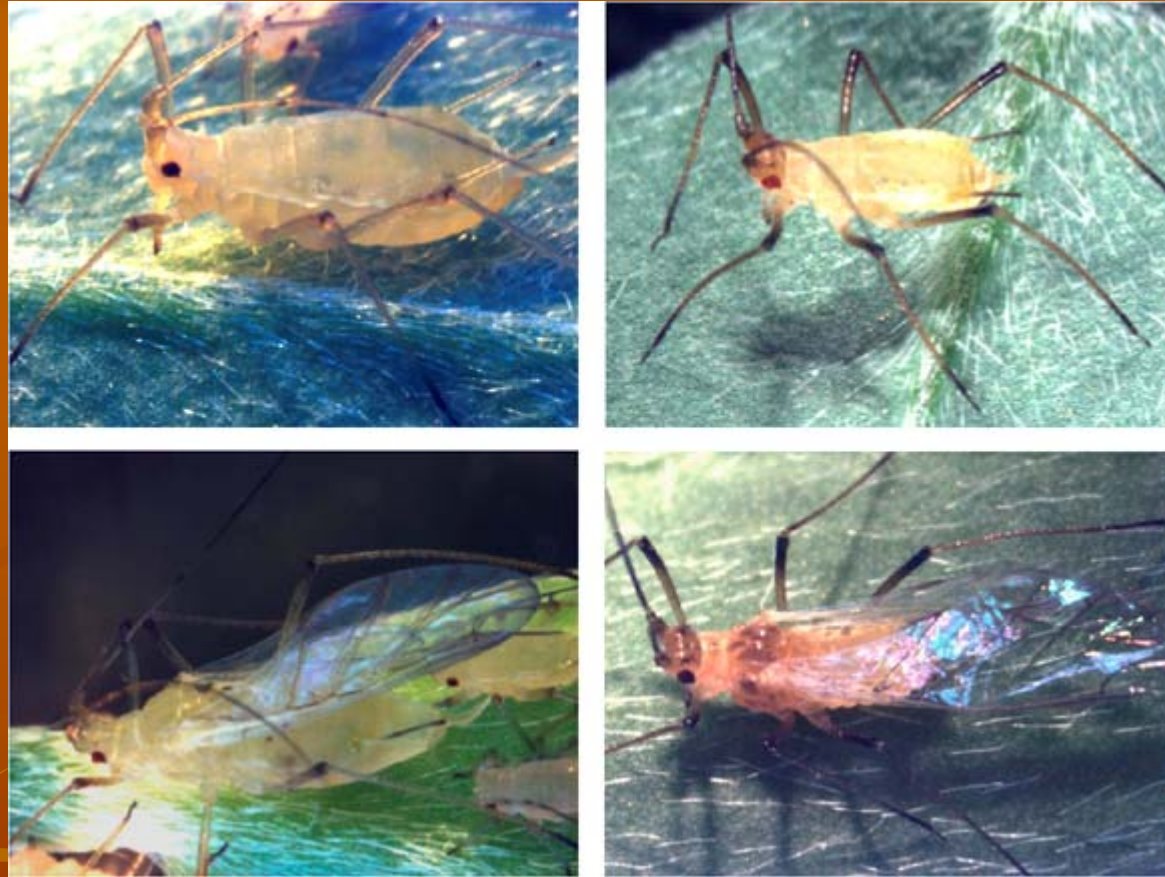


# Aphids

Many species of insects display dispersing and nondispersing morphs. Among these, aphids are one of the best examples of taxa that have evolved specialized morphs for dispersal versus reproduction

- Aphids are a group of about 4,400 species of small insects that feed on the phloem fluid of plants. Many species of aphids attack important agricultural crops and are therefore of major economic importance. Aphids combine three traits - thelytokous parthenogenesis (obligate parthenogenesis where females give birth only to female offspring), short generation time (about 10 days on average), and telescoping of generations (where granddaughters begin developing directly within the daughters which are themselves not yet born) - to reach very large population sizes very quickly. These reproductive characteristics allow aphids to quickly colonize ephemeral resources and quickly growing plants and make them ideal enemies of monocultured crops. Many species of aphids display complex life cycles with alternation of sexual and asexual generations and host plant alternation. Host alternation has evolved at least three times independently in the aphids: (1) in the Phylloxeroidea, (2) in the common ancestor of the Pemphigidae, Hormaphididae, and Anoeciidae (Aphidoidea), and (3) in the Aphididae (Aphidoidea)
- <http://www.tolweb.org/Aphidomorpha>



