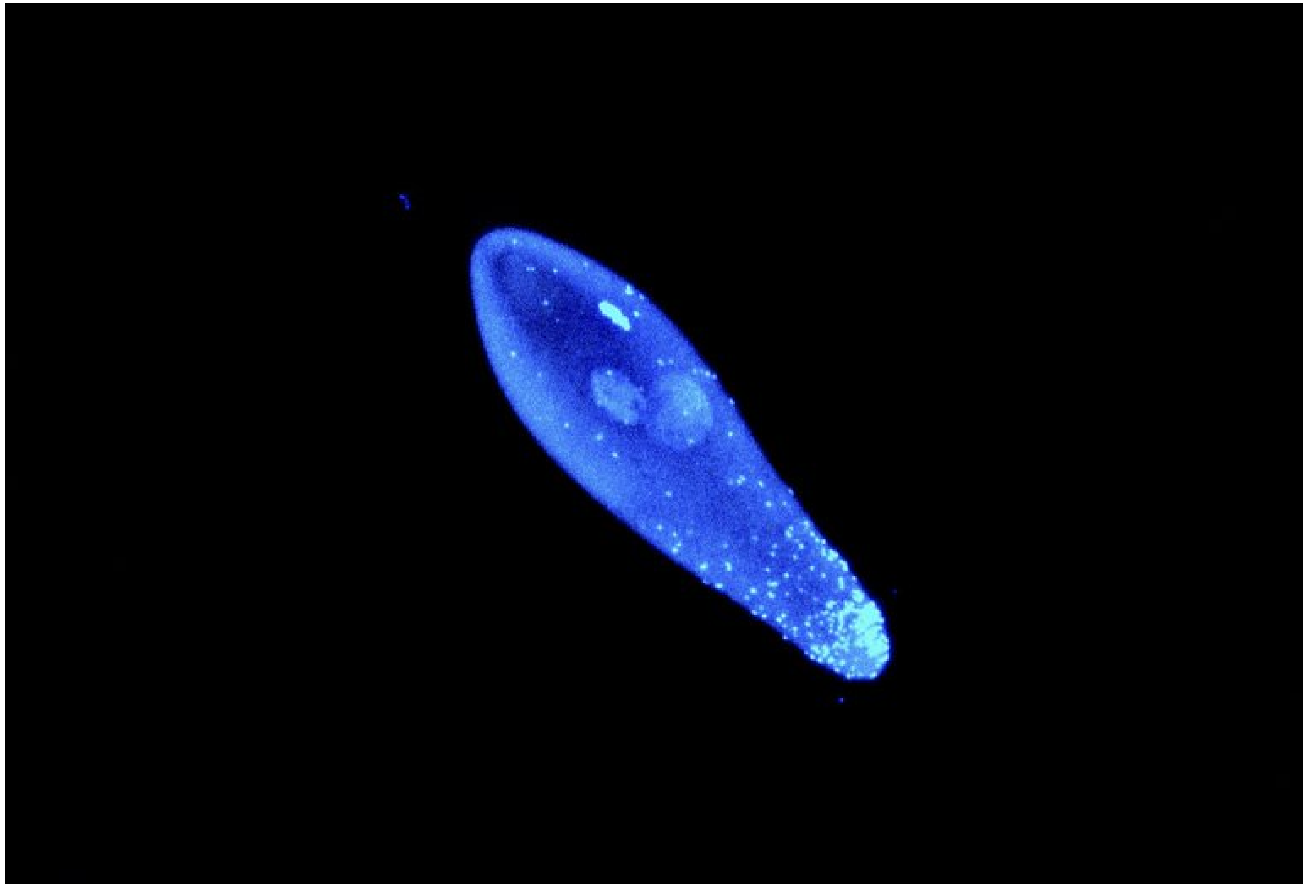
Wolbachia infection among mosquito species of metro Atlanta

