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HIGH ALTITUDE AGGREGATIONS OF *ANETIA BRIAREA* GODART ON HISPANIOLA (NYMPHALIDAE: DANAINAE)

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ABSTRACT. High altitude aggregations of the danaine *Anetia briarea* Godart were observed near the summit of Pico Duarte (2500–3000 m) in the Dominican Republic. These observations represent the highest elevation record in the West Indies for butterflies and the first report of high elevation aggregations in the genus *Anetia*. *Anetia briarea* and *Danaus plexippus* are now the only two neotropical danaines known to form high altitude aggregations, suggesting that this behavior may be a plesiomorphic character for the Danainae.

Additional key words: Dominican Republic, migration, diapause.

Several aggregations of adult *Anetia briarea* Godart (Nymphalidae: Danainae), with interesting similarities to those of another danaine, the Monarch (*Danaus plexippus*), were discovered on Pico Duarte in the Dominican Republic, the highest peak in the West Indies (3175 m), in September 1988. The aggregations are apparently well known to the local guides who frequent the mountain, as they repeatedly told us of this phenomenon before we reached the area involved. This situation is similar to that of the now-famous Mexican Monarch colonies in Michoacan, the “discovery” of which came as a surprise to locals who had always known they were there (Urquhart 1976).

Seasonal aggregation of Monarch butterflies is a well known phenomenon in the nearctic region (Calvert & Brower 1986 and citations therein), but adults of few other species of Lepidoptera are known to form such aggregations. The Old World danaine, *Euploea core* (Cramer), forms overwintering aggregations in the temperate portions of its range in Asia and Australia (Ackery & Vane-Wright 1984 and citations within). In the Neotropics, only *Eurema daira* (Godart) (Pieridae), *Smyrna karwinskii* (Hübner) (Nymphalidae), and *Calaenorrhi-*

nus fritzgaertneri (Bailey) (Hesperiidae) are reported to form aggregations (Denlinger 1986, DeVries et al. 1987); however, these three species aggregate in moist microhabitats at low to moderate elevations (Muyshondt & Muyshondt 1974, Janzen 1983, DeVries et al. 1987). The southern "tropical" Monarch colonies are high elevation phenomena (Calvert & Brower 1986).

Seasonal aggregation by adult tropical insects is usually associated with reproductive diapause (Denlinger 1986). Adult diapause is reported in only seven species of tropical butterflies (Denlinger 1986, DeVries et al. 1987), including *E. दौरा*, *S. karwinskii* and *C. fritzgaertneri* as well as in the Monarch (Brower et al. 1977). Aggregation during diapause can have several functions in tropical insects. Aposematic species can reduce the chance of predation (Wolda & Denlinger 1984). Aggregation may also reduce evaporative water loss, lower incident radiation, and facilitate mate searching at the end of diapause (Denlinger 1986).

One of five species in the neotropical genus *Anetia* (Ackery & Vane-Wright 1984), *A. briarea* is endemic to the Greater Antillean islands of Cuba, Isla de la Juventud (Isle of Pines), and Hispaniola. Ackery and Vane-Wright (1984) point out that virtually nothing is known of the biology of *Anetia* species. Alayo and Hernández (1987) have summarized knowledge of the Cuban subspecies [*A. b. numida* (Hübner)], repeating the old larval host record of *Jacquinia* (Theophrastaceae) (Gundlach 1881). Schwartz (1989) recently summarized what is known about the nominate subspecies (*A. b. briarea*) on Hispaniola, reporting adults to be inhabitants of mesic hardwood forest, and alluding to possible migratory behavior. Of 46 localities Schwartz recorded for the species on Hispaniola, only 8 are below 900 m elevation. At one of these low elevation sites (Haiti: Fond Parisien, sea level), Gali and Schwartz (in Schwartz 1989) suggest that the many fresh individuals in the area indicated a downward migration from higher elevations. Schwartz' collection records indicate a pronounced seasonality of abundance, the number of records (i.e., specimens) per month being January (1), March (2), April (7), June (45), July (106), August (11), September (1), October (2), December (3). To our knowledge there are no published reports of high elevation seasonal aggregations in this genus.

OBSERVATIONS ON PICO DUARTE

In August and September 1988 we made several trips into high elevation areas of the Dominican Republic, including an ascent of Pico Duarte, the highest peak in the West Indies. Apparently, we were the first entomologists to collect on Pico Duarte. These localities are within Parque Nacional de Almando Bermudez and persons collecting in the

Parque without the proper permits are subject to arrest and prosecution under Dominican law. Enforcement by park personnel is active, and should be taken very seriously.