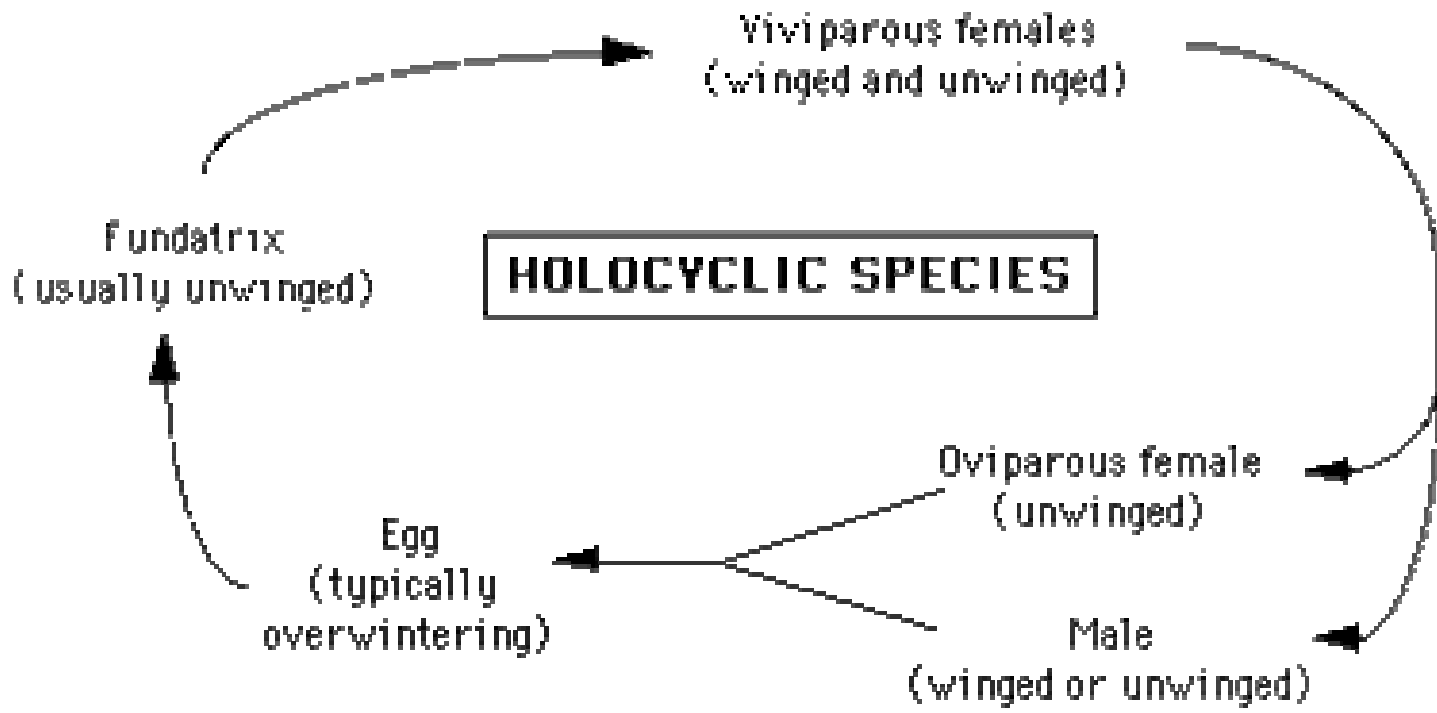
**The female polyphenism (left) and male genetic polymorphism (right). In both cases, discrete alternative wingless (top) or winged (bottom) morphs are produced**  
**<http://www.nature.com/hdy/journal/v97/n3/full/6800863a.htm>**

