A Friendly Reminder that AToL Is Really ANoL

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Main Points

- **Reticulation (hybrid speciation and horizontal gene transfer/introgression) is so common in some groups that the AToL project should incorporate it from the outset.**

- **Detection and reconstruction of reticulation is in its infancy.**

- **Combined data analyses will require explicitly ruling out reticulation.**

- **Systematics will need to become more intimate with population genetics.**

Unruly Nature

Whatever is not forbidden will occur.

-- Gerald Myers

(ca 1980)

In Other Words

- **If a set of genes can be brought together in a cell, survival and reproduction will be determined by the phenotype produced in the environment of the organism.**

- **If the organism can survive and reproduce as well as or better than its competitors, it "works" no matter the mating/process that produced it**

Evidence of HGT in Bacteria

- **Relatively large proportions of bacterial genomes appear to be subject to horizontal gene transfer.**

- **Recent evidence indicates there is probably a "core" set of genes that are unlikely to be involved in HGT (Daubin et al. 2003. Science 301:829).**

- **Can these low transfer genes be routinely identified and used for reconstruction?**

  - **Need to look in order to know**

Hybrid Speciation in Eukaryotes

- **Primarily found in plants, but also some fish and amphibians**
  - **Also in some reptiles but these are usually sterile asexual lineages.**
  - **What's up with fungi?**
- **Most recent estimates suggest that about 7% of new fern lineages have arisen by hybrid speciation and 3-4% of angiosperm lineages (Otto and Whitten. 2000. Annu. Rev. Genet. 34:40)**

Current Methods for Detecting and Reconstructing Hybrid Speciation are in their Infancy

Phylogenetic Trees: Models, Methods, and Results

- **Models of speciation: YES**

- **Models of sequence evolution: YES**

- **Tree distances and accuracy measures: YES**

- **Methods and optimization problems for tree inference: YES**

# Phylogenetic Networks: Models, Methods, and Results

- **Just two years ago:**
  - **Models of speciation: NO**
  - **Models of sequence evolution: NO**
  - **Network distances and accuracy measures: NO**
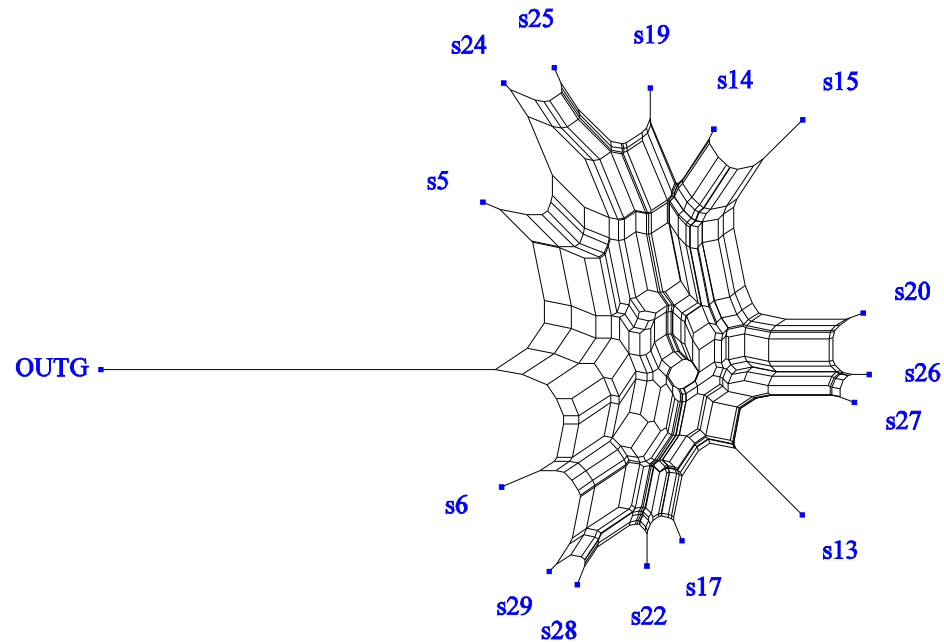 - **Methods and optimization problems for network inference: YES/NO**

