Observation of *Dasyprocta leporina* Effects on Dispersal of Large Seeds

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Abstract:

Red-rumped agoutis are considered a key scatterhoarder partly because of their large size. To determine their affect on Dominican rainforest seed dispersal, several control piles and exclosure piles were set along nine transects in three different region of the island. Four motion detecting camera traps and the thread-marking method were also used to accumulate evidence of *D. leporina* activity. The Northwest region experienced the largest rate of seed removal and is the most affected by agoutis.

Introduction:

The red-rumped agouti (*Dasyprocta leporina*) is one of the largest wild mammals found on the island of Dominica. The agouti is considered a very important scatterhoarder of the Neotropics. At dusk and dawn they travel alone or in small groups foraging for fruit and seed material on the forest floor (Silvius and Fragoso 2003). Agoutis have also been known to consume insect larvae when plant products are hard to come by (Silvius 2002). It was introduced to the island 2,500 years b.p. by the Kalinago people(Wing 2001). Since then, *D. leporina* has been hunted for its nutritional value. However, hunting is now under seasonal regulation by Dominican government.

Apart from the occasional attack of a boa (*Boa constrictor nebulosus*), the agouti experiences a very low predation rate. Therefore, they possess the potential to dramatically affect the rate of seed mortality and dispersal of those tree species from which they feed. However, effects of *D. leporina* may be altered interspecific competition created by presence of other fruit and seed predators such as opossums (*Didelphis marsupialis*), rats (*Rattus rattus, Rattus norvegicus*) mice (*Mus musculus*), and wild pigs (*Sus scrofa*).

Trees have been co-evolving with mammals since the Tertiary forming a mutualistic relationship (Tiffney 2004). Plants utilize mammal predation by growing fleshy fruits that hold large seeds (Jansen et al. 2004). Mammals that either ingest or carry away the seeds provide a mode of long-distance transportation that facilitates seed dispersal. The agoutis' caching behavior provides dispersal and protection for the seed. While the seeds are stored under ground in a cache intended to be eaten later, many may be forgotten giving the seed a prime environment for germination.

Methods and Materials:

During the whole of this study I worked with Ben Taylor who had set up the majority of this project. My original plan for my project was to observe the occurrence of agoutis around the Springfield Station and document they preference of scents using Classic Match perfume and sardines. I set out two cameras on the Massacre trail leading south of the Station and the other two on the Mt. Joy trail heading north of the Station. The cameras remained in the field for five days. During that time not a single agouti was spotted. Only one opossum and a feral dog were attracted to the scent. I later learned that Ben was performing an in depth project on *D. leporina* concerning their effect on seed dispersal. So I used my camera in coordination with his experiment to help him identify what species and how many were removing seeds from his test piles.

Ben had chosen three regions of Dominica for the experiment. The Northwest region is comprised of a primary growth rainforest and is protected within the Morne Diablotin National Park. The Northeast region also contains productive rainforest and is held within the Northern Forest Reserve. The last region chosen was situated near Middleham Falls in the Southwest area of Dominica. Like the Northwest, this location is protected from human interference; however, the majority of this forest is relatively young due to the destruction experienced 30 years ago caused by a severe hurricane.

Ben had set three transects of 250 meters in each region. At every 50 meters, he placed stations that held an exclosure seed pile and a control seed pile. Therefore, a total of 108 seed piles were assessed during the course of the study. Each seed pile possessed nine large seeds that were all heavier than 2 grams. The seed piles were represented by seven neotropical tree species: Duss ma, Swar ca, Ster ca, Tovo pl, Turp oc, Cong re, and Tric se. The control piles consisted of placing the seeds directly on the forest floor providing access to all seed predating species. The floor was not cleared or altered in anyway so as to maintain a completely natural setting. The exclosure seed pile was a one meter^2 area enclosed by 50cm high walls that were held in place by four rebar stakes. The exclosure was designed to negate only the D. leporina's entry into the area. The top of the exclosure remain open for avian seed predators, and a 7cm gap between the forest floor the mesh barrier was provided to allow all small terrestrial species access to the seed piles. Ben checked all of the seed piles every three days and recorded the number and species type of any missing seeds.