# Differences between winged and wingless aphid morphs

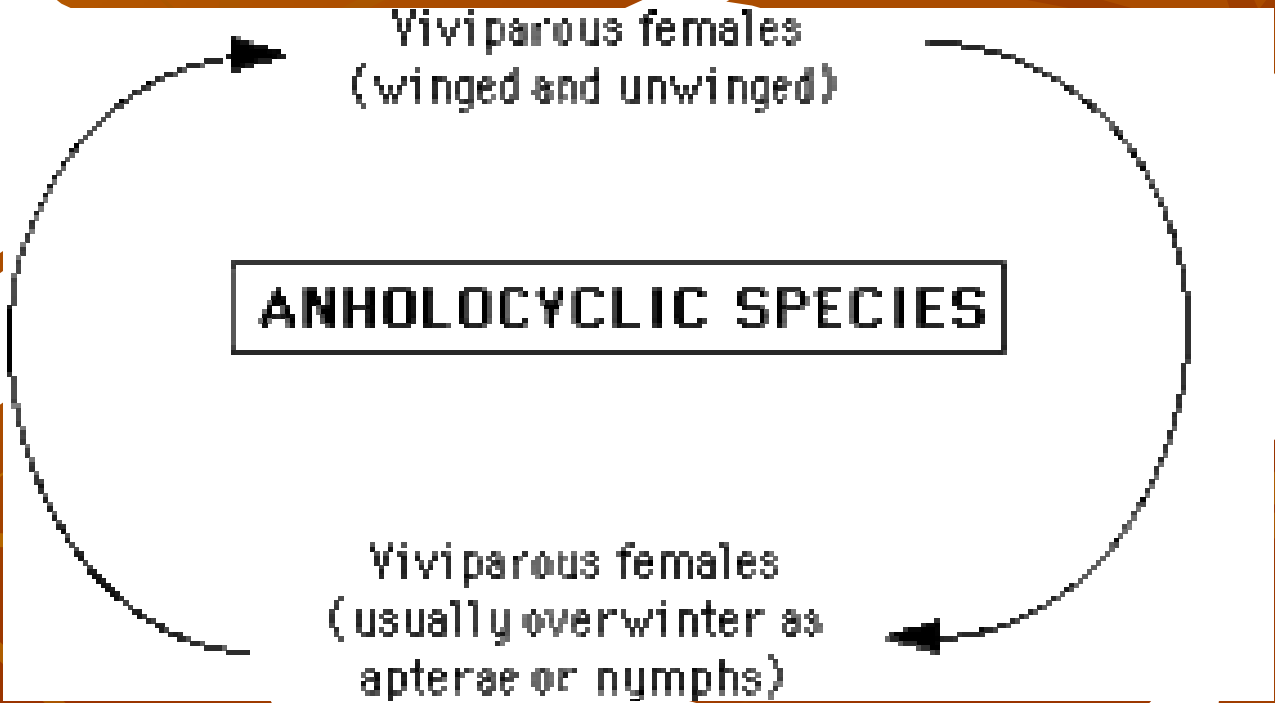
- The winged and wingless phenotypes in aphids differ in a range of morphological, physiological, life history and behavioural features. Besides having wings and functional flight muscles, the fully winged morph exhibits heavier sclerotization of head and thorax, more fully developed compound eyes, ocelli, longer antennae, more rhinaria, and sometimes larger siphunculi and cauda
- <http://www.nature.com/hdy/journal/v97/n3/full/6800863a.html>

## ■ **Alternation of Generations**

- Aphids are one of the few groups of animals that undergo cyclical parthenogenesis - that is, the alternation of one or many generations of asexual (parthenogenetic) reproduction with a single generation of sexual reproduction. All asexual generations are entirely female. Species that produce both sexual and asexual morphs are holocyclic. When a species produces only asexual morphs it is anholocyclic.
- In a holocyclic life cycle, as illustrated below, both asexual and sexual morphs are produced at different times of the year. Note that males are present only in one part of the life cycle. They are produced de novo by parthenogenetic females, usually only in the autumn. Aphids can accomplish this feat because they have an XO sex determining mechanism. Individuals with two sex chromosomes (XX) develop into females, whereas individuals with one X chromosome (XO) develop into males. To produce a male, a special "mini-meiosis", which involves only the X-chromosomes, eliminates one of the X chromosomes during oogenesis. Blackman (1974, 1987) provides a detailed review of the phenomenon .



- In contrast, anholocyclic species only produce asexual females. They do not produce sexual females and males. Comparing the diagram of holocycly above, with the diagram of anholocycly below, notice that more than just the sexual males and females are missing from the anholocyclic species. In fact, anholocyclic species also lose the direct descendants of the sexual morphs, namely the egg and the fundatrix. Since the fundatrix is often specialized for feeding on the primary host (see discussion of host alternation) (anholocyclic species often lose the primary host. Thus, simplification of the life cycle often, but not always, entails both loss of the sexual morphs and loss of host plants. Although many species are either holocyclic or anholocyclic, many other species possess both holocyclic and anholocyclic populations .



