

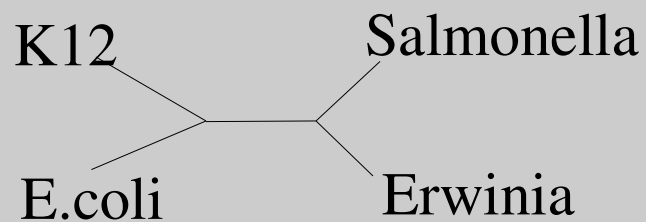
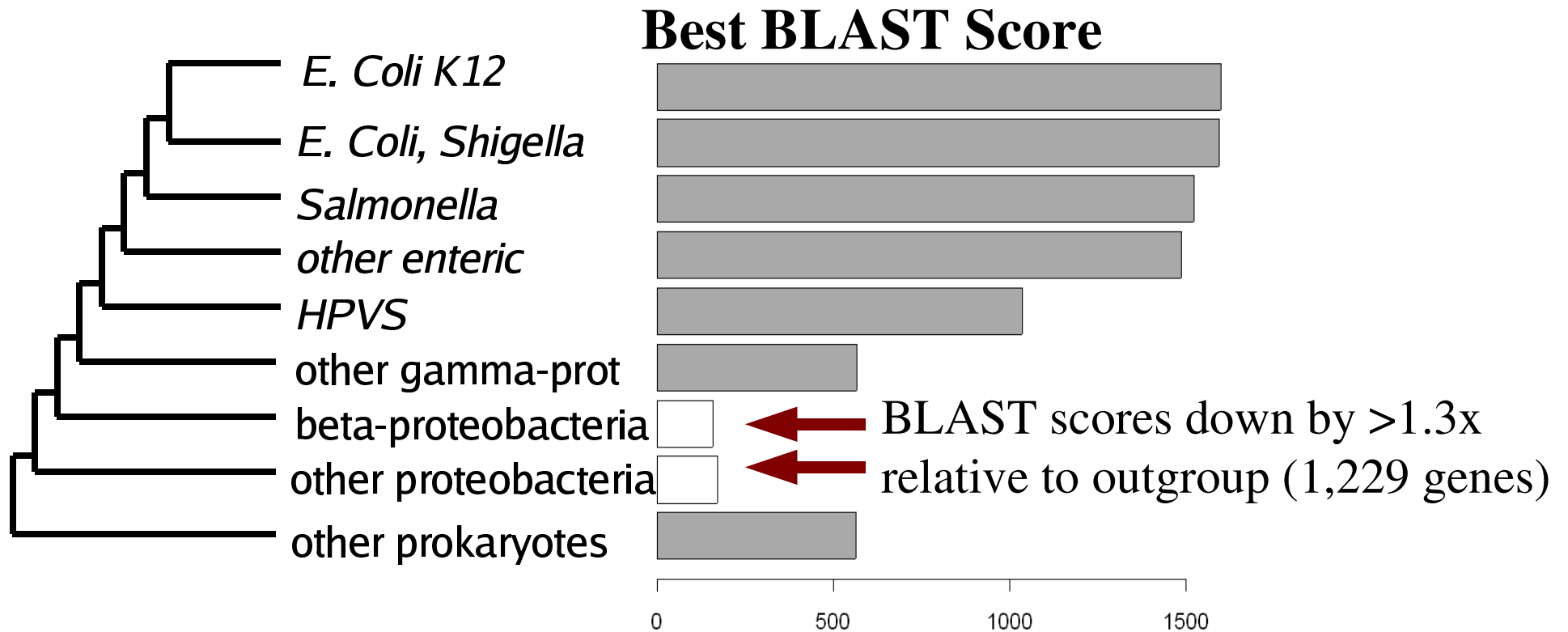
The Regulation of Horizontally Transferred Genes