James Russell and Rebekah Williams

Georgia Gwinnett College

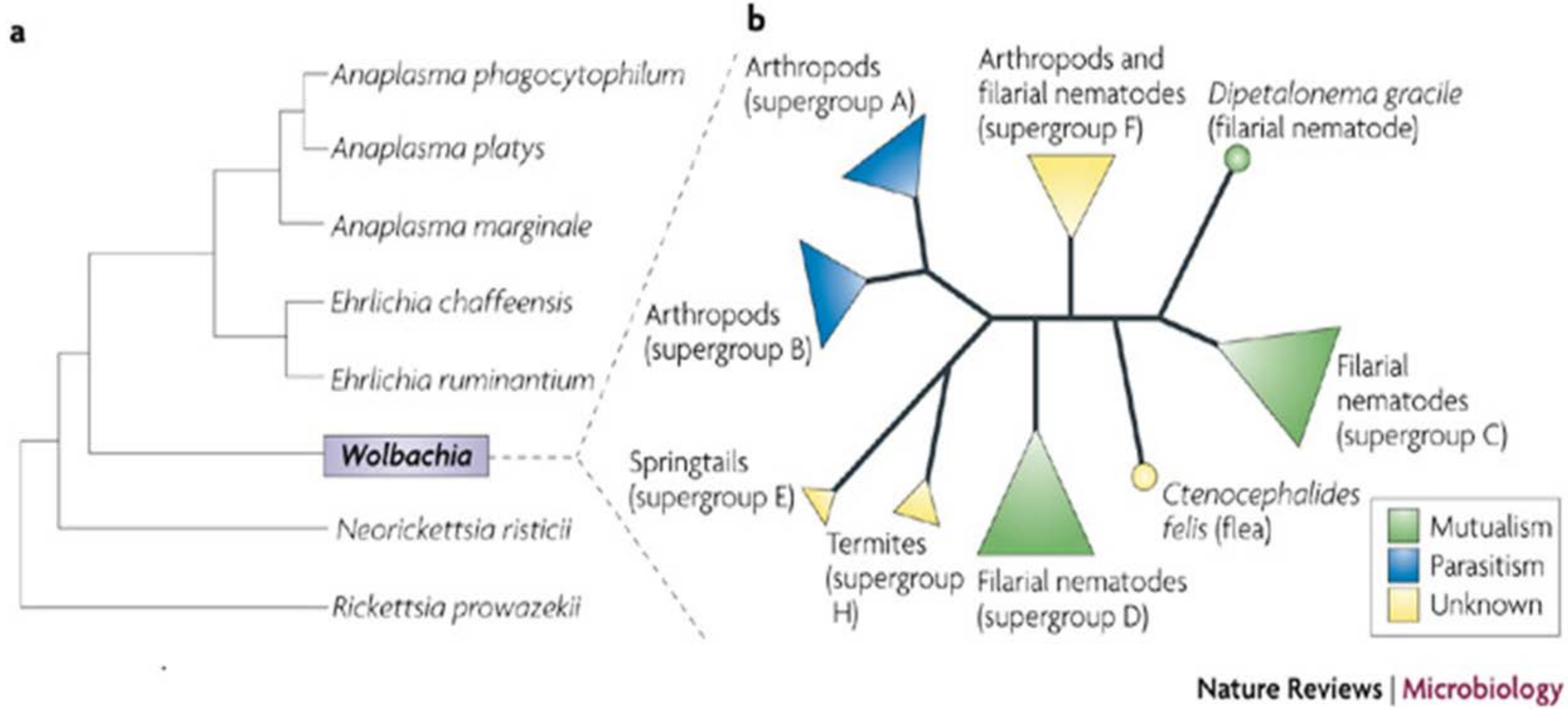
Wolbachia

- Intracellular, maternally inherited symbiotic bacteria
- Found in ~20% of insect species
- Many different symptoms of infection



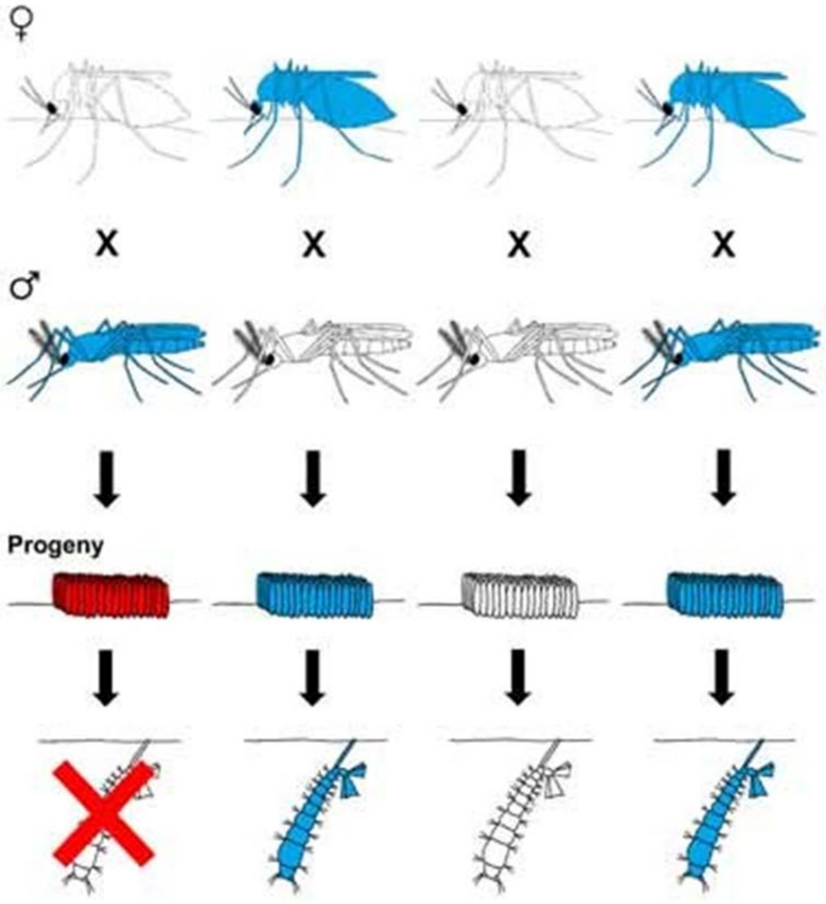
Phenotypes of *Wolbachia*

- Mutualistic:
  - Nematodes
- Parasitic:
  - Sex ratio distortion:
    - Parthenogenesis induction
    - Feminization of genetic males
    - Male killing
  - Reproductive barrier:
    - Cytoplasmic incompatibility

