Effects of extreme climate events on the circadian pattern of fruit dropping and seed dispersal by terrestrial frugivorous mammals

Progress Report, August 2025

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This report corresponds to the first year of project implementation and summarizes the progress achieved and the difficulties encountered during this period. The central objective of this research is to understand how extreme climatic events, increasingly frequent under climate change scenarios, may alter fruit-fall patterns and the interactions between plants and terrestrial frugivores, with special emphasis on the nance tree (*Byrsonima crassifolia*) and the associated fauna in the tropical dry forest of Costa Rica, an ecosystem highly vulnerable to climate change.

During this period, a full monitoring season was conducted (July–September 2024). The first season, focused on recording the fruit drop pattern of ripe nance fruits and the visits of associated frugivores, was successfully completed and provided consistent data on the temporal availability of fruits and frugivore visits. The second season is currently underway (July–September 2025) and will allow for the comparison of the interannual dynamics of this process, which is essential for assessing the influence of variable climatic factors, such as wind speed and rainfall, on the reproductive phenology of the species.

To document both fruit fall and frugivore activity, 40 camera traps were installed across 20 nance trees. Each tree was equipped with two cameras: one aimed at a fruiting branch to record fruit fall, and another mounted on a stake at ground level to monitor animal activity. This strategy has generated a substantial volume of information. To date, 238 000 photographs have been obtained, of which 93 000 correspond to fallen fruits and 145 000 to animal records. In total, we recorded 15 species, of which 86% (n = 13) are mammals and 14% (n = 2) are birds. 73% (n = 11) of the recorded species are frugivores. In addition, 3 large carnivore species of conservation concern were recorded (jaguar, puma, and ocelot), highlighting the importance of this ecosystem and nance as a food resource for biodiversity conservation (Table 1).

The preliminary results confirm the importance of studying circadian patterns of fruit fall in relation to frugivore activity, an aspect that has been little explored in tropical ecology. Furthermore, the simultaneous recording of climatic variables and animal behavior will allow, in later stages of the project, an assessment of how extreme weather events influence fruit availability and, consequently, seed dispersal dynamics.

During the second monitoring season, we encountered several challenges, primarily due to the limited availability of fruiting trees. Our study relies on trees with abundant fruit production, which attract frugivorous animals as the fruits gradually fall. However, this season fruit availability was very low, making it difficult to track fruit fall and resulting in very few wildlife records. We believe that storms, which occurred earlier than usual and with great intensity before the fruiting season, may have severely affected the crop by destroying flowers and/or causing the premature fall of developing fruits. These limitations reduce the quality of the data collected during this second season. Moreover, they highlight an aspect we had not previously considered and point to a potential new

mechanism through which climate change may be impacting key ecosystem processes such as seed dispersal. In the coming months, monitoring will continue, the collected information will be systematized, and a comparative analysis between seasons will begin. However, given the challenges faced during the second season, we foresee the need for an additional year of data collection to ensure robust and reliable results.

A key objective of this project is not only to generate scientific knowledge but also to integrate local communities into research and conservation processes. To this end, joint activities will be carried out with the Biological Education Program of the Guanacaste Conservation Area, engaging children and young people to raise awareness about the impacts of climate change on tropical dry forests. By fostering environmental awareness among future generations, these actions strengthen both conservation efforts and the adaptive management of species in one of the ecosystems most vulnerable to climate change.

Table 1. Species recorded by camera traps on nance trees (*Byrsonima crassifolia*) in the tropical dry forest of the Área de Conservación Guanacaste, Costa Rica.

Class / Order	Family	Scientific name	Common name	Frugivore
Mammalia				
Rodentia	Cuniculidae	*Cuniculus paca*	Lowland paca	X
	Dasyproctidae	*Dasyprocta punctata*	Agouti	X
Carnivora	Carnivora	*Canis latrans*	Coyote	X
		Urocyon cinereoargenteus	Gray Fox	X
	Felidae	*Leopardus pardalis*	Ocelot	
		Panthera onca	Jaguar	
		Puma concolor	Puma	
	Mephitidae	*Mephitis macroura*	Hooded Skunk	
	Procyonidae	*Nasua narica*	White-Nosed Coati	X
Artiodactyla	Cervidae	*Odocoileus virginianus*	White-tailed Deer	X
	Tayassuidae	*Dicotyles tajacu*	Collared Peccary	X
		Tayassu pecari	White-lipped Peccary	X
	Tapiridae	*Tapirus bairdii*	Central American Tapir	X
Aves				
Galliformes	Cracidae	*Crax rubra*	Great curassow	X
		Penelope purpurascens	Crested guan	x