Morgan Price
Arkin group
July 2006

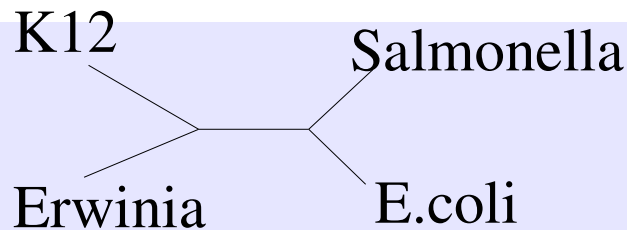
Summary

- Bacteria evolve by acquiring (& losing) genes
 - How do these genes get regulated?
 - How do new regulators arise?
- Horizontally transferred (HGT) genes are
 - under complex regulation
 - often regulated by adjacent transcription factors (TFs)
 - “neighbor regulators” evolve by repeated HGT
- HGT of neighbor regulation allows prediction
 - sensitivity & specificity > 40% (gene neighbor method)

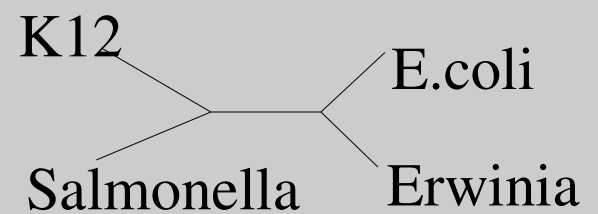