On 5 September 1988, on Pico Duarte between La Compartacion (2350 m) and the weather station (3075 m), at elevations ranging from 2500 to 3000 m, over a distance of 2 km, we observed several aggregations of *A. briarea* on branches of *Pinus occidentalis* Swartz (Pinaceae). The area was unique in that the trees were festooned with fruticose *Usnea* lichens (Ascolichen: Lecanorales: Lecanorineae) (Plate 1, upper). The forest both above and below this area was also pine, but lacked the heavy loads of lichen.

Aggregations were from 4 m to ca. 10 m above the ground, and rather widely spaced, on mostly east-facing slopes. We estimated that the half-dozen colonies closely examined each had 75–250 individuals. Other individuals were basking or flying nearby. The vast majority in each colony were simply hanging in a clump. The appearance of the colonies was very much like some of the smaller California Monarch colonies on a warm, sunny winter day (Plate 1, lower).

DISCUSSION

The occurrence of high-elevation aggregations of a danaine on Hispaniola brings several questions to mind. First, what is the function of this behavior? As no mating pairs of *A. briarea* were seen in the aggregations we observed, we suggest reproductive diapause is the most likely physiological condition of the aggregating individuals, an hypothesis we plan to investigate on future visits.

Second, what are the seasonal and physical factors involved in this behavior? We have no information beyond our one day of observation, and the testimony of the guides. That the behavior is of long duration and in stable locations cannot be doubted, as it is well known to local people. Schwartz (1989) records a seasonal abundance of *A. briarea* at middle elevations in June and July, and virtually none from September to March. If these dates are indicative of a 7-month reproductive diapause, it would not be unique among tropical insects. Wolda and Denlinger (1984) report reproductive diapause and aggregation of a Panamanian beetle lasting 10 months. Seasonal cues, though less obvious than in the temperate zone, are known to work in the tropics, with daylength and humidity being the best studied (Tanaka & Denlinger 1984, Denlinger 1986). Within the high areas of the Cordillera Central, there are many entomologically unexplored peaks that could be used to isolate and identify the required geographical factors involved.

Lastly, how does this discovery impact our view of better studied danaines and their evolution? Hispaniola occupies a central place in



PLATE 1. Aggregation of *Anetia briarea* in *Pinus occidentalis* on slopes of Pico Duarte, Dominican Republic. Upper: lichen-festooned trees with *Anetia* cluster in center. Lower: close-up of *Anetia* aggregation shown above.

Western Hemisphere danaine evolution. Of the 14 species in the New World, 8 occur on Hispaniola. Of the five spp. of *Anetia*, three occur there. *Anetia* possesses many plesiomorphic characters (Ackery & Vane-Wright 1984), and is considered by some (Forbes 1939) to represent the sister-group of the rest of the subfamily. All five species are montane, with *A. thirza* being recorded up to 3500 m in Costa Rica (Hall 1983). Schwartz (1989) records *A. briarea* and *A. pantherata* up to 2288 m, which is previously the highest elevation record of a butterfly in the Dominican Republic. He records *A. jaegeri* up to 2300 m in Haiti, which is previously the highest elevation record for a butterfly from Hispaniola and the West Indies. Alayo and Hernández (1987) do not record elevations for the Cuban species, but indicate that all are montane.

It is intriguing to compare the behavior of a primitive group of montane danaines, one of which has now been demonstrated to exhibit seasonal migrations and aggregation on high elevation sites dominated by conifers, with the Monarch, which exhibits similar behavior. In fact, a comparison of the Mexican Monarch overwintering sites with those discovered for *Anetia briarea* shows some interesting similarities (Monarch data from Calvert & Brower 1986). The Monarch sites are between 19 and 20°N latitude, whereas the Hispaniolan sites are at 19°02'N. The Mexican sites are between 2928 and 3357 m, whereas the Hispaniolan are between 2500 and 3000 m. In each locality, the two danaines aggregate on conifers on mountain slopes. It is possible that a tropical montane ancestor of the Monarch, similar to *Anetia*, with seasonal high elevation roosts, later evolved to exploit a temperate resource by returning from increasingly long migrations to high-elevation tropical roosts during adverse weather conditions (i.e., winter). Perhaps it is more parsimonious, in light of the very little information known about the New World Danainae, to think of high-elevation aggregation and reproductive diapause as a plesiomorphic behavior for the modern species, and synapomorphic for the subfamily.

These high elevation phenomena are by definition difficult to reach. The fact that this discovery comes so late in the exploration of the West Indies points out the limitations of previous road-based collecting. It will take many more observations by lepidopterists willing to search far beyond the end of the road to test the hypothesis proposed here.

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