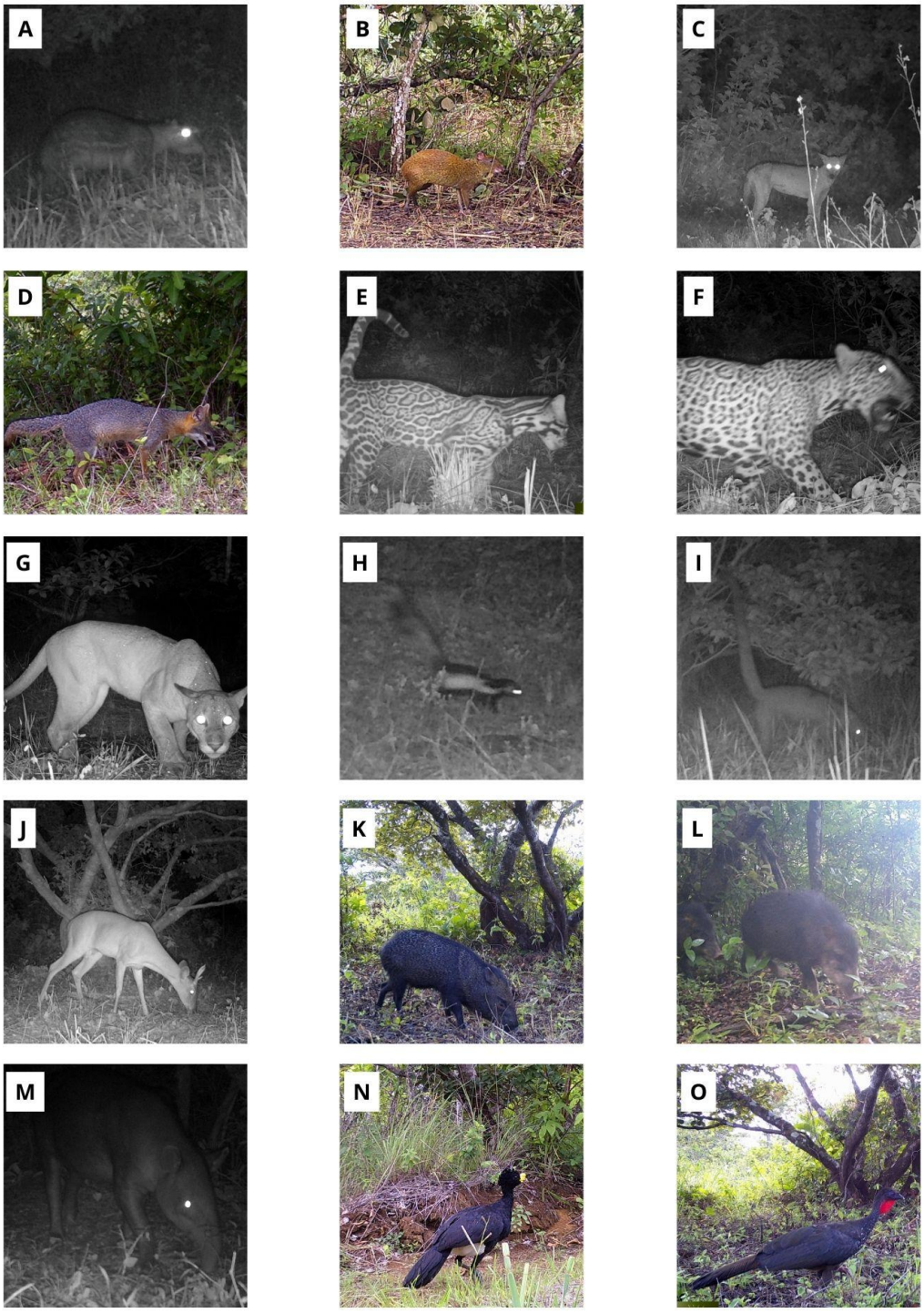

Figure 1. Species recorded by camera traps on nance trees (Byrsonima crassifolia) in the tropical dry forest of the Área de Conservación Guanacaste, Costa Rica. A) Lowland paca; B) Agouti; C) Coyote; D) Gray Fox; E) Ocelot; F) Jaguar; G) Puma; H) Hooded Skunk; I) White-Nosed Coati; J) White-tailed Deer; K) Collared Peccary; L) White-lipped Peccary; M) Central American Tapir; N) Great curassow; O) Crested guan.

Figure 2. Camera-trap images monitoring the fall of nance fruits. The red circle highlights a group of fruits before (left) and after (right) falling within a 30-minute interval.