More often, arthropods are sampled by concentrating them from larger areas or volumes. This concentration is influenced by the behavior of individuals, which varies between species and thus introduces almost insurmountable problems of bias (Poole 1974). Baiting attracts ants from surrounding areas and preferentially samples species that are generalized omnivores with highly developed recruiting ability. It undersamples specialized predators and ants that forage beneath the litter. Sifting litter concentrates large volumes of bulk litter, preferentially sampling species that (1) are not quick enough to escape the litter-gathering process, (2) can be dislodged from large litter fragments to which they cling, (3) are not crushed by the sifting process, and (4) readily drop from the suspended litter when it is in the extraction bag. Pitfall traps may undersample sit-and-wait predators and species that can cling to vertical surfaces. Intensive manual searching of litter plots (with its concomitant high cost) comes closest to unbiased community characterization, but even in this case the search must be extremely thorough and painstaking so as not to miss extremely small (circa 1 mm long) and cryptic litter ant species. More often than not, small cryptic ants will be undersampled.

Study Objectives

How important these caveats are will depend on the objectives of the study. Study objectives can be portrayed as a set of questions asked of a data set. Here I discuss some of those questions and how to answer them. I use an example data set (Table 13.1) to illustrate the analysis methods that I discuss. This is a real data set, produced by an arthropod survey project in a lowland rainforest in Costa Rica (Project ALAS; see Longino 1994; Longino and Colwell 1997). Each "sample" is the combined ants from 13 soil-litter cores, taken over a 13-month period from the perimeter of a 10-m-radius circle and extracted in Berlese funnels. The soil-litter cores were 14.5 cm in diameter and 10 cm deep. Sixteen samples are shown: eight from old-growth forest and eight from second-growth forest. The values in the table are the numbers of adult workers.

What Is the Rate of Species Accumulation in the Sampling Program?

This question alone has no pretensions of describing community characteristics. The question has relevance to what is called "strict inventory" (Longino and Colwell 1997), in which a goal is compiling the largest possible species list for the least effort. Strict inventory is practiced by taxonomists who wish to sample many taxa efficiently for museum study.

The rate of species-accumulation is observed with a species-accumulation curve (Soberón and Llorente 1993). A species-accumulation curve has some measure of effort on the horizontal axis and cumulative number of species on the vertical axis (Fig. 13.1). Examples of effort measures include number of samples, number of individuals observed, time spent collecting, time required to process and identify specimens, and monetary cost of the inventory process. To obtain a species-accumulation curve from a species-by-sample matrix in a spreadsheet, first accumulate abundance across rows and then replace each nonzero value with 1 (this can be done by dividing each value by itself plus 1, then rounding). The column sums will be the species-accumulation curve (Table 13.2). A particular ordering of samples produces a particular species-accumulation curve. The last point on the curve will be the total number of species observed among all the samples. Changing the order of samples may change the shape of the curve but not the endpoint. A smoothed or average species-accumulation