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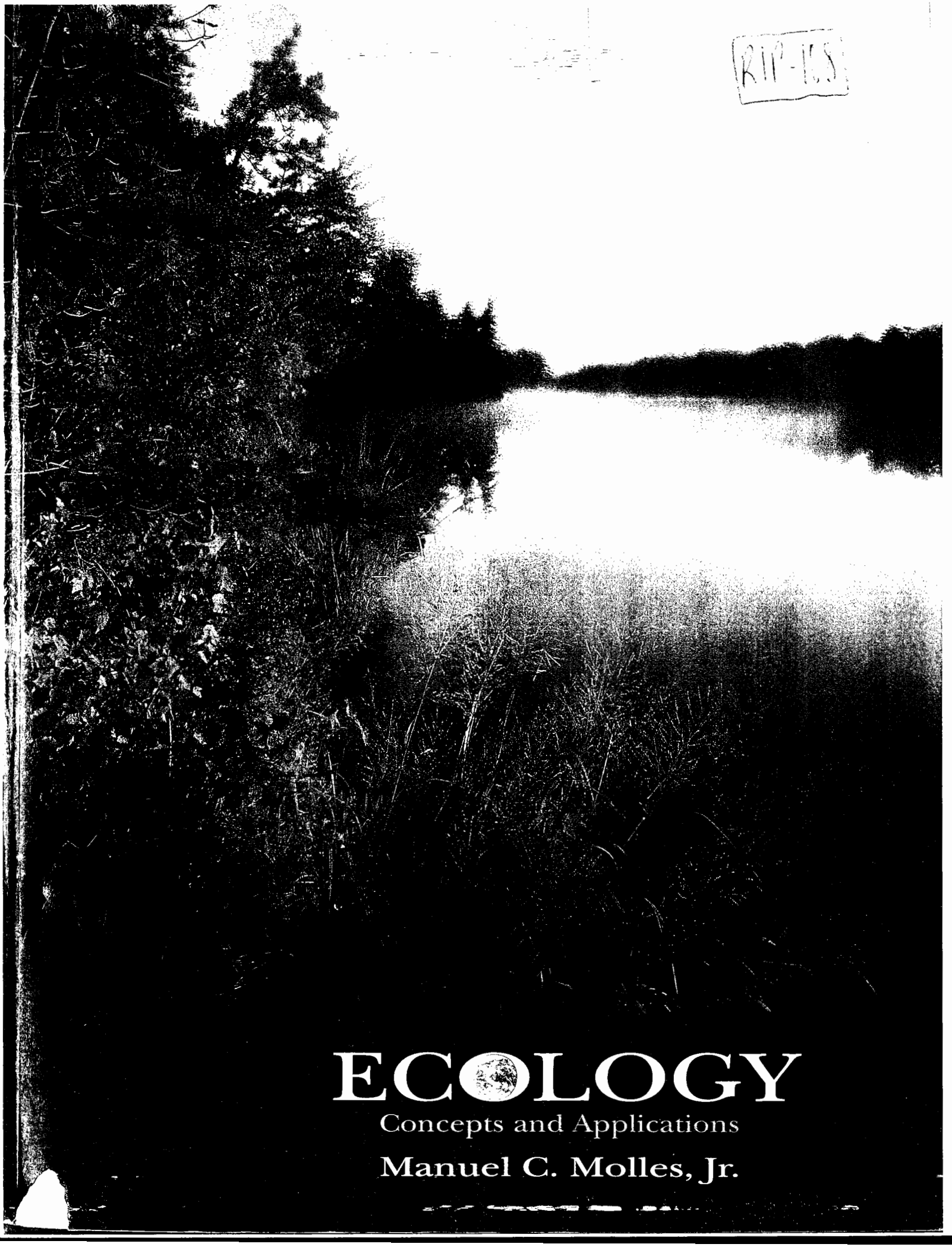

ECOLOGY

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Manuel C. Molles, Jr.
University of New Mexico