Finding HGT Genes in *Escherichia coli*



6% Native
0.1% confident

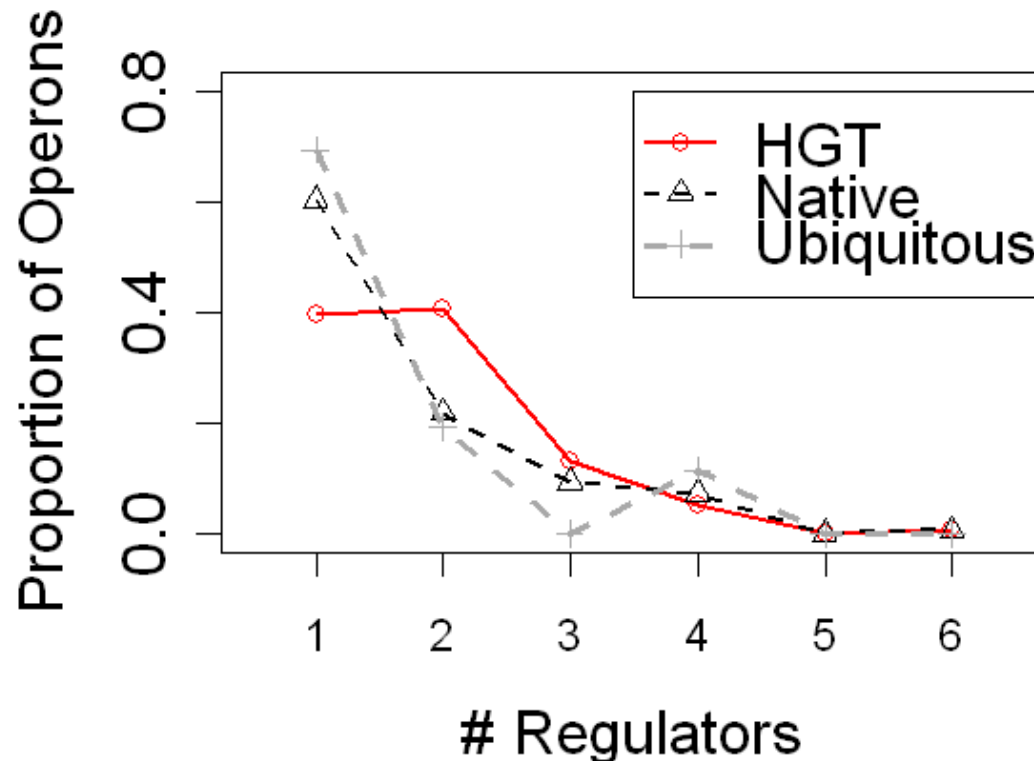


92% HGT
71% confident*



3% Weird
0.1% confident

Complex Regulation of HGT Genes



HGT > Native

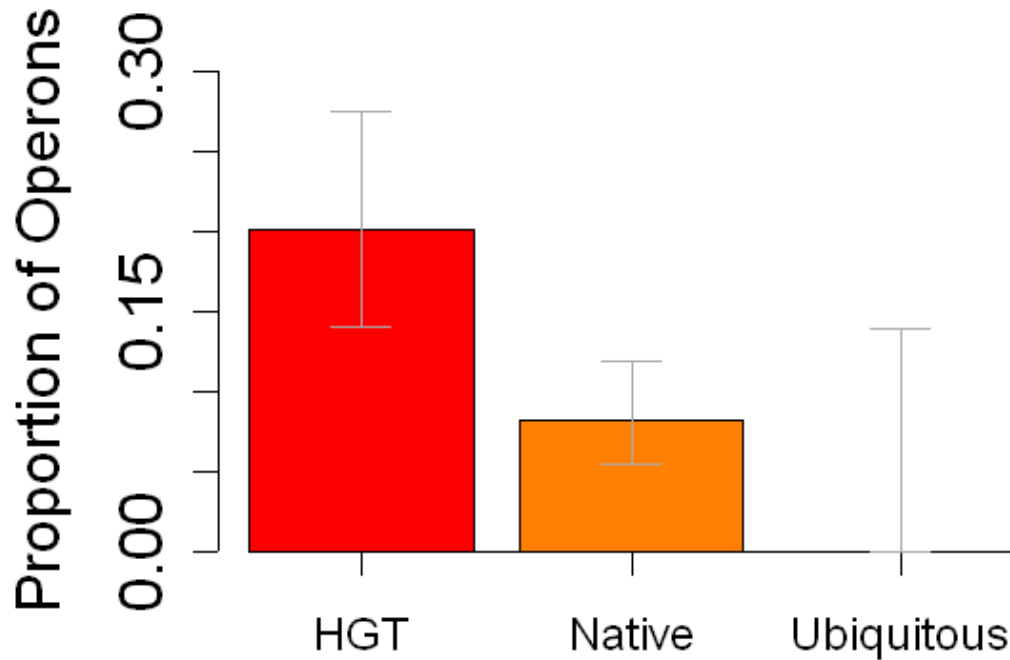
$p < 0.0002$, Wilcoxon test

Data from ColiNet

(Shen-Orr *et al.* 2002)

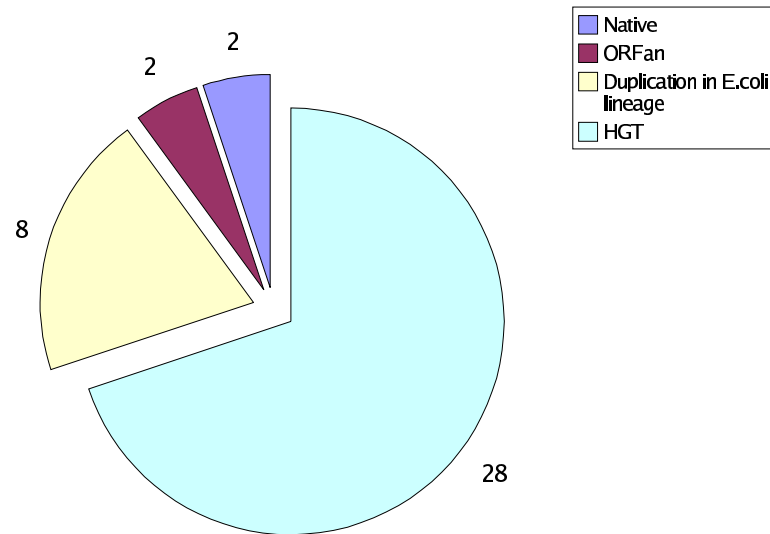
- HGT operons often regulated by CRP & another TF
 - Fits high TF content of large bacterial genomes
- Doesn't consider other regulation
 - stringent response, attenuators, translational control