Camera traps and a spool-and-line method were employed to determine the fate of the missing seeds. These two techniques were used to corroborate the quantitative evidence accumulated from the seed piles. We enlisted four motion detecting camera traps to document possible seed predator action in the Northwest and the Northeast regions. I supplied two Cubbeback digital cameras that I set to still image mode. They would capture images once every minute for as long as motion was detected. I also brought two more than were used to record video. These were made by Moultrie and are called 160 Digital Game Cameras. I set the Moultrie cameras to high-resolution video mode. Once motion was sensed by the cameras, a five second video was recorded of the area. After the video ended, a photograph was taken of the area. We attached each camera to a tree near a station along the transect. We placed seeds two meter in front of each camera to bait possible seed predators or dispersers that were common to those specific regions. All four cameras were in the field for six nights and seven days. The first three of the days were spent in the Northeast region. We collected the cameras and transferred their data at the research station using a USB cable and a card reader. We then relocated the camera to the Northwest region and returned three days later to acquire the new information.

The thread marking method consisted of securing a thread to a large seed to reveal the fate of taken seeds. Ben attached several different spools of thread to stakes situated in the ground at each station on the transects. The end of the thread was tied to seeds of varying size. If the seed was carried away, the thread was pulled along the trail taken be the animal, and lead to the seed's final destination. Furthermore, the fate of the seed may be determined, which include being consumed, cached, or dropped. Ben monitored the seeds until they had been consumed, germinated, and or otherwise became unviable. The thread marking method was able to provide some information that stationary cameras could not.

Results:

I analyzed all of the data collected by Ben. I created the following charts and graphs using Ben's main data sheet. I am responsible for any of the camera data.

Table 1 displays the average rage of seed size for each of the plant species used in the study. Duss ma has the largest mass at 21.381 and biggest overall size. Tric se is at the other end of the scale with the smallest mass and most petite size.

Average seed size	Ster ca	Duss ma	Turp oc	Tovo pl	Swar ca	Cong re	Tric se
Mass	2.675	21.381	3.941	4.919	11.126	3.127	1.935
Length (cm)	2.431	5.411	2.182	3.979	3.415	2.929	2.556
Width (cm)	1.512	2.986	2.129	1.574	2.562	1.555	1.215

Table 1. The average size of each species from a sample of 35 seeds.

On the following page is Table 2, which represents a summary of seeds removed from each region. The removal rate of the control pile was 6.8% higher than that of the exclosure piles. This difference is attributed to seed predation by agoutis. The Northwest control piles have experienced the most seed depletion while the Southwest exclosure piles have had the least amount of seed removal.

	Date 1	Date 2	Date 3	Final Percent Removed
Total Control	**621**	**549**	**504**	**18.8%**
NW Control	246	174	156	36.6%
NE Control	204	171	174	14.7%
SW Control	171	204	174	14.7%
Total Exclosure	**633**	**596**	**557**	**12%**
NW Exclosure	246	209	209	15%
NE Exclosure	204	183	174	14.7%
SW Exclosure	183	204	174	4.9%
Grand Total	**1254**	**1145**	**1061**	**15.4%**

Table 2. The total tally of seeds remaining each day in all three regions.

Below are figures 1, 2, and 3. Each graph depicts the pattern of seed removal changes with time. Each line of a graph represents a date, and the y-axis and x-axis denote the number of seeds still present and the type of plant species. The trend in the Northwest region (Figure 3) expresses the largest drop in seed presence.

Figure 1. The total number of seeds for each species present at each date in the Southwest region.