Where We Are Today

- **Models of speciation: yes**
- **Models of sequence evolution: yes**
- **Network distances and accuracy measures: yes**
- **Methods and optimization problems for network inference: yes**

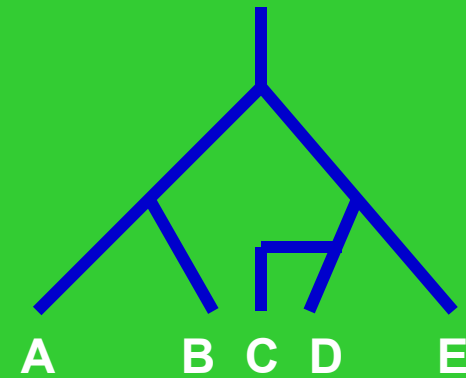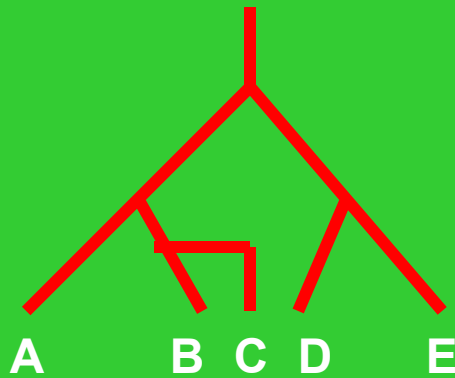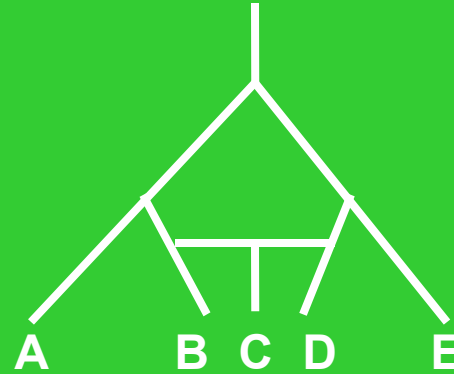# Reconstruction Quality Model Phylogeny: 20-taxon 1-hybrid network
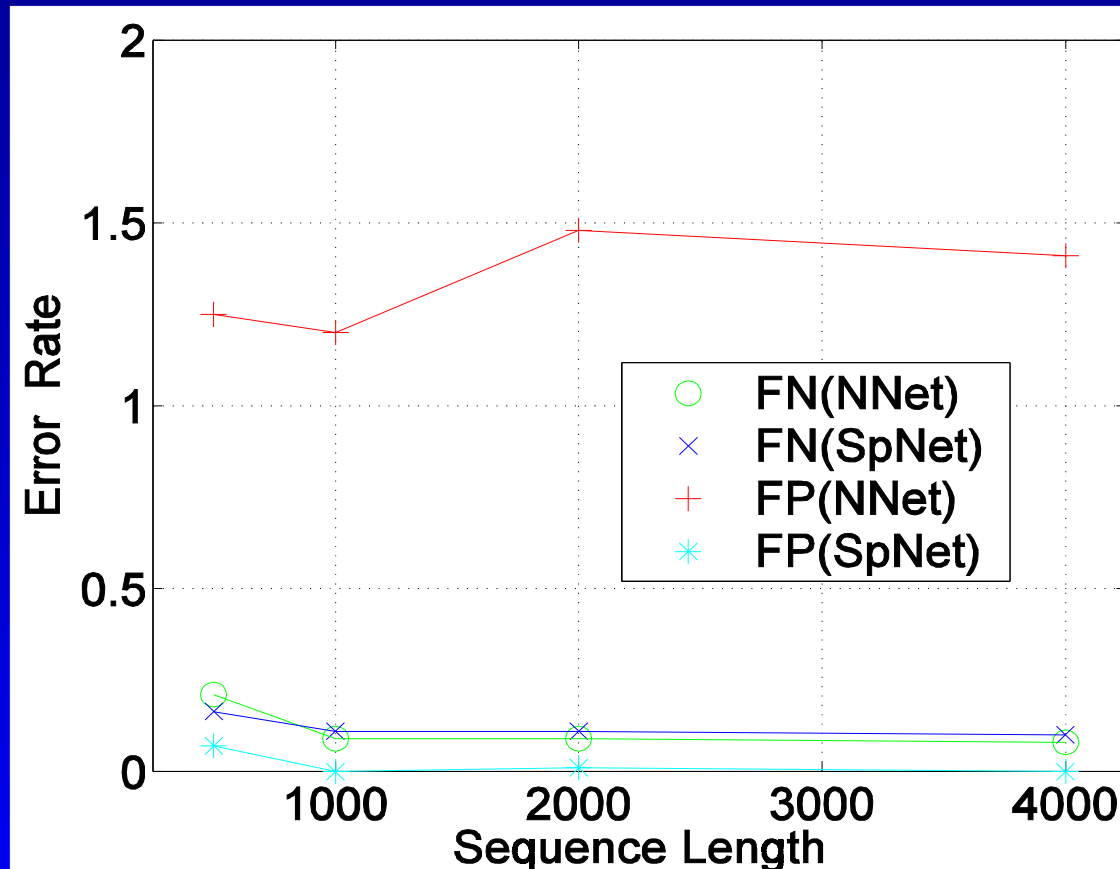
NeighborNet: False Positives

