

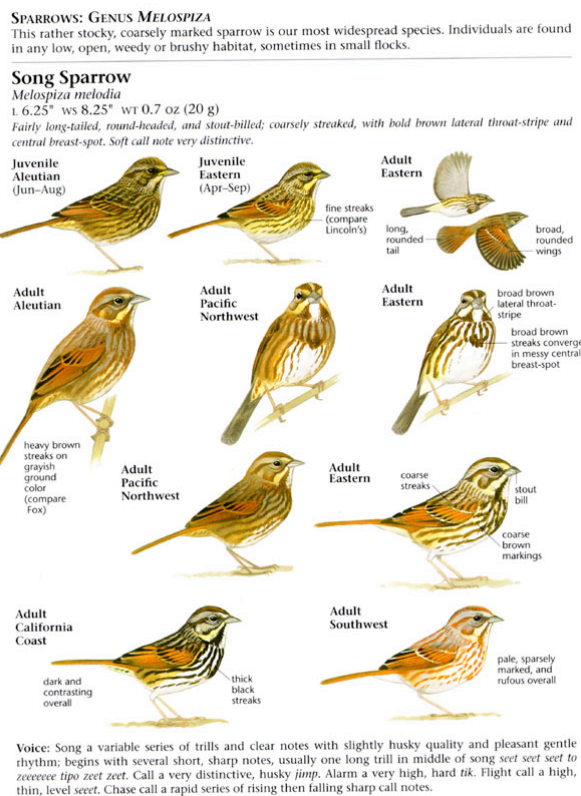
## Variation Correlated With Geography

The phenotypes of the individuals within a species often vary in a systematic way across the range of species. Sometimes, all the individuals in one part of the range will be the same but will be different from the individuals in another part of the range. If these different types of individuals are distinctive enough, each type may be recognized as a **subspecies**. Such differentiation within a species is important because it may lead to **speciation**. This could occur if the different groups within a species became isolated from each other for a length of time sufficient to allow the evolution of **intrinsic reproductive isolating mechanisms**. These are traits that would prevent the individuals of one group from successfully reproducing with individuals of the other group should they ever meet in the wild.

Geographic variation within a species can also be gradual. Such variation is referred to as a **cline**. Clines often occur because of gradual changes in the environment across the range of a species. Ecologists have noted a number of general ways in which the characteristics of the individuals within a species can vary because of climate. Here are three examples:

- **Bergmann's Rule:** The members of a species of warm-blooded animals (endotherms) tend to be larger in colder climates. Larger size decreases the surface/volume ratio and so decreases the rate of heat loss.
- **Allen's Rule:** The extremities (ears, feet, tail) of endotherms tend to be smaller in colder climates. What explanation can you give for this?
- **Gloger's Rule:** The members of a species living in arid regions tend to be lighter in color than those living in more humid regions. Why do you suppose this is?

### Zoogeographic variation in the Song Sparrow (*Melospiza melodia*)





Typical regional variations are shown, but all populations are connected by an unbroken cline of intergrades; many birds seen will be intermediate between those illustrated. Variation is most pronounced in overall color as well as color and thickness of streaking on underparts. Aleutian, Pacific Northwest, and California Coast populations average longer- and thinner-billed than Eastern; Aleutian breeders are 25 percent larger than the general average, while California Coast breeders are 10 percent smaller. There is essentially no variation in voice throughout the range.

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(click to enlarge, from *The Sibley Guide to Birds*, David Allen Sibley, 2000)

The diagram above shows a variety of song sparrow specimens from different populations within the species' North American range. Although this species is migratory, birds of a given subspecies always return during the breeding season to the same general part of the range inhabited by that subspecies. Originally, many of these subspecies were considered full species until additional populations with morphologically intermediate individuals were discovered. The image shows subspecies from: the Aleutian islands in western Alaska, the humid Pacific Northwest, the California Coast, The Northeastern U.S., and the arid Southwest. Which, if any, of the zoogeographic rules are in effect with song sparrow populations?

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