COMUNICACIONES

En esta sección se publican informes cortos de resultados preliminares o de investigaciones en marcha; noticias sobre registros nuevos de insectos y enfermedades o nuevas descripciones botánicas, y en general informaciones cuya publicación se considere debe hacerse en forma inmediata. Incorpora en gran parte el tipo de material que desde 1956 se ha estado utilizando en el proyecto "Comunicaciones Científicas Agrícolas", que contenga presentación de resultados. Los manuscritos para esta sección pueden remitirse a ADALBERTO GORBITZ, Editor de Turrialba.

Biomass changes in early tropical succession

Sumario. Se hicieron cosechas de biomasa en bosques secundarios de dos, cuatro y seis años de edad en el Oriente de Panamá. La masa vegetal fue separada en: hojas, tallos y frutas más flores. La biomasa total aumentó de 1530 g m^{-2} en el rastrojo de 2 años, a 5760 g m^{-2} en la vegetación de 6 años de edad. La tasa de incremento de las hojas llegó a un máximo entre 0 y 2 años; para los tallos y raíces sus respectivos máximos encontrados fueron entre 2 y 4 años y entre 4 y 6 años. Se propone un modelo de desarrollo en el cual los diferentes componentes estructurales de un ecosistema forestal están producidos en varias etapas diferentes durante la sucesión.

The practice of shifting agriculture in the humid tropical lowlands results in large areas of second-growth vegetation. Because succession under such conditions is a rapid process, these second-growth stands are convenient systems for the study of forest development. Do all structural components of an ecosystem increase at uniform rates throughout development, or are growth rates of the various compartments maximal at different times?

One possible answer to the above question was arrived at through field work conducted in connection with the Interoceanic Sea-level Canal Feasibility Study, which included a compartmental harvest of large samples of tropical second-growth vegetation.

Methods

Stands of two-, four-, and six-year-old second-growth vegetation were located within 3 km of Santa Fe in the Darien of eastern Panama. All sites had been through one or more shifting agriculture cycles and the age of the vegetation was determined through local informants. The two-year-old stand was located on a poorly drained alluvium, while the four- and six-year-old stands were located adjacent to one another on an imperfectly drained upland terrace. The area receives about 2000 mm of rainfall per year; the life zone *sensu* Holdridge (4), is Tropical Moist Forest, near its transition to Tropical Dry Forest. All harvesting was done in July and August, during the wet season.

Two adjacent, square, 1/16 ha plots were laid out in each stand. All above-ground plant biomass was harvested, separated into leaf, stem, or fruit + flower compartments, and weighed. Plants rooted inside the plot were included and those rooted outside the plot were excluded, regardless of the location of their branches. Vines were cut at the point where they crossed the plot boundary. Roots were harvested from three diagonally arranged pits per plot. Each pit was 1 m^2 by 0.3 m deep.

Dry weights were determined on three to ten samples of each compartment per plot. These samples, each with a fresh weight of approximately 0.5 kg, were dried at 105°C for 24 hours.

Results and discussion

The data are summarized in Table 1. Each of the four compartments increased in biomass with age, and at all ages stems account for the greatest portion of the vegetation.

The values shown for leaves probably underestimate the amount of photosynthetic machinery in the stands because the many green stems (e.g., *Piper* spp. and *Heliconia* spp.) are not included in the leaf compartment.

The biomass of the fruit and flower compartment was large (2 to 24 g m^{-2}), as would be expected in early successional stages where short life cycles and high reproductive capabilities characterize the pioneer species. Much of the fruit and flower biomass consisted of *Heliconia* inflorescenses.

The root data underestimate the true values because the sampling depth extended only to 30 cm. Most roots, however, were concentrated in the upper 10 cm, and thus were included in the samples. Root surface area, and therefore absorptive capacity, would be expected to be high during early succession, although no data are available to support this contention. The

Table 1.—Compartmental distribution of biomass in three ages of second-growth vegetation. Each plot was 25 m x 25 m and values are g m^{-2}, dry weight.