Open Problems in Hybrid Speciation

- **Detecting reticulation**
- **Representing reticulate evolutionary scenarios**
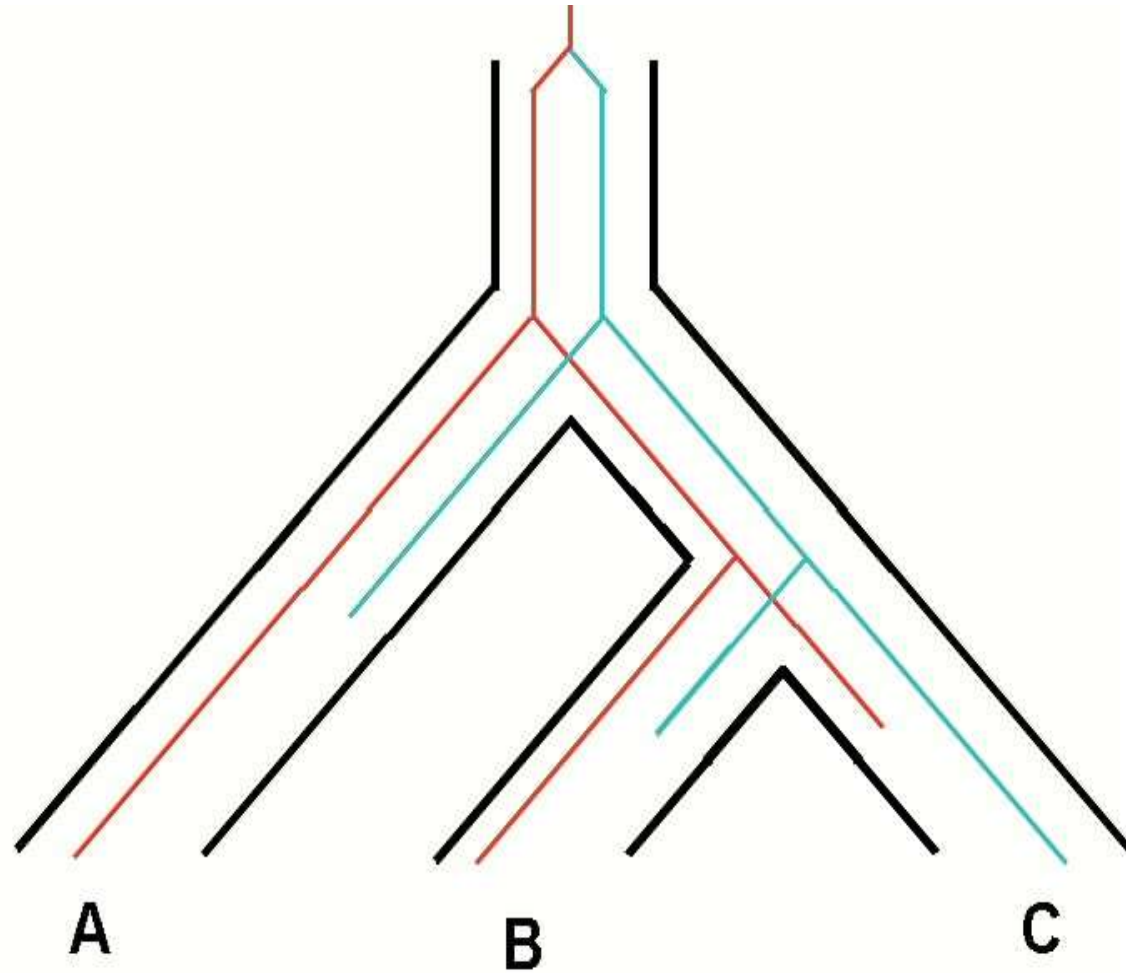