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SEASONAL VARIATION OF STREAMFLOW IN FLORIDA

by
W. E. Kenner

Florida's pattern of streamflow variation is unusual in two respects. First, the month-to-month variation in average streamflow is relatively small; second, the seasonal variations of streams in different sections of the state are different. A convenient way to show seasonal variations of streamflow is to graphically compare monthly average flow, in terms of the percentage of average annual flow as shown on the map.

Several factors contribute to the variation of streamflow. The small month-to-month variability in streamflow is the result of (1) the relatively low variability of average monthly rainfall (Figure 1); (2) the relatively high rate of evapotranspiration in the summer (Figure 2); (3) the large volume of slowly released natural storage in Florida's numerous lakes; and (4) the large and relatively stable inflow of ground water to streams from extensive limestone and alluvial aquifer systems. Two examples illustrate the small variability of average monthly flow of streams of different sizes that drain different geologic terrain.

The Santa Fe River near Fort White has an average discharge of 1,599 cfs (cubic feet per second), drains about 1,100 square miles, and is fed largely by springs issuing from limestone aquifers. The highest average monthly flow (October) is 10.2 percent, and the lowest average monthly flow (February) is 7.1 percent, based on continuous streamflow records for 1933 to 1960. The Shoal River near Crestview has an average discharge of 1,064 cfs, drains about 475 square miles, and is fed largely by seepage from shallow alluvial aquifers and direct runoff. The highest average monthly flow (March) is 11.2 percent and the lowest average monthly flow (October) is 6.1 percent of the average annual flow, based on continuous streamflow records for 1939 to 1960.

Although the average month-to-month variation in streamflow is small, recognizable patterns of seasonal streamflow exist statewide; the pattern in northwestern Florida is distinctly different from the seasonal streamflow pattern of southern Florida.

The graphs on the map show the monthly streamflow, in terms of the percentage of average annual flow that occured for each of 10 representative streams or canals. Averages and percentages representing the seasonal pattern of runoff were computed on the basis of the periods of streamflow record indicated on the graphs, the shortest being the 20-year record for Tamiami Canal outlets. Where more than 20 years of record was available, the longer record was used in the computations. In general, during the spring, streamflow is highest in extreme northwest Florida, moderate in central Florida, and lowest in southern Florida. A gradual but progressive decrease in springtime streamflow from north to south is evident. For example, the combined average for the Escambia River for the spring months of March, April, and May is 40 percent of the annual average; for the Santa Fe River about 25 percent; for the Peace River, about 13 percent; and for the Tamiami Canal Outlets, about 6 percent.

Conversely, the autumn streamflow shows a progressive increase from north to south. The combined average for the autumn months of September, October, and November for the Escambia River is only about 13 percent; for the Withlacoochee River in west-central Florida autumn flow was about 27 percent; for the St. Johns River was 39 percent; and for the Tamiami Canal Outlets (prior to construction of Conservation Area 3) was about 55 percent.

The percentage of summer (June, July, August) flow in relation to the annual flow averages about the same throughout the state and is about equal to that during the winter months (December, January, February), even though about three times as much rainfall occurs during the summer as during the winter. About 20 percent of the annual flow occurs in each of these seasons. An exception is the Upper Peace River basin where a considerably larger percentage of streamflow occurs in the summer than in the winter.

Florida's unusual pattern of seasonal variation of streamflow is due largely to its position in the transition zone between the continental weather pattern of southeastern United States and the tropical weather pattern of the Caribbean Sea. During the winter and early spring the continental pattern, characterized by high pressure air masses that move southeasterly from western Canada across the Central Plains States, predominates in northern Florida. Generally, these air masses flow eastward over the Mississippi Valley, thence to the northeast over the Atlantic Seaboard, and over the Atlantic Ocean. The leading edges of cold air masses meet the warmer moist air masses of the Gulf region and produce the "frontal" weather that results in severe storms and copious rainfall. These weather fronts frequently move across southern Alabama and Georgia and northern Florida but rarely reach as far south as Lake Okeechobee.

Florida's summer and fall climate is sub-tropical and is characterized by local thunderstorms and humid, low-pressure air masses (easterly waves) that usually form in the Caribbean Sea and move westward of north-westward. As these masses of moist air pass over peninsular Florida, precipitating their moisture as rain, they gradually dissipate with correspondingly less rainfall on northwestern Florida and southern Georgia and Alabama. Occasionally an easterly wave becomes intensified and forms into a tropical storm or hurricane. High winds and heavy rainfall accompany such storms which often add to the normal late summer and fall rains in southern Florida.