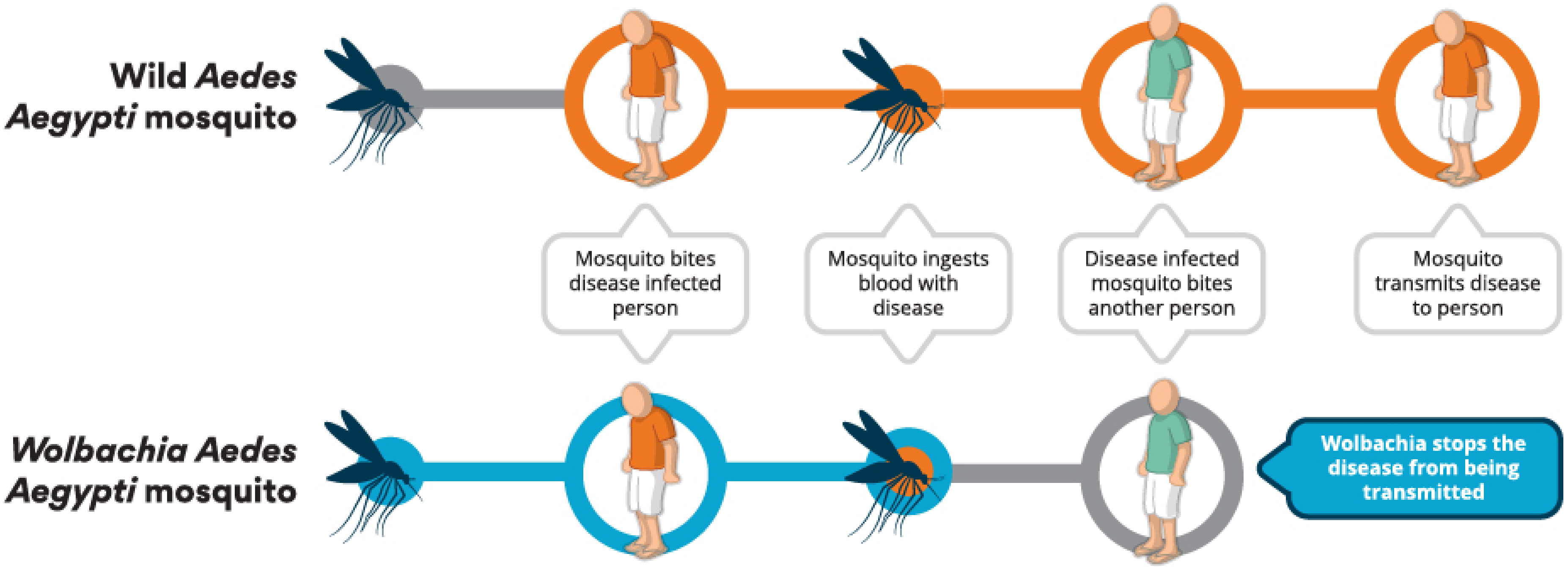


Cytoplasmic Incompatibility (CI)

- Eggs from uninfected females fertilized with sperm from infected males cannot develop



Application (CI)



Application (CI)

OPEN ACCESS Freely available online

PLOS | NEGLECTED TROPICAL DISEASES

Wolbachia Enhances West Nile Virus (WNV) Infection in the Mosquito *Culex tarsalis*

Brittany L. Dodson[1,2], Grant L. Hughes[1,2,3], Oluwatobi Paul[4], Amy C. Matacchiero[5], Laura D. Kramer[5,6], Jason L. Rasgon[1,2,3*]

Consequences of CI *Wolbachia*

- Selection pressure on uninfected females
- *Wolbachia* infection sweeps to fixation (Turelli et al. 1992)
- Eventual speciation due to reproductive barrier (Bordenstein et al. 2001)

Predictions

- Reduced gene flow between uninfected and differentially infected populations
- Linkage disequilibrium: mitochondria and *Wolbachia* inherited together
- Co-evolution between mitochondrial and *Wolbachia* genomes

Significance of Study

- Mosquito-vectored diseases:
  - Arboviruses
  - Parasitic helminths: heartworm
  - Protozoans: malaria

Smart Science: Wolbachia Bacteria Might Stop Zika and Dengue Viruses (Forbes 2016)