- **Inferring reticulate evolution**
- **Visualization**
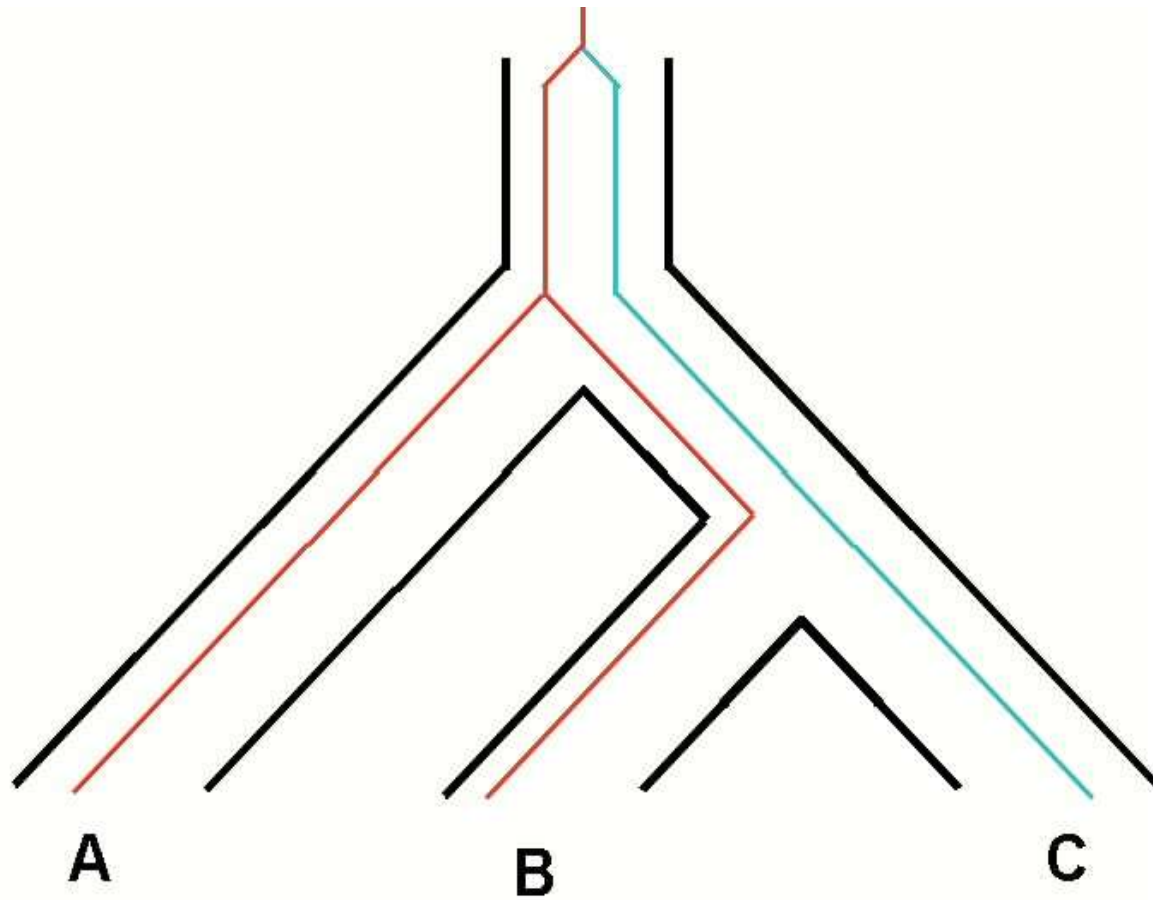
Deciding Whether to Combine Datasets