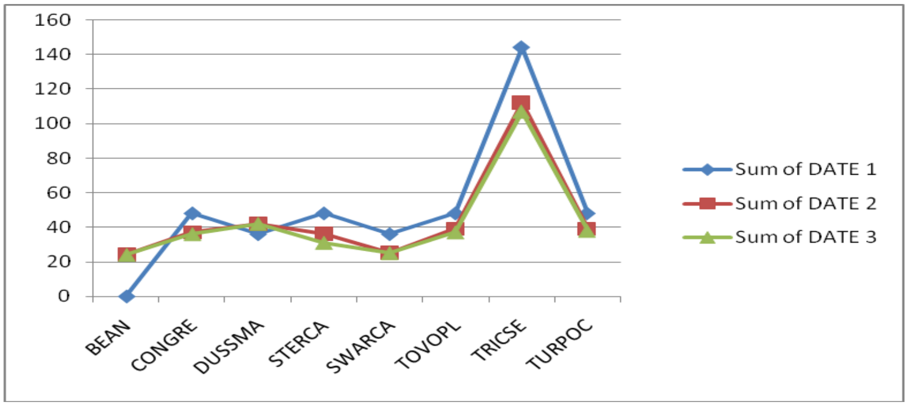


Figure 2. The total number of seeds for each species present at each date in the Northeast region.

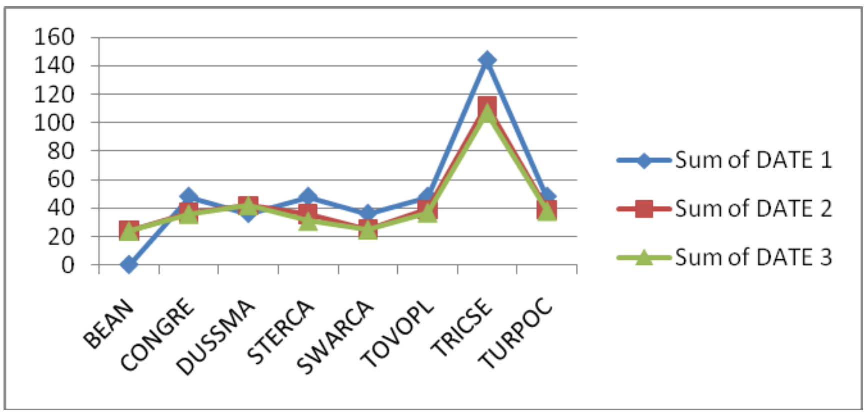
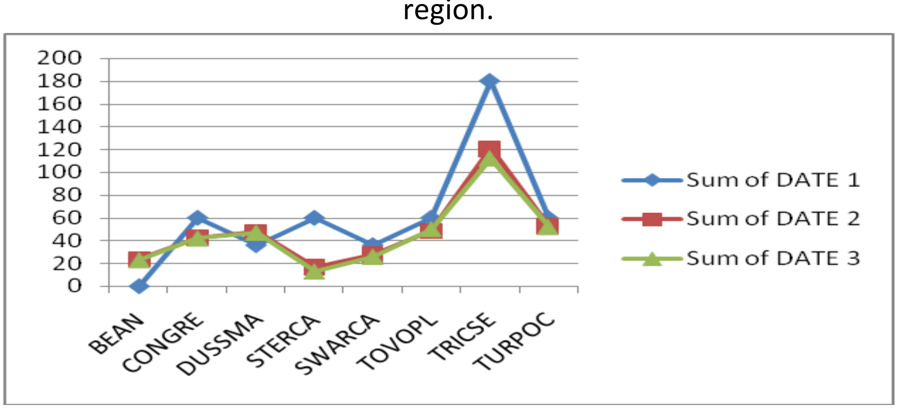


Figure 3. The total number of seeds for each species present at each date in the Northwest region.



Graphs 4, 5, and 6 represent different aspects of transect NE 1 from the Northeast region.

Figure 4 exhibits the overall seed removal pattern seen on that transect. Swar ca is the first species to be targeted for removal from the piles. It is missing completely from the control graph (Figure 5) and is almost entirely absent from the exclosure graph (Figure 6).