Collection and Morphological Identification

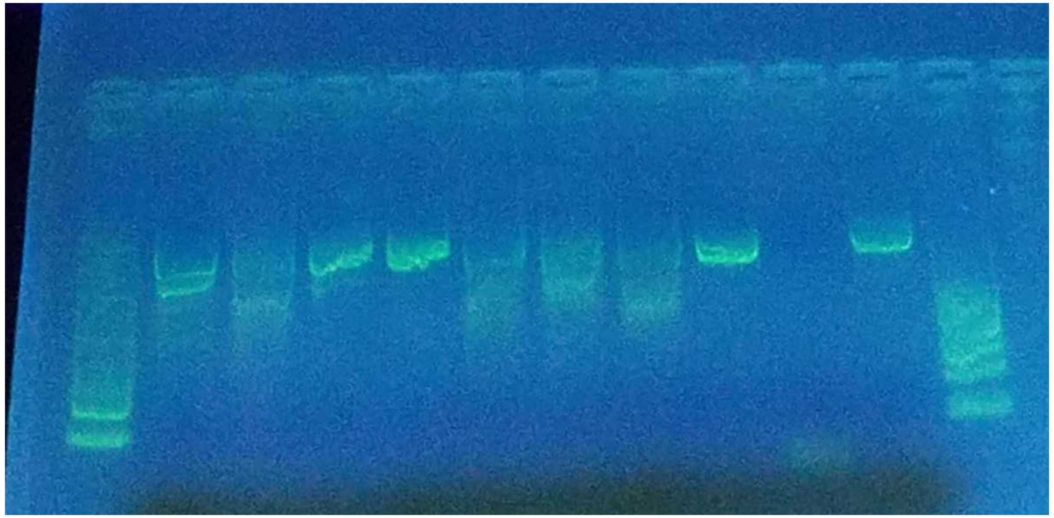
Anopheles punctipennis

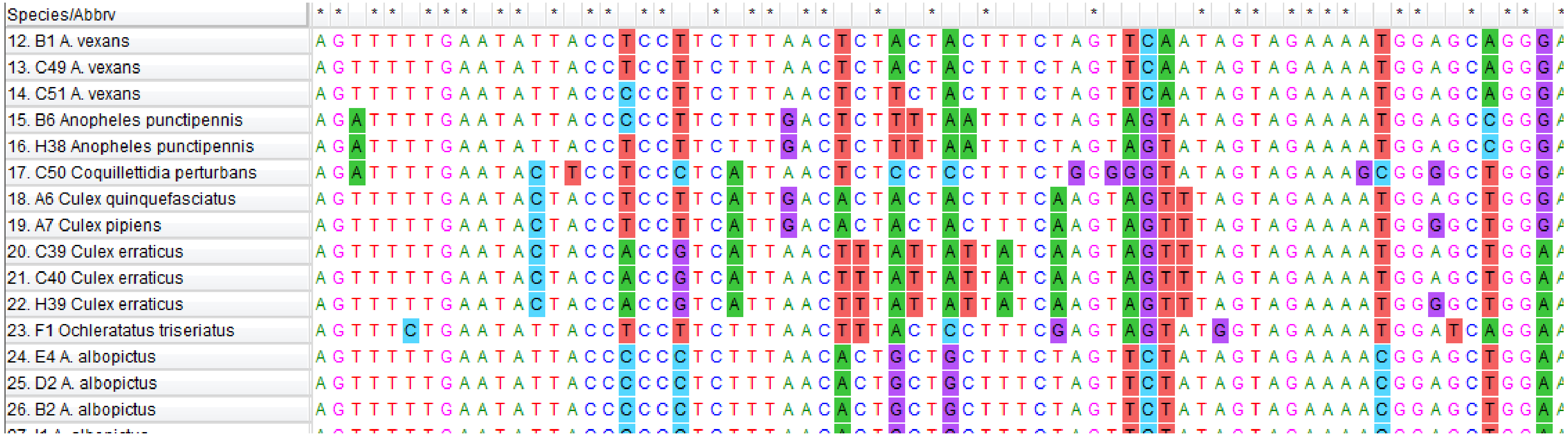
Culex spp.

