Cardisoma* specimens could be captured for observation. This species is difficult to capture during daylight during dry periods as they remain in their burrows and are not easily be removed without the use of spade to dig out a burrow.

Thick gloves are useful in protecting fingers from pinchers during hand capture for those inexperienced with the proper method of grabbing the crab from behind and grasping the rear of the carapace. Baited pitfall traps or small drift fences were not used but could potentially be beneficial in the capturing of crabs (especially *Cardisoma guanhumi*) in areas that cannot be visited during night activity hours.

Captured crabs were measured for carapace length and width and then placed in a terrarium properly suited to the habitat in which they were obtained. A period of at least three nights was given after initial placement into the terrarium to give the crabs ample time to become acclimated to the terrarium and construct their burrows. Small pieces of bread were provided as food for the crabs and placed at burrow mouths in the mornings to allow easy access. After three days, rocks under which burrows were constructed were removed along with the inhabitant and measurements were taken for burrow mouth dimensions, burrow tunnel dimensions, den area dimensions, and den circumference. A thin piece of string was used to assess these measurements as rulers and large tape measures are cumbersome inside the terrarium. Loose sediment and clumps of soil from poorly compacted soil falling back into burrows during measurements made exact measurements difficult to obtain. Burrow measurements were deemed not to be of significant value due to the limited number of specimens, small area of terrariums not allowing enough room for proper burrow construction, and difficulties in obtaining exact measurements of burrows.

Results:

- ***Gunotia dentata* (Cyrique)**

This crab can be found around freshwater sources; rivers, streams, lakes, drainage and seepage areas, across most of the island at almost any elevation. Chace and Hobbs (1969) noted that these crabs are not often present in the lower portions of rivers near the mouths where *Cardisoma* are more plentiful. *Gunotia dentata* was not observed in drier habitats or areas with no freshwater source nearby. Burrow observations were taken at the Archbold Research Station. Colonies and individual burrows were plentiful amongst the leaf litter and rocks on the hillsides surrounding the Check Hall River. Large adults were most often observed in the Check Hall River. Juveniles were found on rock bars in the riverbed. Mid- sized adults were observed on hillsides out of the riverbed more often than in the water or burrowed into the riverbed.

Crab burrows seen scattered across the hillsides did not have mouths near the protection of stones or roots. These burrows often entered the hillsides perpendicularly for a few centimeters and then changed to an angle more parallel to the hillside as the burrow went deeper. Burrows in flat areas were always seen neatly tucked between roots of trees or the base of large rocks or boulders. These burrows were oval in shape, with little dirt accumulation around the mouth of the burrow. Burrow mouths were often larger than its carapace width, allowing them to sit facing outward at nights. Tunnels were usually narrower, giving the crab just enough room to move back in forth when turned sideways.

Burrowing activity of captured *Gunotia dentata* in the terrariums was mostly homogenous across size ranges. Initial activity began with the crab apparently testing soil by pressing large claws into the ground in several areas before choosing a site to begin burrowing. After choosing a site, specimens would first remove large clumps of soil and small rocks one piece at a time with their claws. After all the clumps had been removed, it began using its walking legs to scrape dirt under its body away from the direction of the burrow. After scraping a small amount of dirt underneath its body, it would either use the walking legs of the opposite side of

its body to push loose soil out of the burrow, or turn sideways and use its pinchers like a bulldozer would to push the soil out of the burrow.

- ***Gecarcinus ruricola*** (Black Land Crab)

This crab was observed far away from water sources, and at high elevations. The area of highest abundance was noted was at Cabrits in the Caribbean Dry Forest. Crabs burrows here were found on steep rocky slopes. Kristy Venable (2004) observed *Gecarcinus ruricola* at Batali Beach at dark and also along the roadsides on the return trip from Batali Beach to Springfield Station. A large colony was also observed at Champagne Beach on the steep slopes of the mountainside.