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## ■ **Host Alternation**

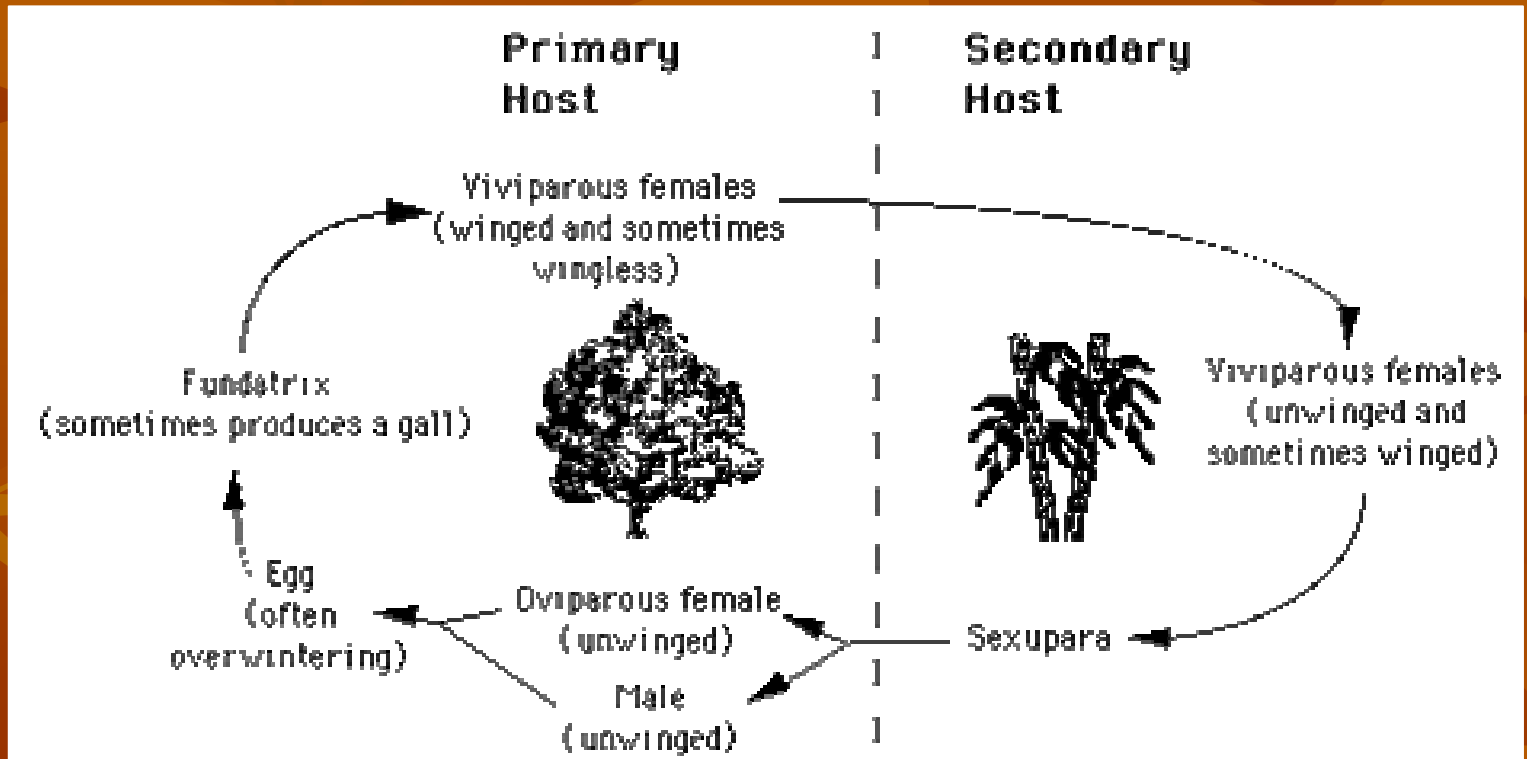
- Many species of aphids alternate between two taxonomically different host plants at different times of the year. When an aphid species uses only a single host plant it is autoecious. Species that alternate between two host plants are called heteroecious. Two distinct kinds of heteroecious life cycles are found in aphids. Species of the Hormaphididae, Anoeciidae and Pemphigidae have a type of heteroecy with sexuparae. Other aphid species with host alternation do not have sexuparae, but have a life cycle with winged sexual females and winged males.

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- A typical life cycle of a heteroecious species from the Hormaphididae, Anoeciidae, or Pemphigidae is illustrated below. Aphids alternate between two taxonomically unrelated host plants. The primary host, a tree or shrub, is considered the "ancestral" host, in that the monoecious ancestor of aphid is thought to have attacked such trees. The secondary host is often an herbaceous plant. A specialized winged morph, the sexupara, flies from the secondary host to the primary host and deposits sexual males and females. The males and females mate and the female typically produces a single egg. In temperate regions the egg overwinters and produces the fundatrix, or foundress, in the spring. In many species the fundatrix induces abnormal plant development that results in a gall in which the colony lives for one or several generations.