- CDC light trap baited with dry ice as a source of CO_2

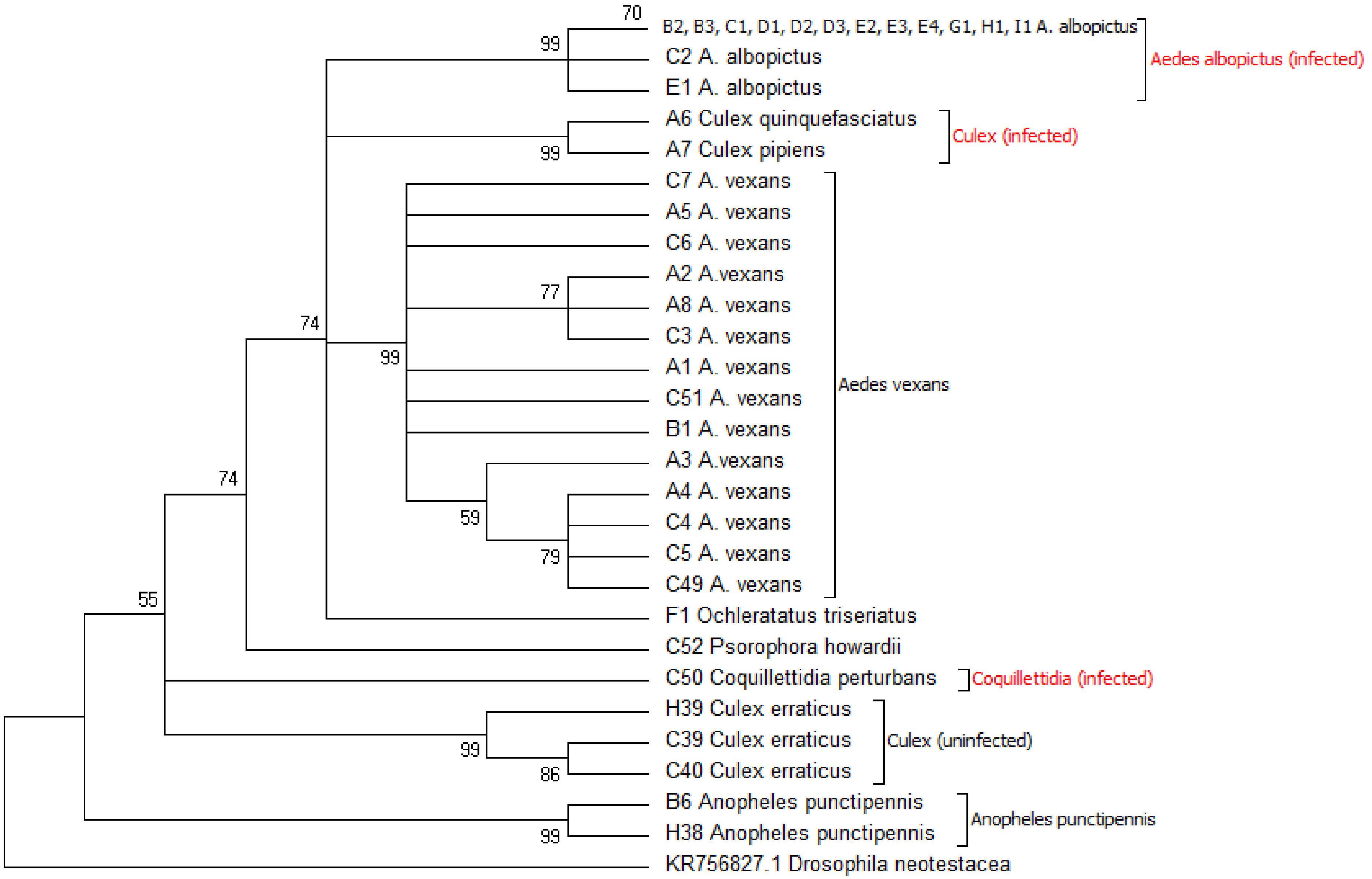
Molecular Identification & Phylogenetic Analysis