Most *G. ruricola* that were observed at Cabrits were found in crevices between rocks, in or under rotten logs, in holes in the trunks of trees near ground level, or in dens under trees in which a large area encompassing nearly the entire width of the trunk's diameter had been excavated. Several times, multiple crabs were seen in one burrow. In one large tree missing bark around half its circumference, with much exposed heartwood, 5 large crabs were observed in one large burrow that was dug partially into the wood and partially into the ground. In one account, both a large and small *ruricola* were both discovered in a single shallow burrow under a rock about 1.5 feet in diameter. Many Black Crabs were discovered by overturning the uppermost stones of rock piles that showed no sign of burrowing. Burrows that were observed at Cabrits National Park and Champagne Beach had a distinctive "porch" area in front of the burrows' mouths of very fine compacted soil. These "porch" areas extended out from the mouth a distance approximate to the width of the burrow.

This species was very difficult to observe in a terrarium. During daylight hours no activity was recorded. Mounds of loose soil were pushed into the burrow mouths, essentially blocking them off for most of daylight hours. Observations at night were for the most part a failure, as even the slightest light caused the crabs to halt burrowing activity and retreat back into burrows.

Feeding activity was observed for *Gecarcinus ruricola* #1. One night, it was observed tapping its walking legs around the mouth of its burrow and in a crack between two rocks making up walls of its burrow. A small cicada was collected off a light on the veranda of Spring House and dropped into the edge of the crack in the rocks near #1's legs. As the bug beat its wings and rolled around, it touched one of the crab's legs. A claw quickly extended from inside the burrow, grasped the cicada, and then the crab retreated back into its burrow. Soon after, audible crunching sounds could be heard coming emanating from the burrow.

- ***Gecarcinus lateralis*** (Touloulou)

Burrows of *Gecarcinus lateralis* are difficult to distinguish from burrows of *G. ruricola*. Observed burrows were oval in shape but were much rougher in outline than *G. ruricola*, and often lacked the distinctive "porch area" present at the mouth of most *ruricola* burrows. Burrows excavated when trying to obtain this species proved to be deep, with crab burrows with mouths under 5 cm often extending up to and beyond two feet in depth. Many *G. lateralis* were also found dwelling in crevices between rocks at Champagne Beach. Although found in many of the same areas, Arlington James (2004) stated that *G. lateralis* is found near the coast more often than at higher elevations. Chace and Hobbs (1969) observed *Gecarcinus lateralis* at Cabrits, into the Antrim Valley, around Scott's Head, and noted numerous young individuals south of the mouth of the Layou River along the northern slope of Tarou Cliffs. Here they were observed in burrows mostly less than 2 feet in depth into the talus slope usually under the shelter of large stones. Kristy Venable (2004) observed *Gecarcinus lateralis* around Rodney's Rock, Batali Beach, and found them most accessible at Champagne Beach. *G. lateralis* specimens captured for observation were discovered at Champagne Beach.

Burrowing activity was recorded for this species. Activity began with the crab removing small rocks and clumps of dirt one piece at a time from the area chosen for burrowing. After the area had been cleared of larger impediment, the *lateralis* would scrape soil loose with its claws until a sizeable amount was accumulated. It would then drag the dirt out of the burrow with

the crook of its claw arm. After dirt was removed from the burrow, the crab would back up, drop the soil, and use its claws alternately to push soil away from the burrow.

Because of the similarity in habitat between the two species of *Gecarcinus*, two *G. lateralis* specimens were placed into the terrarium in which two *G. ruricola* had previously constructed burrows but were now removed to test whether a species would utilize a burrow constructed by another species rather than expend the energy to construct an entirely new burrow. Soon after introduction to the burrow, *lateralis* #2 moved into a pre-existing burrow from a *ruricola* of a similar size. After approximately an hour had elapsed, *lateralis* #2 left the burrow to explore the terrarium. While this was occurring, *lateralis* #1 moved into the burrow and began performing burrow maintenance. When *lateralis* #2 returned to the burrow and tried to enter, #1 performed a sumo-like pushing pattern to eject #2 from the burrow. After ejecting #2, #1 assumed an aggressive posture (claw arms extended and raised) at the mouth of the burrow until #2 left the vicinity. After another hour had passed, #1 exited the burrow and picked up a nearby blade of grass. While only out of the burrow for a matter of minutes, #2 managed to slip back inside. Upon returning and finding the burrow occupied, #1 pushed his way partially into the burrow and forced #2 out. Both crabs assumed aggressive postures. #1 picked up #2 by its claw arms and carried it away from the burrow before dropping it and running back to the burrow. After this, several more attempts were made by #2 to retake the burrow which resulted in further pushing matches before finally giving up and starting a burrow in a new area. The *G. lateralis* crabs choosing confrontation before digging a new burrow validated the thought that the crabs would take over a pre-existing burrow, even one that was made by a different species, rather than expend the energy to make an entirely new burrow.