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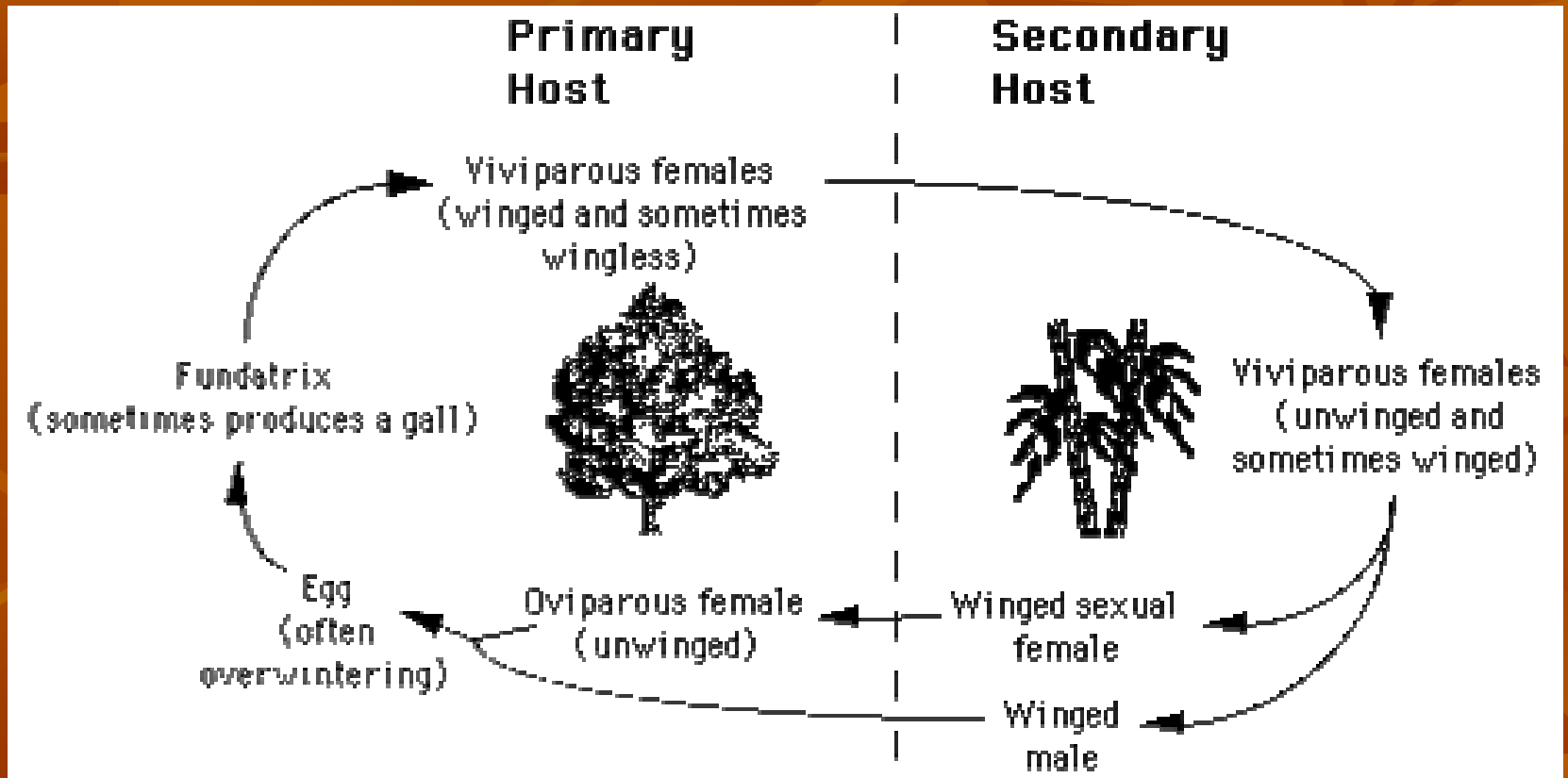
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- Some species of the Aphididae have a different kind of host alternation, as illustrated below. The primary difference is that sexuparae are not produced. Instead, winged males and specialized winged females depart from the secondary host. The females produce unwinged oviparous females that mate with the winged males .

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