- DNA sequencing
- Alignment and neighbor-joining analysis

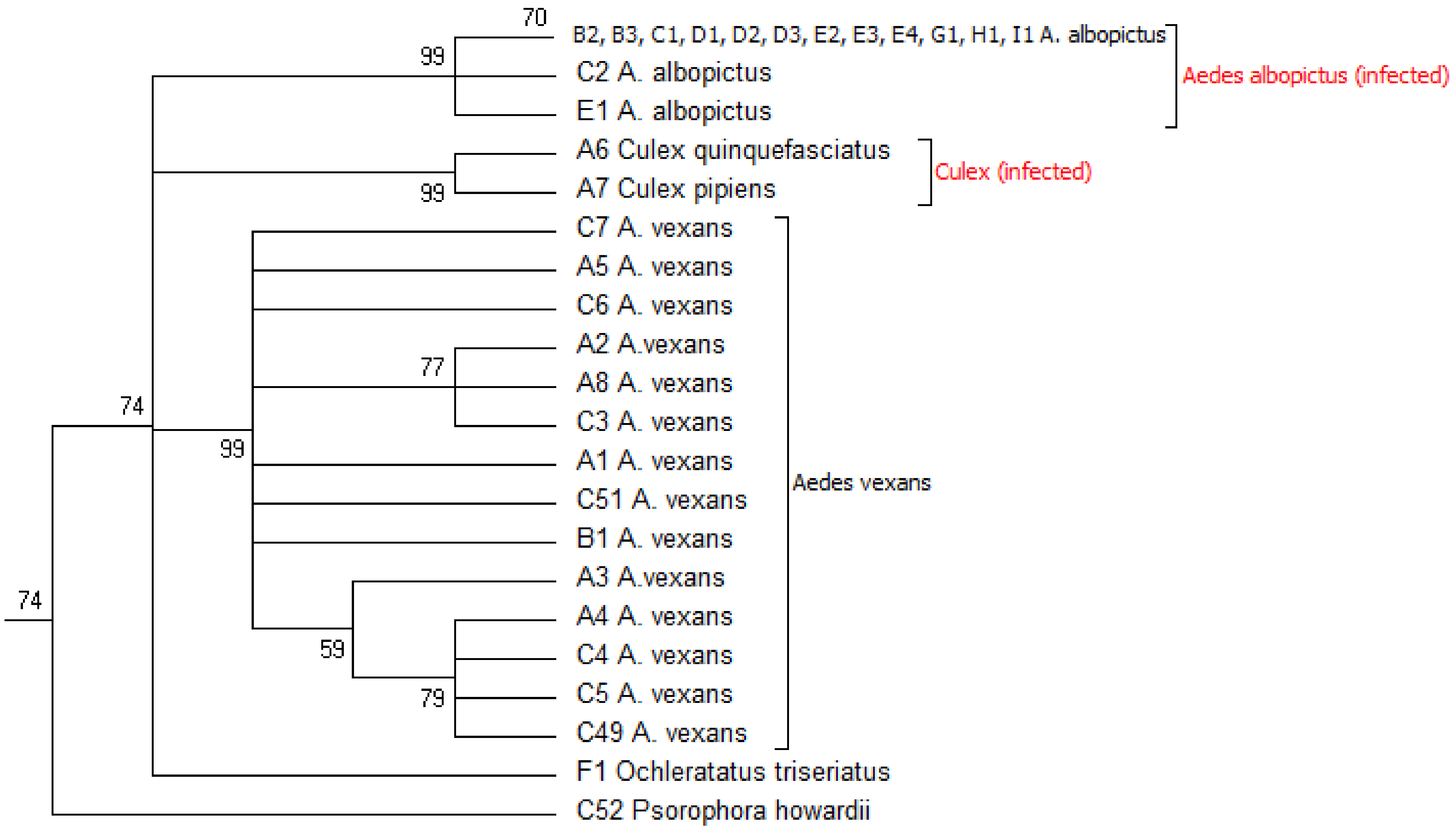




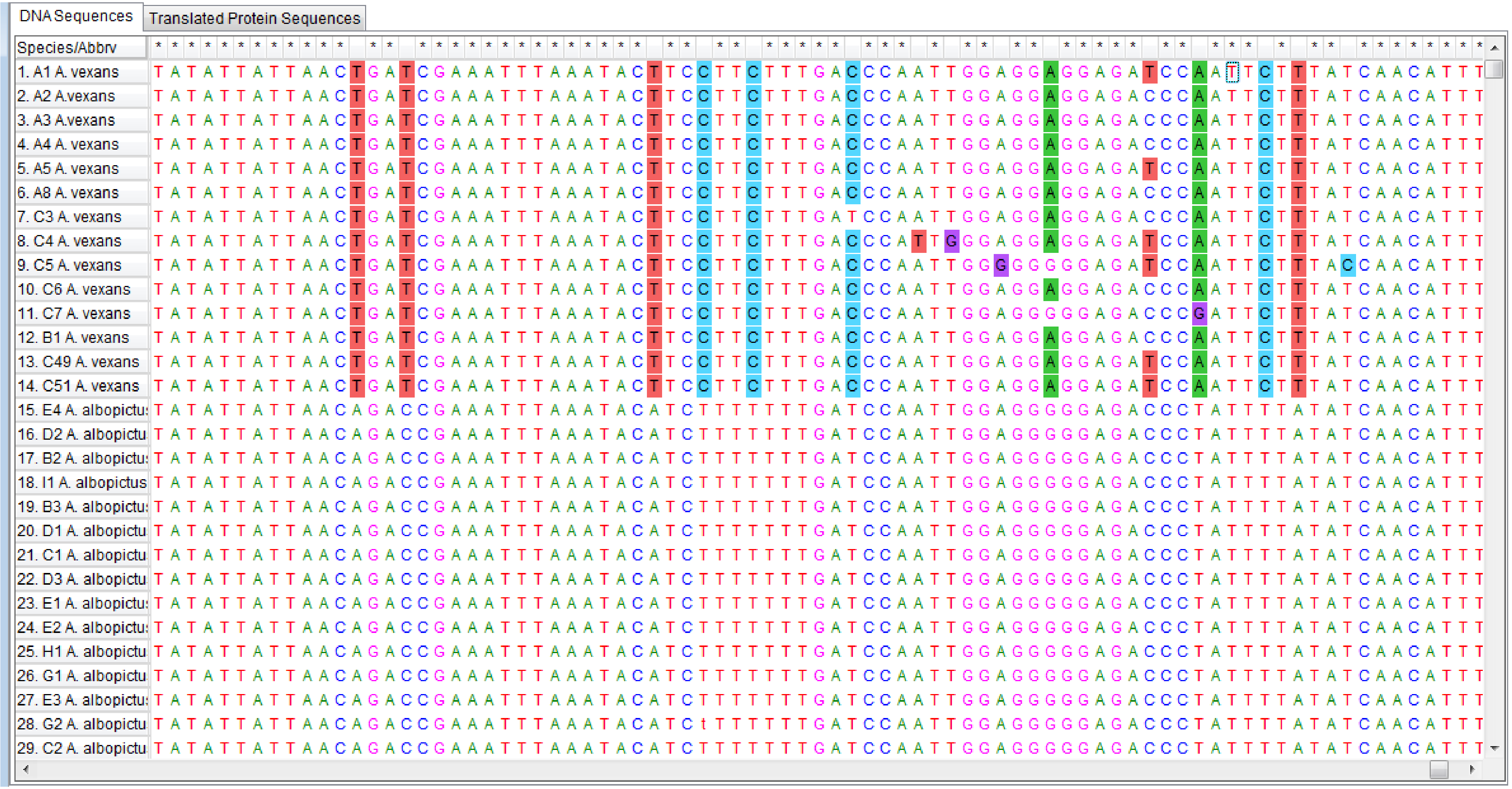
Mitochondrial diversity



Aedes diversity

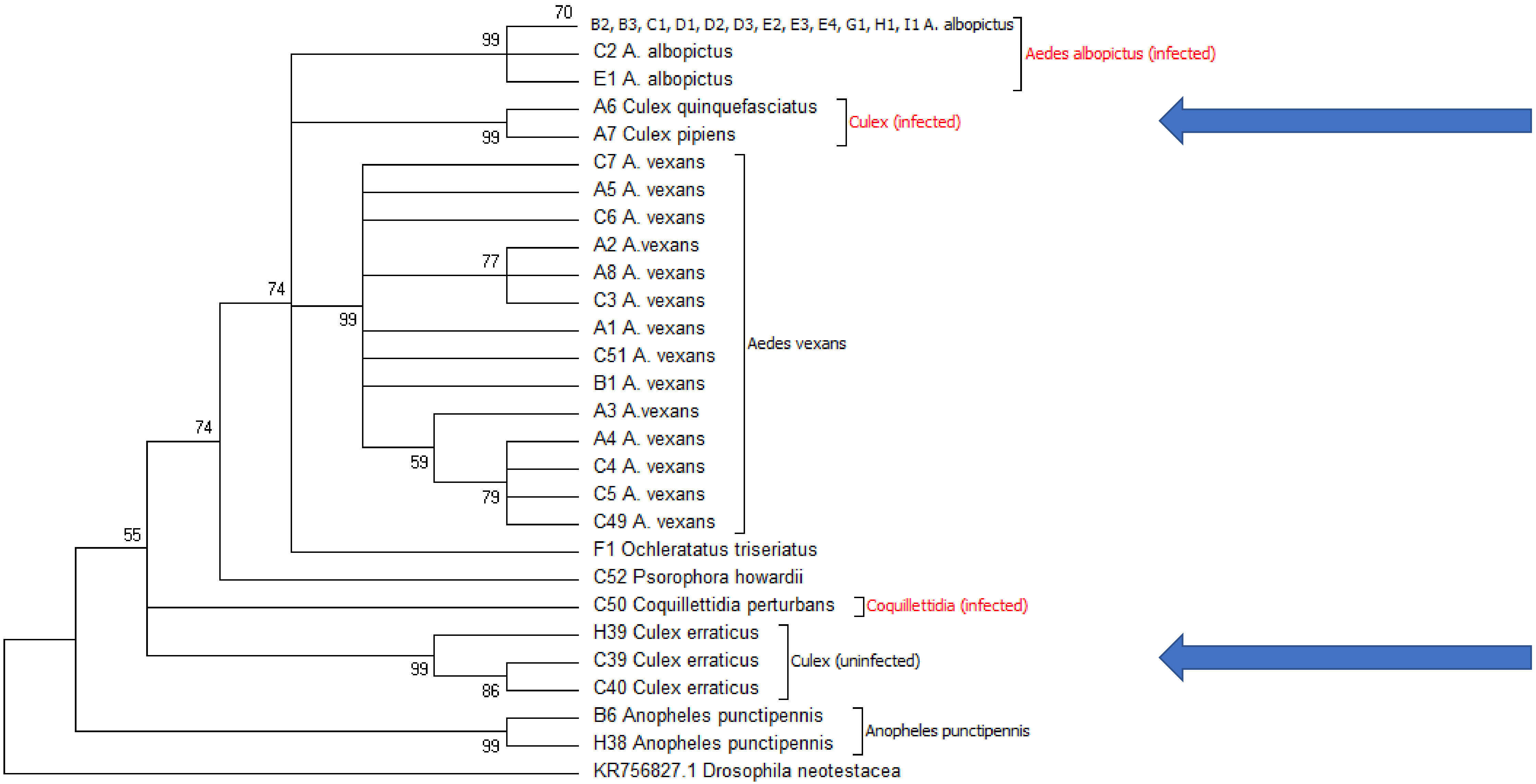


Aedes diversity

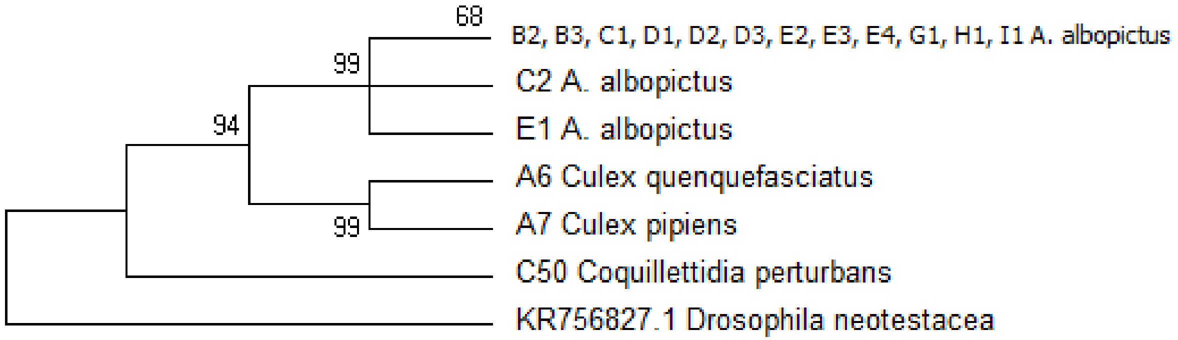


- Alignment of all *Aedes* sequences illustrates difference in genetic variation between mosquitoes uninfected and infected with *Wolbachia*

Culex infected vs. uninfected

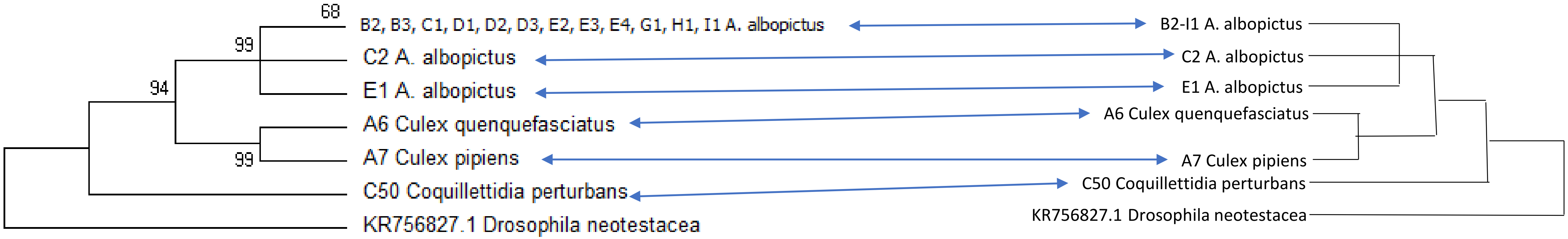