Figure 4. The grand total of seeds for each species present at each date on transect NE 1.

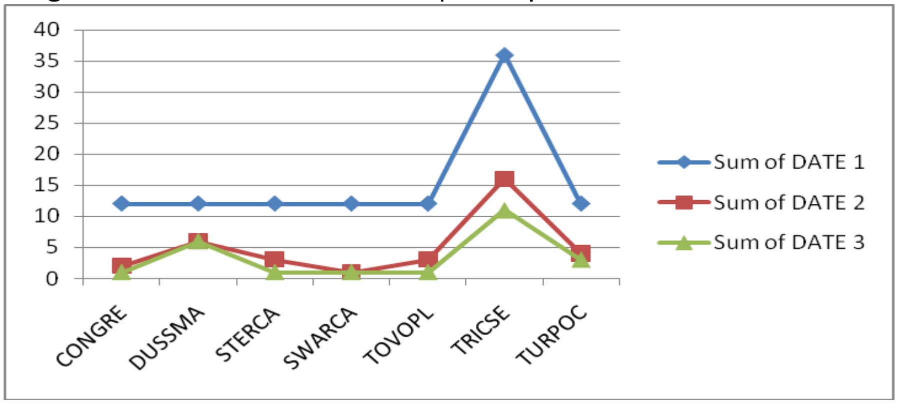


Figure 5. The total number of seeds remaining in the control piles of transect NE 1.

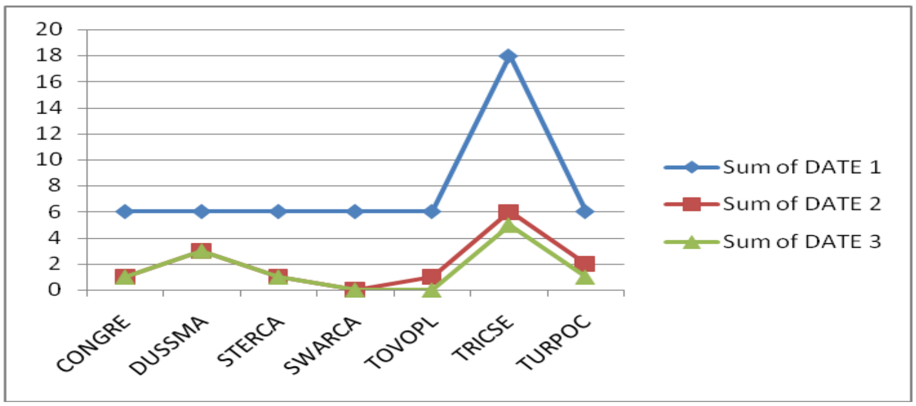
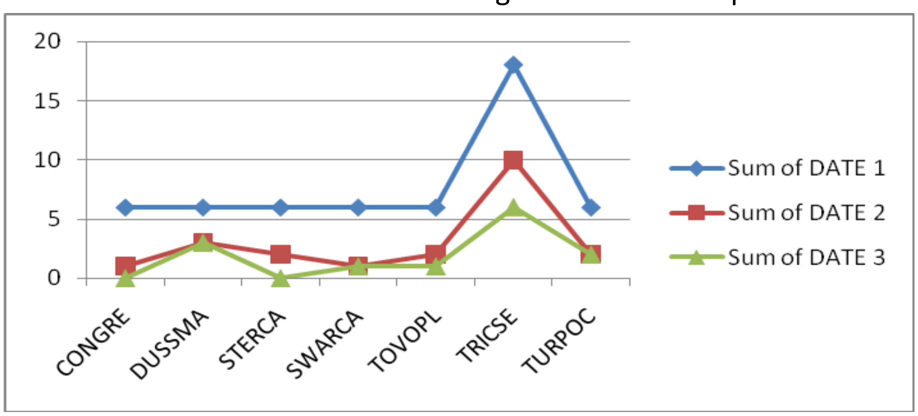


Figure 6. The total number of seeds remaining in the exclusure piles of transect NE1.



