

member of a high-altitude community spends practically all its time devouring and predated [sic] on every other member species" (pp. 80-81).

- (h) The base of the ecological pyramid is Collembola.
- (i) The fauna is impoverished in number of species (perhaps to only three of four in a community), but the number of individuals per species may be very large.

#### ANTS RECORDED FROM HIGH ALTITUDES

Weber (1943:341-346) has assembled a list of records with locations and elevations in meters and in feet. The following totals include only workers recorded above 2000 m (=6560 ft), except in North America where for some unexplained reason he includes only those at or above 10,000 ft: the Himalaya 37 species, other Asiatic records 15, Alps 1, North America 16, South America 12, Africa 62.

Gregg (1963) recorded for Colorado 33 species at or above 10,000 ft. In Nevada there are 19 species at or above 10,000 ft.

*Formica picea lochmatteri*, which is found at an elevation of 15,749 ft in the Himalaya (Weber 1943:351), is the world's highest known ant. The Nearctic champion is apparently *Formica neorufibarbis*, which has been taken at 14,260 ft on the summit of Mt. Evans in Colorado (Gregg 1963:533). The Nevada champion is likewise *Formica neorufibarbis*, taken on Boundary Peak in Esmeralda County at 12,160 ft. (The summit of Boundary Peak is the highest elevation in Nevada: 13,145 ft.)

Deserving special mention here is *Tapi-noma sessile*. Creighton (1950:353) gave its range as "southern Canada and the entire United States with the exception of desert areas in the southwest. The incidence of *sessile* appears to decrease sharply in the Gulf Coast region but it has been taken in Florida, Alabama, Mississippi and Texas." We collected it three times in Deep Canyon near Palm Desert, California (Wheeler and Wheeler 1973:106), which is in the Colorado desert. "The ants have been found to nest all the way from sea level to heights of over 10,000 feet" (Smith 1928:319).

Gregg (1963:446) reported it up to 10,505 ft in Colorado. So the Nevada record of 11,320 ft on Boundary Peak must be the highest not only in Nevada but also anywhere the species is found.

#### ADAPTATIONS

Because the Arctic-alpine is the harshest terrestrial environment on earth, one may ask what special adaptations permit certain species to live and even thrive in it:

1. Pigmentation. The insects of high altitudes have a large amount of melanin in their integument. The black color enables them to warm up faster and earlier in the morning as well as earlier in the season. This ensures them a longer working period during the all-too-short summer.

2. Atrophy of wings. This enables them to stay in their suitable environment in spite of violent winds. (This does not apply to ants.)

3. Prolonged hibernation. Such species hibernate most of the year and sometimes for two years.

4. Subsurface life. Few species live on the surface. (This does not apply to ants, whose workers may be very active on the surface when conditions are favorable.)

5. Increased clothing. Hairs, scales, and wax are more abundant.

6. Cold stenothermy. High altitude insects are usually active at temperatures near freezing; this prevents desiccation. Many develop normally at -1.5 to 5 C (31-41 F) during summer. Some will be killed in a few minutes by exposure to the warmth of a human hand.

#### ADAPTATIONS OF ANTS

Ants by their very nature are preadapted to life in a wide variety of environments, including some of the harshest on earth. We have discussed elsewhere (Wheeler and Wheeler 1973:7) their preadaptations to another harsh environment, the desert:

1. *Social life*: The cooperation of many individuals is advantageous anywhere in foraging, nest construction, defense, and care of the young.