- ***Cardisoma guanhumi*** (White or Swamp Crab)

Cardisoma guanhumi burrows are the most distinctive and often the largest of all the observed terrestrial crabs. Burrow mouths are often perfectly round, and notably larger in diameter than the width of the occupant's carapace. Burrows appear to enter the ground at a

shallow angle. Arlington James (2004) notes that *Cardisoma* burrows are very deep and extend down to the water table, even during the dry season. Colonies of burrows discovered were randomly scattered out on the ground in tree lines abutting marsh or beaches. There was not any apparent relation of burrow placement to the protection of trees or rocks. Burrow locations were found in sand and mud soils.

Cardisoma guanhumii is noted by Chace and Hobbs (1969) to be possibly the most commonly seen crab on Dominica. The species is present in almost any low-lying coastal area, especially around the Layou River. Kristy Venable (2004) located *Cardisoma* at Batali Beach and Cabrits. Explorations in this study discovered large colonies at Batali Beach, St. David's Bay, and all around the trail leading from the road near the Cabrits National Park entrance to the Cabrits Swamp. Beach colonies were discovered in the tree line off the beach and usually near a river outlet into the sea. Swamp colonies were found in close proximity to the brackish water.

No specimens of *Cardisoma guanhumii* were captured for observations on specific burrowing behaviors. Areas populated this species were not visited at night when they are more active. Visits to populated areas during the day were made with no digging utensils to remove a crab from its deep burrows. Many individuals were positively identified in their burrows by looking inside the wide mouths with a flashlight. This species has very distinctive black hair-like spines on the dactyls of their walking legs which can be seen easily made out and are often homogeneously gray or blue in color.

Discussion:

Terrestrial crabs on Dominica are significantly more active during the night hours and usually remain inside their burrows during the day. There are several possibilities that may explain the pattern of nocturnal behavior. Headstrom (1979) provided a good description of the gill morphology and adaptations that enabled these crabs to live out of the water. He also stated that these crabs also may need to remain in their burrows during the day so that they might retain water in the cool damp soil of their burrows. Another possibility is susceptibility of this species to predation. Arlington James (2004) states that many crabs meet their demise at the hand of the Yellow-Crowned Night Heron. An observation at Champagne Beach, in which a large group of freshly dead crab carapaces and limbs were found on the beach surrounded by the footprints of large wading birds, further backed this statement. By keeping activity restricted to the night, these crabs may be limiting their exposure to a larger number of potential diurnal predators that would have any easier time spotting these creatures with the aid of daylight.

Interspecies intolerance was one factor looked into to describe the reasons for these similar species of decapods to pick such varied habitat. One hypothesis is that different species were mostly intolerant of each other and that aggression would occur should habitat encroachment by another species occur. Observations undertaken by this study did not support this hypothesis as a major player in the reason for different habitat selections by the different species of land crabs. While gathering information did not uncover whether or not *Guinotia dentata* laid eggs in fresh or saltwater, Arlington James (2004) noted that both species of *Gecarcinus* must return to the sea to lay their egg masses and stimulate larval development. A trip to the sea and back to burrows would almost definitely ensure trespassing over the territory of multiple species of crabs, especially that of *Cardisoma*, which seems to dominate coastal beaches. If different species were overly territorial, it would be logical to expect aggression during breeding seasons when crabs would pass through each other's territories.

Also, while colonies of different species were not intermixed, colonies of different species were located in several areas that were in close enough proximity (20-30 M) to ensure that these species would encounter each other during nightly wanderings. If intolerance were a key issue, it is improbable that these colonies would occur in such a close proximity and that overlap of habitats would be much less common. Lastly the observation of the two different species of *Gecarcinus* placed together in the terrarium did not indicate open hostility of one species towards the other. Aggression was only observed through burrow defense. Once settled, these species did not harass each other and seemed to prefer avoidance rather than conflict.