Population Genetic Issues

- **Population genetic reticulation masquerading as hybrid speciation**
  - **Meiotic recombination**
  - **Sexual recombination**
- **Lineage sorting**
- **Resolving this will require combining coalescent models with phylogenetic models**
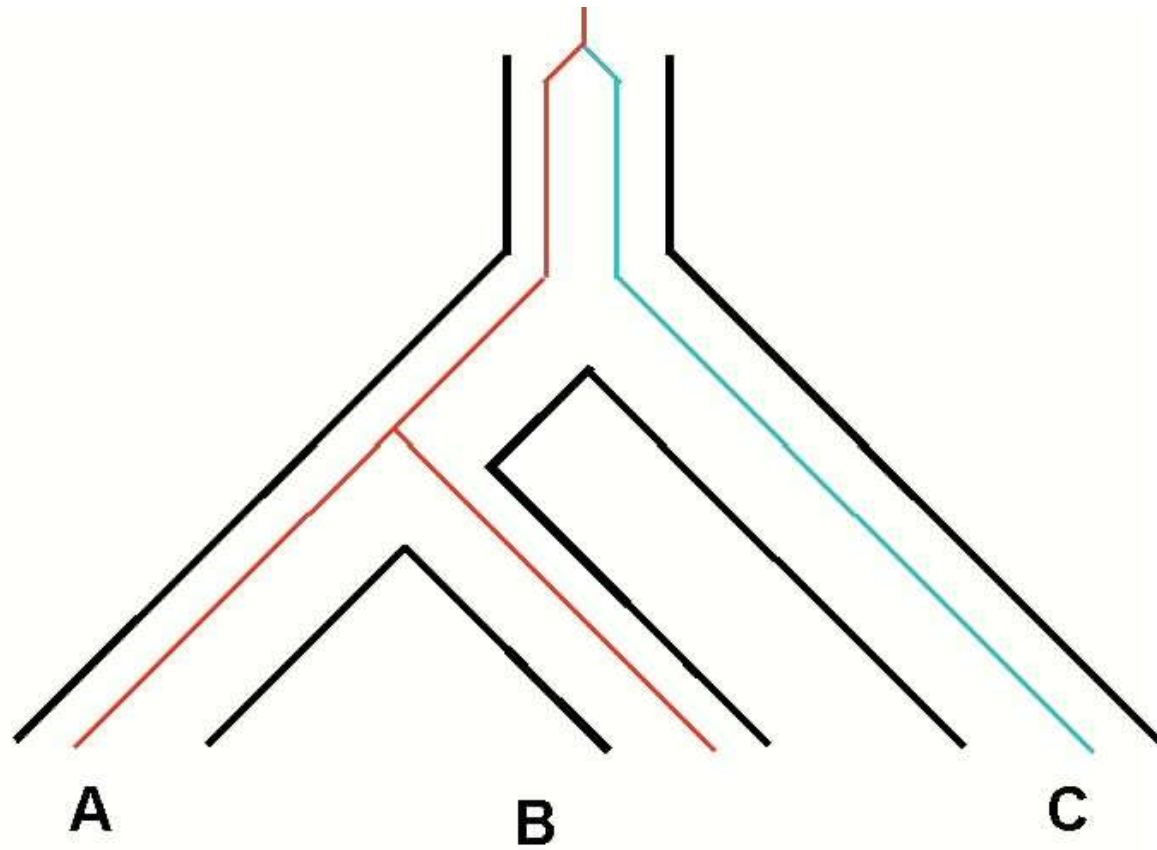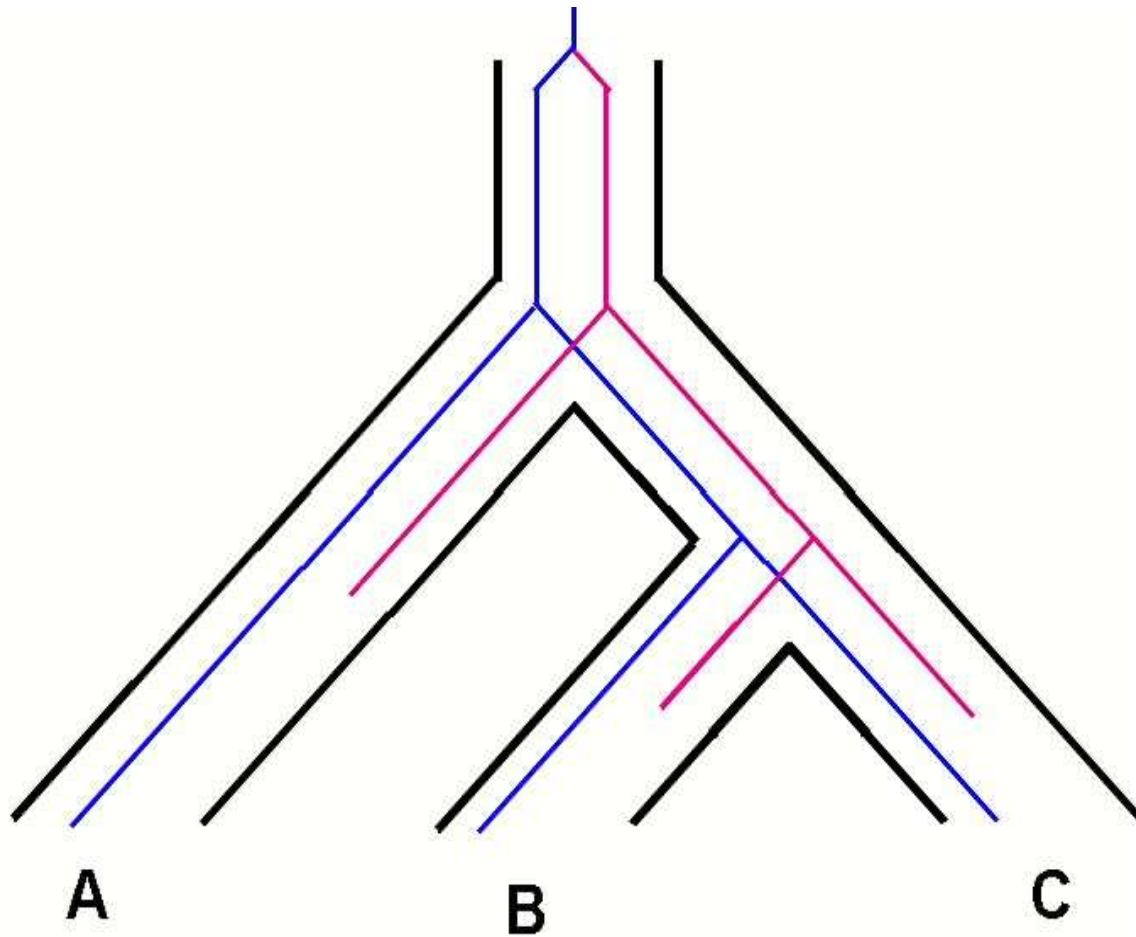
Lineage Sorting: Gene Tree/Species Tree

Gene Tree/Species Tree

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