The line of demarcation between areas dominated by the two weather types is not sharp. The continual north-south shifting of the tropical and continental air masses results in a seasonal distribution of rainfall that has a predominantly continental pattern in northwestern Florida, is less continental and more tropical in central Florida, and is predominantly tropical in southern Florida. The pattern of seasonal rainfall caused by the interplay of the two weather systems, seasonal variations in evaporation, and releases of water to streams from stored ground water are all reflected in Florida's pattern of seasonal variation of streamflow.

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Figure 1. Monthly Average Rainfall for the 30-year period, 1931-1960 at De Funiak Springs, Lake City, Gainesville, Avon Park, and Belle Glade.

Figure 2. Monthly Average Pan Evaporation at Woodruff Dam, Gainesville, and Hialeah.

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The Santa Fe River near Fort White has an average discharge of 1,670 cfs (cubic feet per second), drains about 1,100 square miles, and is fed largely by springs issuing from limestone aquifers. The highest average monthly flow (September) is 10.8 percent, and the lowest average monthly flow (May) is 7.1 percent, based on continuous streamflow records for 1933 to 1972. The Shoal River near Crestview has an average discharge of 1,042 cfs, drains about 475 square miles, and is fed largely by seepage from shallow alluvial aquifers and direct runoff. The highest average monthly flow (March) is 11.0 percent and the lowest average monthly flow (November) is 6.2 percent of the average annual flow, based on continuous streamflow records for 1939 to 1972.

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The graphs on the map show the monthly streamflow, in terms of the percentage of average annual flow that occurred for each of 10 representative streams or canals. Averages and percentages representing the seasonal pattern of runoff were computed on the basis of the periods of streamflow record indicated on the graphs, the shortest being the 32-year record for Tamiami Canal outlets. Where more than 32 years of record was available, the longer record was used in the computations. In general, during the spring, streamflow is highest in extreme northwest Florida, moderate in central Florida, and lowest in southern Florida. A gradual but progressive decrease in springtime streamflow from north to south is evident. For example, the combined average for the Escambia River for the spring months of March, April, and May is 40 percent of the annual average; for the Santa Fe River about 25 percent; for the Peace River, about 13 percent; and for the Tamiami Canal Outlets, about 8 percent.

Conversely, the autumn streamflow shows a progressive increase from north to south. The combined average for the autumn months of September, October, and November for the Escambia River is only about 12 percent; for the Withlacoochee River in west-central Florida autumn flow was about 37 percent; for the St. Johns River was 38 percent; and for the Tamiami Canal Outlets was about 48 percent.

The percentage of summer (June, July, August) flow in relation to the annual flow averages about the same throughout the state and is about equal to that during the winter months (December, January, February), even though about three times as much rainfall occurs during the summer as during the winter. About 20 percent of the annual flow occurs in each of these seasons. An exception is the Upper Peace River basin where a considerably larger percentage of streamflow occurs in the summer than in the winter.

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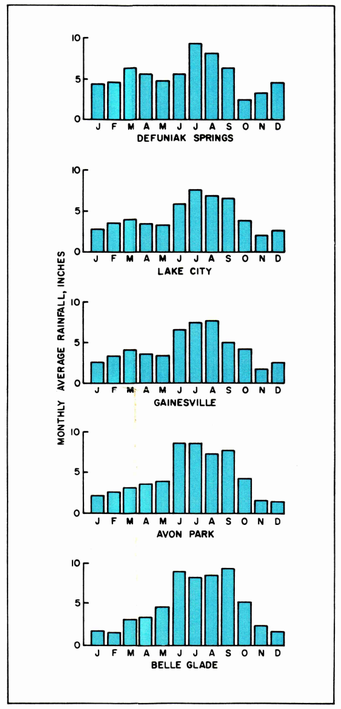

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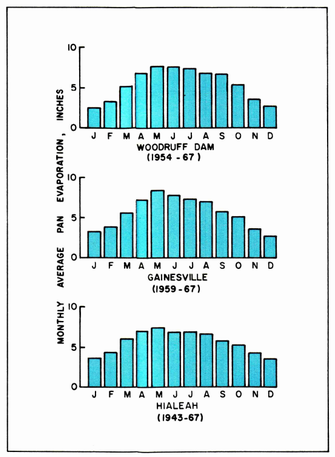

Figure 2. Monthly Average Pan Evaporation at Woodruff Dam, Gainesville, and Hialeah.