Graphs 7, 8, and 9 present the overall, control, and exclosure aspects of transect NW 2 from the Northwest region. Figure 7 show a rapid decrease in all seed species present on the transect. Ster ca is the primary target for removal from these piles. It is the only species to that experiencs a large decrease in the exclosure piles. However, almost all species are removed from the control pile.

Figure 7. The total number of seed for each species present on each date at transect NW 2.

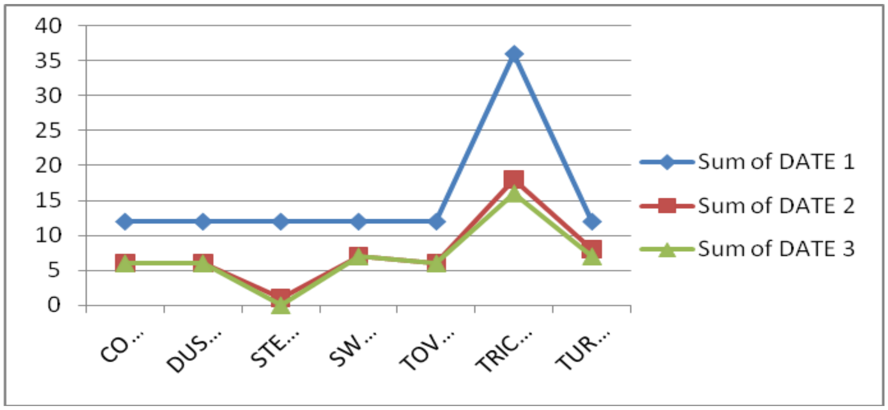


Figure 8. The total number of seeds remaining in the control piles of transect NW 2.

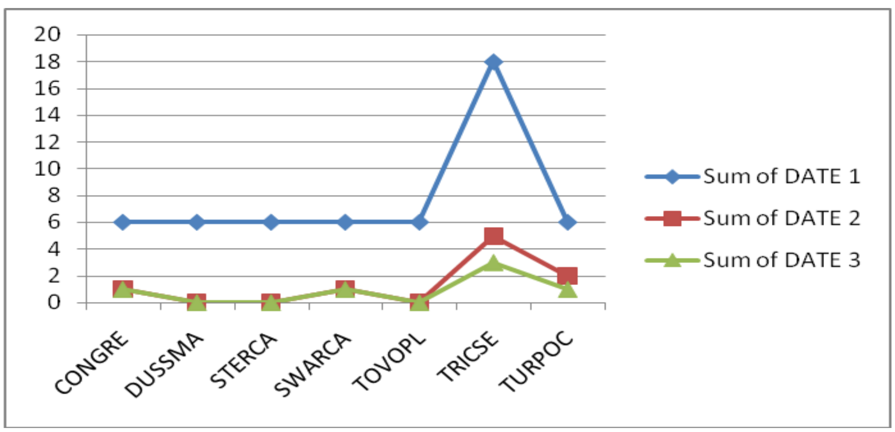


Figure 9. The total number of seeds remaining in the exclosure piles of transect NW 2.

