

THE MICROCLIMATE DIFFERENCE BETWEEN A DECIDUOUS FOREST AND ADJACENT RIPARIAN FOREST IN GUANACASTE PROVINCE, COSTA RICA

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ABSTRACT

The microclimate of evergreen riparian forest along the Río Potrero below a large waterfall is briefly contrasted with microclimate of the adjacent deciduous forest in the dry season and wet season. Near the end of the dry season, a station in the riparian forest had soil temperatures 6.5°C cooler, air temperatures 5.5°C cooler and a relative humidity 20 percentage points higher than a station 62 m away in the deciduous forest. In the rainy season, differences between the two sites were largely obliterated.

When working in lowland tropical deciduous forest in the dry season, one is often struck by the very great differences between the physical climate in the deciduous forest and the climate in the immediately adjacent strips of evergreen riparian forest. In the dry season, the moister, shadier and cooler riparian forest appears to be of great biological importance as a refuge for animals from the drier, lighter and hotter deciduous forest (Janzen and Schoener 1968, Janzen 1973, 1975). However, there appear to be no detailed descriptions of these differences in climate in the literature.

With this in mind, the temperatures and relative humidity were measured at a deciduous forest—riparian forest interface on the banks of the Río Potrero about three km downstream from where this river crosses the Pan American Highway about 15 km southwest of Bagaces, Guanacaste Province, Costa Rica. The exact site is on the northeast river bank and canyon edge about 200 m downstream from a 75 m tall waterfall in the east end of COMELCO, a large ranch owned by the Stewart family (see Frankie *et al* 1975 for a description of the general area). From the lip of the canyon the slope drops about 75 m to the water edge (about 50 m horizontal distance). This slope is rocky and dotted with tall evergreen trees

(*Spondias mombin* L., *Trichilia* sp., *Ficus* sp., *Hymenaea courbaril* L., *Anacardium excelsum* (Bert. & Balb.) Skeels, etc.). It appears to have never been logged. Inland from the lip of the canyon the terrain is flat and covered with a broken canopy of typical deciduous forest trees (*Guazuma ulmifolia* Lam., *Tabebuia* spp., *Cochlospermum vitifolium* (Willd.) Spreng., *Luehea* spp., *Dalbergia retusa* Hemsl., *Pterocarpus rohrii* auct., *Bombacopsis quinata* (Jack.) Dugand, *Enterolobium cyclocarpum* (Jacq.) Griseb., *Lysiloma seemanii* Brit. & Rose, *Bursera simarouba* (L.) Sargent).

The transect begins 32 m from the lip of the canyon (stations 1, 2 and 3 are on the flat terrain below the seasonally deciduous forest). Measured along the slope, it is 61 m from the lip of the canyon to the water's edge (stations 4 through 9 are on this slope). Table 1 shows the physical environmental values for these 9 stations at the end of the dry season (21 May 1975, 10:00-10:15 am, clear day with scudding clouds), the middle of the rainy season just after the usual mid-rainy season dry spell (23 August 1975, 7:00 - 7:30 am, high overcast day with rain in afternoon), and the peak of the rainy season that occurs in the second half of the rainy season (26 September 1975, 10:15 - 10:35 am, high overcast day with rain in afternoon).

It is evident that the difference between the deciduous and riparian forest in the dry season is very large. For example, stations 2 and 8 are 62 meters apart as measured along the ground, and about 50 m apart on the horizontal. In the 21 May records at station 8 the soil surface temperature is 6.5°C cooler, the air a meter off the ground is 5.5°C cooler, and the relative humidity is 20 percentage points greater than at station 2. Small wonder that animals move into the riparian forest as the dry season comes on. To get this large a difference in mean annual temperature for two weather stations in Costa Rica, they have to be about 1,000 m apart in elevation.

During the rainy season, the differences between the deciduous and riparian forest largely disappear. On 23 August, station 2 and 8 had essentially identical soil temperatures and air temperatures, and only differed by 6 percentage points in relative humidity. However, it should be noted that these values were recorded about three hours earlier in the morning than those in the dry season, and therefore show the ameliorating effect of the night. On 26 September, the rainy season records were taken at the same time of day as the dry season records, and station 2 and 8 differ by less than 1°C in soil temperature, by about 3°C in air temperature, and 21 percentage points in relative humidity. However, a difference of 21 percentage points in relative humidity at the top of the humidity scale is biologically far different from the same difference at the bottom of the scale, which is where the difference occurred in the dry season.

Of a somewhat more subjective nature, it should be added that working in the riparian forest in the dry season is roughly like working in the blast of an air conditioner. The upstream waterfall and its accompanying mist cools and humidifies the air, which then pours down the river canyon. Confined within the canyon, this stream of cool and moist air has a large local effect. Far downstream,

where the terrain flattens out, the effect is dissipated and the difference between the riparian forest and the adjacent deciduous forest is about half as great as it is near the waterfall. However, even this amount of climate modification by the river is certainly adequate to generate a local cool and moist refugium during the dry season.

In conclusion, it should be mentioned that the increasing agricultural exploitation of the Bagaces—COMELCO region, and specifically the area immediately above the waterfall, is very likely to destroy both the water flow and the actual riparian forest itself at the site where these measurements were taken. This site is perhaps the best remaining example of a "moist canyon effect" in Guanacaste Province. It and its organisms are thus unique. I wonder if it is really worth a few extra steers for export or a few extra bags of rice to destroy it for the future inhabitants of Costa Rica.

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Resumen

El microclima del bosque perennifolio inmediato a una caída de agua en el curso del río Potrero, se compara brevemente con el microclima del bosque caducifolio vecino, durante las épocas seca y lluviosa.

Hacia el término de la estación seca, una localidad dada del bosque perennifolio tiene temperaturas (6,5°C en el suelo y 5,5°C en el aire) más bajas y humedad relativa 20 puntos (%) más alta, que una localidad similar del bosque caducifolio.

Durante la época de las lluvias, las diferencias entre ambas localidades de referencia son menores.

La experimentación se realizó en COLMECO, Bagaces, Provincia de Guanacaste, Costa Rica.

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Table 1. Physical environment parameters along a gradient from flat terrain deciduous forest (station 1) to the river's edge in riparian forest (station 2). The break from deciduous forest to evergreen riparian forest occurs halfway between station 3 and 4.

Station	Surface soil temperature (°C)			Air temperature (°C)			Relative Humidity (%)			Light intensity (FC)
	21 May	23 Aug	26 Sept	21 May	23 Aug	26 Sept	21 May	23 Aug	26 Sept	21 May
1	33.9	25.0	27.2	35.3	24.7	28.1	46	88	80	3000
2	35.0	24.5	26.4	35.8	24.5	27.5	45	89	75	2400
3	31.4	25.0	25.6	33.9	24.7	27.2	45	91	76	3400
4	31.6	24.5	25.4	33.2	24.6	26.7	46	91	78	3400
5	30.5	24.2	25.0	32.2	24.2	25.6	48	94	92	800
6	28.9	24.3	25.1	32.9	24.2	25.3	48	95	96	300
7	30.1	24.7	25.6	30.6	24.5	25.3	51	95	95	200
8	28.5	24.9	25.6	30.3	24.8	24.7	65	95	96	70
9	27.7		25.6	29.6		25.3	76	96	95	50
water	26.6		25.0							