

2. *Nest structure*: Since ants' nests are excavated in the soil, they require no biologically expensive building materials; they are completely flexible as to plan; they are extremely efficient in that they afford a wide range of temperature and moisture conditions, from which the ants can select an optimum.

3. *Nocturnal activity*: Many species are active both day and night and, of course, all ants are able to function in the total darkness of their nests.

4. *Speed*: Many species can run rapidly. This would be especially useful in high altitudes, for there is a lot of work to be done in the short summer.

5. *Omnivorous diet*: The majority of ants are omnivorous; their food consists of insects, honeydew, seeds, and plant exudates.

6. *Integument*: One of the general adaptations of insects to life in any terrestrial environment is an integument that is relatively resistant to water loss. It also aids in the regulation of body temperature, a very important role in small, cold-blooded animals.

Are there, then, any special adaptations of ants for high altitudes? Did evolution need to do any special remodeling before ants could thrive at high altitudes? The answer is no. But color is a preadaptation that becomes especially important at high altitudes. Black and red are common ant colors in all biomes, but there are many ant colors. Among our Alpine Biome ants, however, all species are black or dark brown or a combination of red and black or red and dark brown—colors which absorb heat most rapidly, black being most efficient. Furthermore the bicolored species of *Formica* are polymorphic: the large major workers have the head and thorax (or only the thorax) red, but the gaster is black or dark brown. The smaller workers, however, become progressively more infuscated until the minims are practically black. These small minims warm up and become active earlier in the morning; the larger and redder majors begin work later. If the midday sun becomes too hot for the minims, the majors and medias can keep on working.

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Ant faunas are impoverished at high altitudes. Van Pelt (1963:205) found this to be true of the much lower mountains in the Blue Ridge Province of the southeastern United States, where the highest elevation is 6684 ft: "The number of ant forms, and in most cases the numbers of colonies, decreased with increasing altitude."

W. M. Wheeler (1917:460) made much of slope: "In mountain regions slope exposure in its relation to insolation is a very important factor in the local distribution of ants. . . . Northern slopes in the northern hemisphere are usually, for very obvious reasons, almost or quite destitute of ants. . . . [Forel] finds that ants prefer the eastern and southern slopes as these are the situations in which they have the longest day for their activities during the breeding season, since they are early awakened by sufficiently high temperatures of the soil and air from the lethargy induced by the chill night hours, and even though the slope may be in the shade during the afternoon the warmth is sufficient to sustain their activities till sunset. On western slopes, however, the morning hours are too cool and are therefore practically lost to the ants, whereas the afternoon hours are too warm."

Wheeler also stressed the importance of steepness (p. 462). In front of a steep slope facing the sun the heated air rises more rapidly to greater heights before it is cooled to the general temperature of the stratum it penetrates.

Ants "always greatly prefer the more gradual slopes and alpine meadows, probably because the soil of such places retains a more abundant and more equable supply of moisture and because their surfaces are much less exposed to rapid evaporation both from direct insolation and from air-currents" (W. M. Wheeler 1917:462).

If treeless alpine environment is a harsh one, then a forest ought to be a great improvement. But this is not necessarily so. A dense forest with a solid canopy is a hostile environment. "Ecologically significant are those areas in which no ants are found. All of them are above 6000 feet, and almost all occur within forests of spruce-fir or fir" (Van Pelt 1963:221).