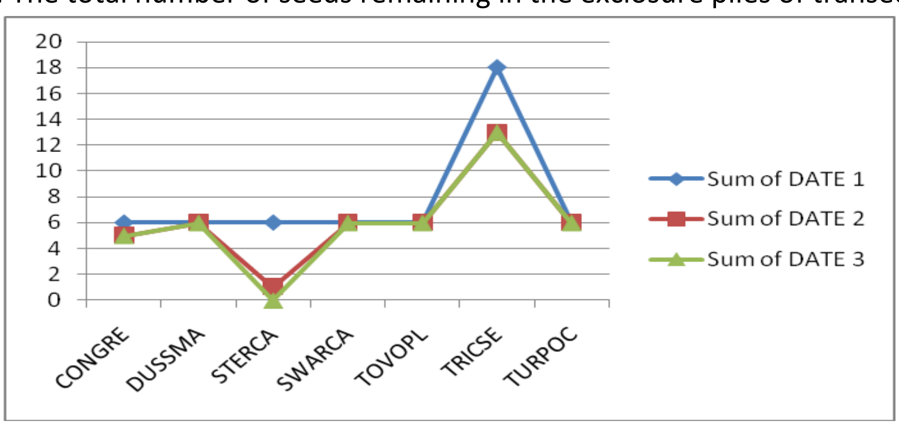


Figure 10. The anaylsis of the data collected by the camera traps.

Location	Date	Camera 1	Camera 2	Camera 3		Camera 4	
				Photo	Video	Photo	Video
NE	5-30-2009	X	X	X	X	X	X
NE	5-31-2009	X	X	X	X	X	X
NE	6-01-2009	X	X	X	X	X	X
NE	6-02-2009 (morning)	X	X	X	X	X	X
NW	6-02-2009 (evening)	X	X	1 Rat	1 Rat	X	X
NW	6-03-2009	X	X	X	3 Rats	X	X
NW	6-04-2009	X	X	X	4 Rats	X	X
NW	6-05-2009	X	X	1 Rat, 1 Agouti	3 Rats, 1 Agouti	X	X

Discussion:

Each other three regions demonstrate different rates of seed removal from both the control pile and exclosure pile. The average seed removal rate was the lowest in the Southwest region at 1.8%. This area is still in the process of recovering from a devastating hurricane that occurred approximately 30 years ago. Many tree species common to a mature forest may still be absent from the current habitat. The condition of this young forest could be inhospitable to the usual seed predators found on Dominica. An absence of scatterhoarders and other plant predators could explain the low removal rates.

The Northeast accrued a moderate seed removal rate at 14.7%. While the habitat is constructed of mature rainforest, the land is not protected against hunters. Studies have shown that hunting can negatively alter seed distribution by decreasing ground mammal densities (Beckman and Muller-Landau 2007, Forget and Jansen 2007). The graphs from the transect NE 1 support this idea. The seed removal rate was only marginally higher in the control piles than the exclosure. The lack of a distinct difference suggests that there were large mammals present for exclusion. Crabs may be the primary seed predators in the Northeast area; although, there is no camera evidence to confirm it. At this location, the floor of the forest is inundated with crabs. While passing several of the station, I noted many crab burrows were built within the walls of the exclosures. Furthermore, the spool-and-line set up provided additional support. One of the threads that was originally attached to a Duss ma seed was found later leading directly into the depths of a crab burrow.

The Northwest region had the greatest percentage (25.8%) of overall seed removal. Of that percentage, 21.6% is contributed to agoutis. This area consists of old-growth rain forest and is protected from hunters by the Dominican National Park Service. Agoutis are prominent in this region. In fact, during a hike to set up camera traps, I saw a group of four agoutis foraging near one of the transects. Further evidence for the presence of agoutis is seen in the seed removal patterns of transect NW 2. From the exclosure piles, the Ster ca seed appear to be the most affected. All other seeds, apart from the Tric se remain relatively untouched. The Stre ca and the Tric se are the two smallest seed species. All species of seeds display a significant drop in the control piles. This difference is accredited to the agoutis because they are the mostly likely species that could handle maneuvering such large seeds as the Duss ma. Rats and mice are more likely to target the smaller seeds due to their smaller body size. Evidence from the camera traps corroborates this theory. Numerous rats were caught on video consuming several seeds; however, none appeared to be attracted to the larger seeds. The camera captured one agouti, which went directly for a large seed and began to eat it. Also, a few small-seed-threads from the spool-and-line area followed paths that seemed more characteristic of a rat than a large agouti. The threads trailed through tight holes in the vegetation and under branches that an average size agouti would most likely walk over.