Compartment	Age of Stand (years)					
	2		4		6	
	Plot 1	Plot 2	Plot 1	Plot 2	Plot 1	Plot 2
Leaves	356.3	361.5	578.7	588.3	793.9	483.7
Stems	786.6	1086.4	3221.8	3177.4	4204.7	3076.1
Fruits & Flowers	2.8	1.7	12.7	15.8	23.9	4.8
Roots	315.0	152.4	305.6	259.5	1725.6	1215.8
TOTAL	1460.7	1602.0	4118.8	4041.0	6748.1	4780.4

root biomass data indicate that the larger, supportive roots are probably not produced until after the first four years of succession.

The biomass data can be compared with those reported by Golley *et al.* (3) for a mature forest located within 5 km of the second-growth stands. There is about twice as much leaf biomass in the mature forest as there is in the six-year-old stand, while reproductive structure biomas is about equal for the two. There is almost ten times as much stem biomass in the mature forest as there is in the six-year-old vegetation; this compartment is the one which continues to increase most in later succession. The root data reported here for the six-year-old stand are 20 to 70 per cent higher

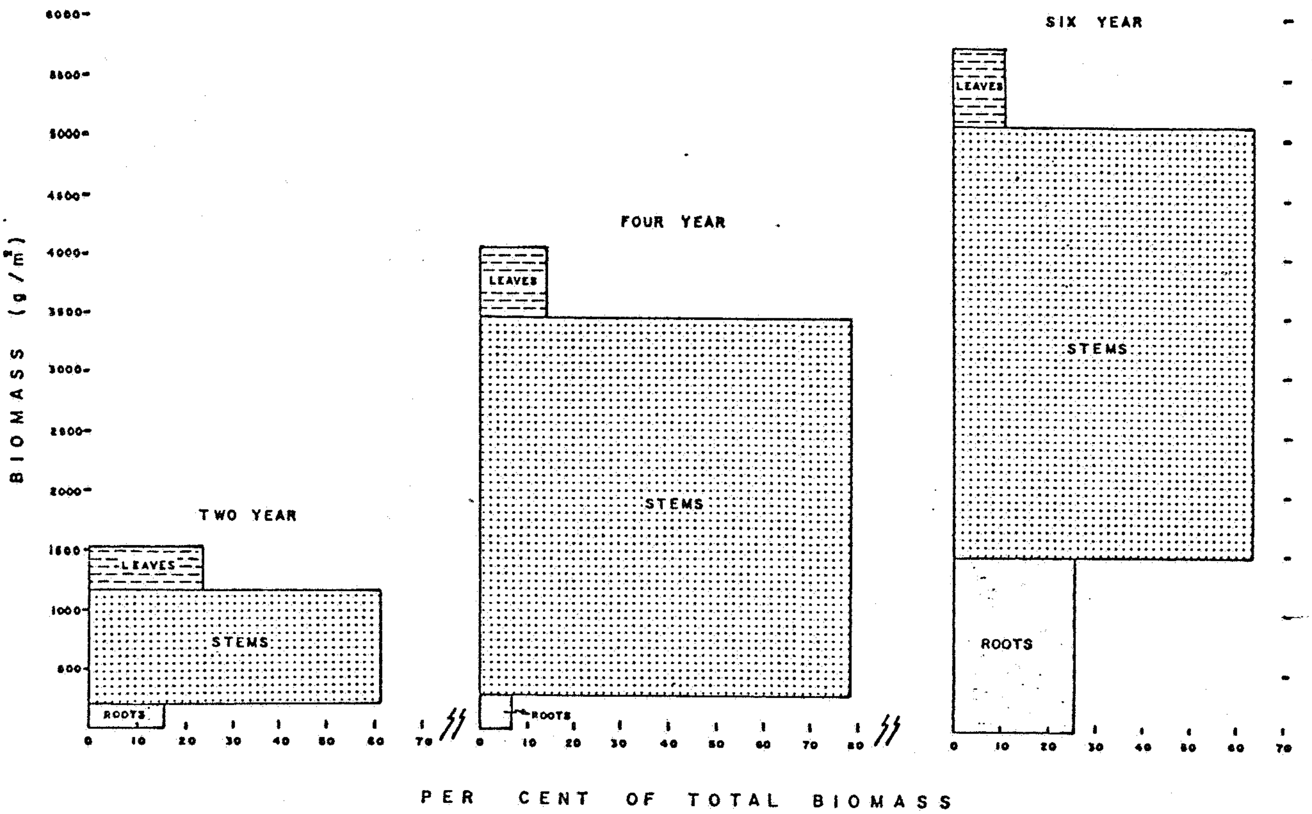

Fig. 1.—*Biomass distribution in three ages of second-growth vegetation.*

than those reported by Golley *et al.* for the mature forest. The difference may represent a sampling error, since the root data are based on a sample of six pits, with a mean and standard error of 1471 $\pm$ 521 g m^{-2}. However, Bartholomew *et al.* (1) report root biomasses of 2575 g m^{-2} in a five-year-old stand and 2268 g m^{-2} in an eight-year-old stand in a comparable climate in the Yangambi (ex-Belgian Congo) region.

The paper by Bartholomew *et al.* (1) includes data from two-, five-, and eight-year-old stands (as well as older vegetation) and uses a compartmental breakdown similar to that employed here with the Panama data. Their data are, in general, higher than those in Table 1, primarily because of the greater stem biomass in the African stands. The Panama data agree closely with those of Snedaker (2) who reports standing crops of wood and leaf plus twig compartments for two-, four-, and six-year-old stands in Guatemala.

In Figure 1 the mean biomass data for the root, stem, and leaf compartments are plotted as fractional histograms. The width of each bar segment represents the percentage of total stand biomass contributed by each compartment. Total biomass is seen to increase almost linearly with age, while the individual components respond nonlinearly. Leaves, for example, increase in total biomass at each age interval, but constitute relatively less of the total biomass of the stand as age increases. Two large increments in compartment size are evident in Figure 1: the change in stems from two to four years, and the change in roots from four to six years.

