

The 'Cake on the plate' syndrome ... and how specialist tansy aphids avoid extinction by hungry predators and parasitoids: insights from the use of polymorphic microsatellite markers

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It was initially shown from 12.2 m high suction trap aerial density data and later confirmed using polymorphic molecular markers (initially allozymes, later high resolution DNA markers, especially microsatellites), that different species of aphids (Hemiptera: Aphididae) have different migratory urges and abilities. Such population genetic differences are manifested in the different patterns obtained for different species: thus highly migratory species (e.g. the grain aphid, *Sitobion avenae* F.) display similar allele frequencies patterns over large geographical distances, apparently intermediate migrants (e.g. blackberry-grain aphid, *S. fragariae* (Walker) and damson-hop aphid, *Phorodon humuli* (Schrank)) show much more local heterogeneity, whilst relatively very 'immobile' species like specialist tansy aphids (i.e. *Macrosiphoniella tanacetaria* (Kaltenbach) and *Metopeurum fuscoviride* Stroyan), which have a metapopulation structure, show highly heterogeneous patterns, even at small spatial scales (see Loxdale & Lushai, 2007 for a review and Massonnet, 2002). If it is indeed true that different aphid species do have different levels of 'migratoriness' manifested as migratory range or ambit, then this may well impact on the ecology and population genetics of the predators, wasp parasitoids and pathogens that attack them.

That different aphids migrate differentially is also no doubt related to the abundance and distribution of their host plant/s (e.g. Cammel et al., 1989) and hence the ease with which the insects not only reproduce but also find new plants when undergoing inter-host migrations during the spring, summer and autumn. The latter often involves in holocyclic species (i.e. with annual sexual phase in which a cold hardy overwintering egg is produced), winged pre-sexual or sexual forms and sometimes, host alternation between a herbaceous spring-summer host and a primary woody host (Dixon, 1998). It is calculated that in the case of the bird cherry-oat aphid, *Rhopalosiphum padi* (L.), only about 0.6% of returning autumn winged migrants find the primary overwintering host bird cherry, *Prunus padus*, and hence can mate and thereby successfully overwinter to produce the next generations (Ward et al., 1998).

Below the boundary level of still air, aphids home in on their hosts using visual and olfactory cues (Dixon, 1998; Irwin et al., 2007). Sexual females have been reported to use pheromones to attract the migrating autumn males (e.g. Pope et al., 2007). The wasp parasitoids (Hymenoptera: Braconidae: Aphidiidae) also use both host plant and aphid cues to find their hosts (Godfray, 1994), and presumably must therefore, where host alternating aphids are concerned, change their behaviour from actively searching on a secondary host/s