Another hypothesis developed to explain the differences in habitat selection was that each species has a biological advantage over other species in different habitat types and towards the food sources found in these different habitat types. *Guinotia dentata* was found in freshwater rivers and observation in captivity indicated that these species consume minnows, prawns, and aquatic algae-like vegetation. This crab's biology may make it a superior competitor in and around freshwater. Both species of *Gecarcinus* were found along the coast on steep rocky slopes and also in the Caribbean Dry Forest, often long distances from any water source. Observations in captivity indicated very low water utilization for these species. Higher drought tolerance may enable them to better exploit areas of the island which are too dry for other species. *Cardisoma guanhumi* burrows were usually located in low-lying coastal areas including beaches and swamps. Observation of a large *Cardisoma* in the Cabrits Swamp and the close proximity of river mouths to beach colonies gave reason to believe that this crab may spend much time in brackish water, a habitat not seen to be used actively by other species in this study.

The different characteristics of the burrows of the different species in this study is most likely related to habitat, terrain, topography, soil profile, and the specific functions each species requires from their burrows. These unique characteristics can be a useful tool in differentiating which species might be in area without positively identifying the inhabitant of a burrow.

- The burrow of *Guinotia dentata* had several unique design characteristics that seem likely to increase the safety of the crab when inside its burrow. Burrows were usually

seen under the protective cover of rocks and trees or on slopes with steep pitches which make reaching the burrows difficult. The angle change of the burrow tunnel noted on several hillsides along the Check Hall River may also increase the difficulty for potential predators to access the crabs. This angle change may also be of some importance during periods of heavy rain and rapid river rise in helping prevent water from flooding the hole or washing it out, possibly through the formation of an air pocket.

- *Gecarcinus ruricola* burrows in the dirt were very neatly maintained indicating constant burrow maintenance. The “porch” area extending from *G. ruricola* burrows is hypothesized to be related to one of two things. Tank observations indicated that *G. ruricola* are almost constantly shifting soil around, in, and out of their burrows. All this soil movement could lead to the accumulation of fine soil at the burrow mouth. Another possibility is that the crabs specifically set up the “porch” to aid in feeding activity. Captured individuals were often seen at their burrow mouths tapping their walking legs to feel about for prey. This fine soil may help the crab detect prey much in the same manner as an ant lion den, with soil displaced by prey sliding into the crab’s legs and letting the crab know that there is prey within reach.
- *Gecarcinus lateralis* burrows seem similar in size and appearance to *Gecarcinus ruricola*. Main discernable differences between the two species was the less maintained appearance of the *lateralis* burrows, without a “porch,” and the location of burrows more often occurring at the base of the slopes of mountains around coastal areas rather than higher up on the slopes. Observations of the species in the tanks indicated that it likely leaves its burrow at night to forage. Positions low on the slopes would allow it to both reach foraging areas with ease and quickly return to the safety of its burrows should a threat become imminent.
- The depths of *Cardisoma guanhumi* burrows could possibly lessen the need for the added shelter of rocks or roots. The large size of the burrows could be related to both the large size of this species and the loose soil in the low-lying areas they inhabit. Sand and mud may require a burrow of larger diameter to prevent collapse of the burrow

from the movements of the crab inside, to lessen soil volume falling into the burrow, or a high amount of maintenance required to keeping the burrow tidy in a habitat of high disturbance from wind and water.

This study addressed many aspects of burrowing behaviors of these four species of Dominican land crabs while opening up a whole field of questions left to be answered. Future studies could address the burrow dimensions of any of these species in relation to carapace dimensions and/or weight for the purpose of statistical analysis. To obtain good data, measurements of the burrows in the wild should be taken before removing the inhabitants for physical measurement or creating a larger impoundment than a terrarium to place captured crabs into. The latter may prove difficult due to the crab's inherent ability to escape captivity with their exceptional climbing abilities. A thorough investigation of feeding preferences of these four species may help shed more light onto the reasons behind each species' specific habitat selection. Determination of sex ratios and size distributions among different colonies of any of the species would also be interesting. A more thorough distribution model of the different species could be constructed through GIS and address distributions of different species across the whole island based on habitat types. Lastly, the gathering observations on the actual act of burrowing for *Gecarcinus ruricola* and *Cardisoma guanhumi* could be gathered to further complete this study.

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