Infected mosquito diversity



Observed *Wolbachia*-positive mosquito diversity

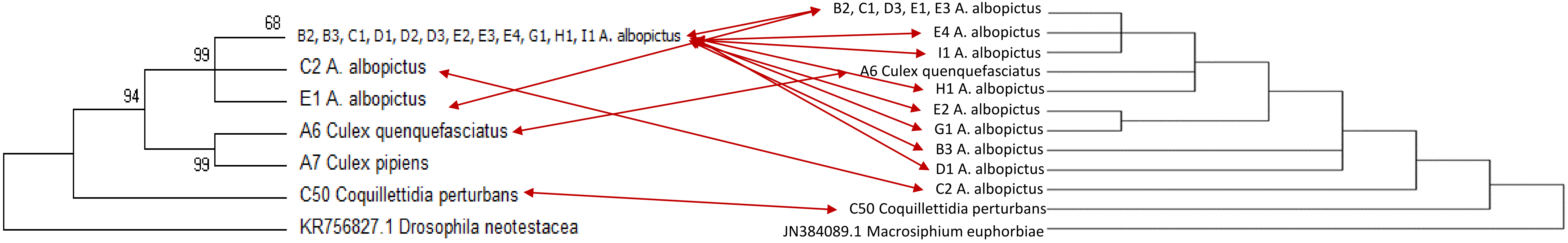
Infected mosquito diversity



Observed *Wolbachia*-positive mosquito diversity

Expected *Wolbachia* diversity

Infected mosquito diversity



Observed *Wolbachia*-positive mosquito diversity

Observed *Wolbachia* diversity

Conclusions

- Selective sweep among infected *Aedes* mosquitoes
- *Wolbachia* influences evolution of infected mosquitoes so they appear more related to other infected mosquitoes than uninfected mosquitoes within the same genus
- Potential for horizontal transmission of *Wolbachia* (water mites)

Future Research

- More mosquito samples and sequences to further support/reject co-evolution and relatedness of infected species
- Nuclear genes or strain specific primers to clarify effect of *Wolbachia* on mosquito evolutionary history
- Possible future screens for arboviruses in locally collected mosquitoes