The mean annual rates of change for each of the three major biomass compartments are shown for the zero to two, two to four, and four to six year intervals in Table 2. The maximum rate of change of each compartment *(underlined in Table 2)* occurs in a different intervals.

The data indicate that during the first six years of development energy is channeled into different compartments at different times. Leaf biomass is produced most rapidly at first, followed by stem production and, later, a surge in root biomass.

Table 2.—Mean rates of change of compartmental biomass. Values are g m^{-2} $year^{-1}$, dry weight. The maximum value for each compartment is underlined.

Compartment	Age Interval (years)		
	0 - 2	2 - 4	4 - 6
Leaves	179.5	112.3	27.6
Stems	468.3	1131.4	220.4
Roots	116.9	24.4	594.1

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JOHN EWEL*
CENTER FOR TROPICAL AGRICULTURE, UNIVERSITY OF FLORIDA
GAINESVILLE, FLORIDA 32601, U.S.A.

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* Present address: Botany Department, University of North Carolina, Chapel Hill, North Carolina 27514, U.S.A.

Comparación de dos técnicas para estimar temperaturas medias, con fines agroecológicos, en localidades carentes de registros

Abstract. Based on thermometric information of 73 meteorological stations in Costa Rica, an evaluation was made of two widely used techniques to estimate average air temperatures of localities where no weather stations exist.

The first technique consists of calculating the equations of the relation altitude/temperature whereas the second is based on calculation of the median gradient based in drawing rectilineous isotherms, reduced to sea level temperatures. Statistical analysis indicates that the estimated temperatures obtained by these techniques are highly similar to the observed temperatures of the localities with temperatures records (F= 465.7 and F= 678.7- respectively). The use of the first technique which is less complicated is recommended for regions where temperature records of a reasonable number of stations are available. The second technique is more complicated and is recommended for cases where less information is available.