

Passive dispersal on mountain slopes: Shell shape-related differences in downhill rolling in the land snails *Arianta arbustorum* and *A. chamaeleon* (Helicidae)*

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Arianta arbustorum has frequently been observed to fall from the vegetation and, due to its nearly globose shell, to roll down steep mountain slopes. In this way individuals can disperse distances of more than 30 m on slopes partly covered by snow. The probability of dispersing large distances by downhill rolling may depend on a variety of factors such as the inclination and fine structure of the slope, the vegetation height, the frequency and size of hindrances (e.g. rocks) as well as the shell shape of the snails. In a field experiment we examined the downhill rolling of two co-existing land snail species *Arianta arbustorum* and *A. chamaeleon* that differ in shell shape.

Sixteen adult snails from both species were collected on an alpine meadow near Lake Wolay at an elevation of 1970 m in southwestern Carinthia, Austria. The two species differed significantly in shell shape (ratio shell height/shell breadth; *A. arbustorum*: mean 0.80, range 0.74-0.86; *A. chamaeleon*: mean: 0.57, range 0.53-0.62). The downhill rolling of the snails was examined on a NW-exposed snowfield (inclination 32°), located 900 m from the site where the snails were collected, at an elevation of 2000 m at the foot of Mount Seewarte on 28 July 1995. To simulate falling down from the vegetation or rocks each test snail was placed on a flat piece of stone at the upper margin of the snow field. The snails were gently pushed so that they fell 10cm down onto the inclined snow field. There the snails either stopped after having glided a few cm or they began to roll downhill on the snowfield. The distance travelled between the starting point and the place where a snail stopped was measured to the nearest cm.

The two species differed significantly in the distributions of the distances dispersed on the snowfield. In *Arianta chamaeleon* 62.5% of the trials ended within a distance of less than 2 m compared to only 12.5% in *A. arbustorum*. On the other hand in only 4.7% of the trials *A. chamaeleon* rolled downhill 12 m or more compared to 45.3% in *A. arbustorum*. Thus, individuals of the two species differed in the probability of beginning to roll once they landed on the inclined snowfield. *Arianta arbustorum* with a globose shell had a significantly higher probability of rolling downhill than *A. chamaeleon* with a more flattened shell.

Downhill rolling may frequently occur in snails living on steep mountain slopes. However, in most cases rolling snails are stopped either by the vegetation or their descent ends in a depression of the uneven surface of the mountain slope. Nonetheless, downhill rolling can result in large distances dispersed.

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