Performing this study of weeks or months rather than days would provide more accurate and conclusive evidence for determining the extent of *D. leporina*'s roll in Dominican seed dispersal. Factors, such as weather, may play a large part in the rate of seed removal. Most likely mammalian seed predators are less likely to forage during time of inclement weather. Disturbances of this sort could cause significant consequences for s short-term study. Lastly, using a more consistent distribution of seed species and number would have afforded evidence that was more conducive to the assessment of agouti participation in seed predation and dispersal. However, this report is only a synopsis of Ben's long-term study. Therefore, the addition of seeds at this point will relatively little affect on the end result of the final project.

Although all of the motion-detecting cameras were used in the field, only one provided digital verification of mammalian activity. However, it revealed very important information. According to many of the Dominican National Park staff that Ben had spoken to, rats and mice were rare in the jungle. The staff believed that these species mainly lived in agricultural areas. The staff told Ben that parrots were the main predators eating his seeds. The camera evidence captured 11 rats on video consuming the test seeds. Parrots are strictly seed predators where as rats exhibit some scatterhoarding behavior. The difference in specie could drastically affect the success of a removed seed. Furthermore, an agouti is captured on video eating one of the large seeds. Although this is not definitive evidence for seed size preference of agoutis, it do not discount the notion. Additionally, all animals were present at the sights during night and early morning hours. Therefore, documenting this evidence in person would be difficult. However, the camera evidence could be improved with more experience and keeping them out in the field longer.

Agoutis are considered a key scatterhoarder partly because of their large size. They are able to manage large tree seeds such as the Duss ma and the Swar ca. This task would be more challenging to a rat or mouse, which seems to favor the smaller seeds like Ster ca. Proper seed dispersal may be the defining factor for a tree to produce successful offspring. D. leporina appear to benefit Dominican rainforest by improving the rate at which seeds are dispersed. However, it would be interesting to see the condition of the forest in the absence of the agouti.

Acknowledgments:

I would like to thank Ben Taylor for all of his help in this joint project. He provided most of the equipment, transportation, and much need guidance. Not to mention, he made learning about plants fun. I want to thank John P. Krawtz for lending two very nice motion detecting cameras to the project. I would also like to thank Dr. Thomas Lacher and Dr. James Woolley for giving me the opportunity to study in Dominica, for supplying supportive advice and offering technical aid. I would like to thank Nancy Osler and ATREC for all their hospitality during the time I was researching. Lastly, I would like to thank Texas A&M University for supporting Dominican study abroad program, which has certainly affected my life in the most positive way.

References:

Beckman, N. G. and H. C. Muller-Landau. 2007. Differential Effects of Hunting on Pre-Dispersal Seed Predation and Primary and Secondary Seed Removal of Two Neotropical Tree Species. BIOTROPICA **39**:328-339.

Forget, P.-M. and P. A. Jansen. 2007. Hunting Increases Dispersal Limitation in the Tree *Carapa procera*, a Nontimber Forest Product. Conservation Biology **21**:106-113.

Jansen, P. A., F. Bongers, and L. Hemerik. 2004. Seed mass and mast seeding enhance dispersal by a neotropical scatter-hoarding rodent. Ecological Monographs **74**:569-589.

Silvius, K. M. 2002. Spatio-temporal patterns of palm endocarp use by three Amazonian forest mammals: granivory or 'grubivory'? Journal of Tropical Ecology **18**:707-723.

Silvius, K. M. and J. M. V. Fragoso. 2003. Red-rumped agouti (Dasyprocta leporina) home range use in an Amazonian forest: Implications for the aggregated distribution of forest trees. BIOTROPICA **35**:74-83.

Tiffney, B. H. 2004. Vertebrate dispersal of seed plants through time. Annual Review of Ecology Evolution and Systematics **35**:1-29.

Wing, E. S. 2001. Native American Use of Animals in the Caribbean. Pages 481-518 *in* C. A. Woods and F. E. Sergile, editors. Biogeography of the West Indies: Patterns and Perspectives. CRC Press LLC.