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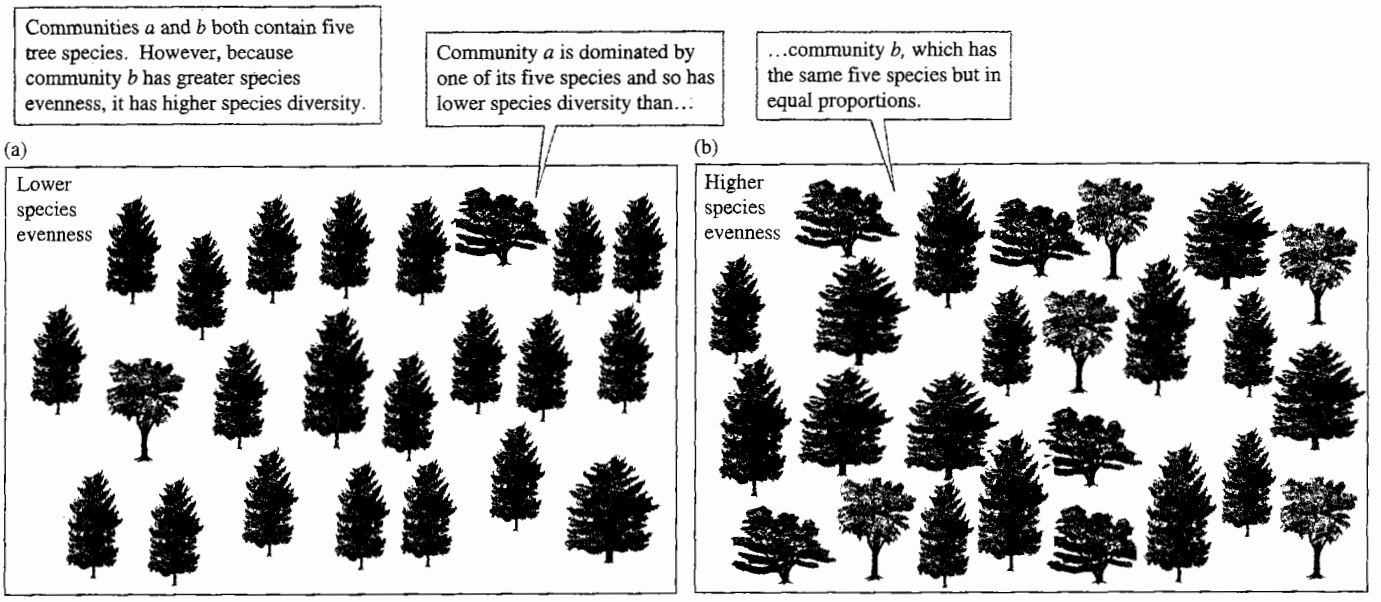

FIGURE 13.5 *Species evenness and species diversity.*

Ecologists define **species diversity** on the basis of two factors: (1) the number of species in the community, which ecologists usually call **species richness,** and (2) the relative abundance of species, or **species evenness.** The influence of species richness on community diversity is clear. A community with 20 species is obviously less diverse than one with 80 species. The effects of species evenness on diversity are more subtle but easily illustrated.

Figure 13.5 contrasts two hypothetical forest communities. Both forests contain five tree species, so they have equal levels of species richness. However, community b is more diverse than community a because its species evenness is higher. In community b, all five species are equally abundant, each comprising 20% of the tree community. In contrast, 84% of the individuals in community a belong to one species, while each of the remaining species constitutes only 4% of the community. On a walk through the two forests, you would almost certainly form an impression of higher species diversity in community b, despite equal levels of species richness in the two forests. That impression can be quantified.

A Quantitative Index of Species Diversity

Ecologists have developed many indices of species diversity, the values of which depend upon levels of species richness and evenness. Let's apply one of the commonly used indices of species diversity to our hypothetical forest communities.

A commonly applied measure of species diversity is the Shannon-Wiener index:

$$H' = -\sum_{i=1}^{s} p_i \log_e p_i$$

where:

H' = the value of the Shannon-Wiener diversity index

p_i = the proportion of the ith species

$\log_e$ = the natural logarithm of p_i

s = the number of species in the community

To calculate H', determine the proportions of each species in the study community, p_i, and the $\log_e$ of each p_i. Next, multiply each p_i times $\log_e p_i$ and sum the results for all species from species 1 to species s, where s = the number of species in the community, that is:

$$\sum_{i=1}^{s}$$

Since this sum will be a negative number, the Shannon-Wiener index calls for taking its opposite, that is:

$$-\sum_{i=1}^{s}$$

The minimum value of H' is 0, which is the value of H' for a community with a single species, and increases as species richness and species evenness increase.

Table 13.1 shows how to calculate H' for our two hypothetical forest communities. The different values of H' for the two communities reflect the difference in species evenness that we see when we compare the two forests depicted in figure 13.5. H' for community b, the community with higher species evenness, is 1.610, while H' for community a is 0.662. We can also use a graph to contrast communities a and b.