Neighbor Regulation of HGT Genes



HGT > Native
P < 0.005
Fisher exact test

Evolution of Neighbor Regulation



Of the 28 HGT neighbor regulators

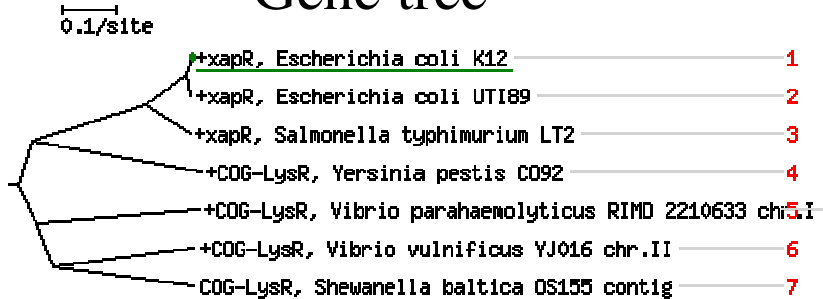
- 20 were co-transferred with the regulated operon
 - allows prediction
- 4 were HGT at the same time but from different sources
- none regulate native operons
- 20 show repeated HGT within the γ -Proteobacteria!
 - strong selection?

Mostly HGT, not duplication

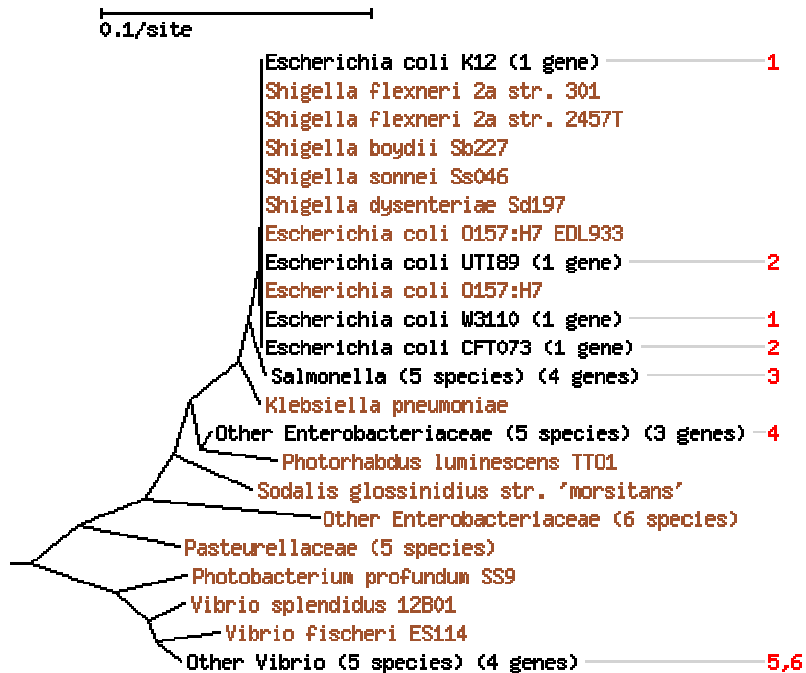
Examples of Complex HGT

xapR

Gene tree

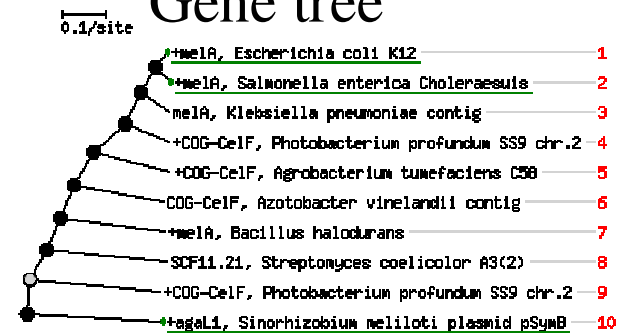


Species tree

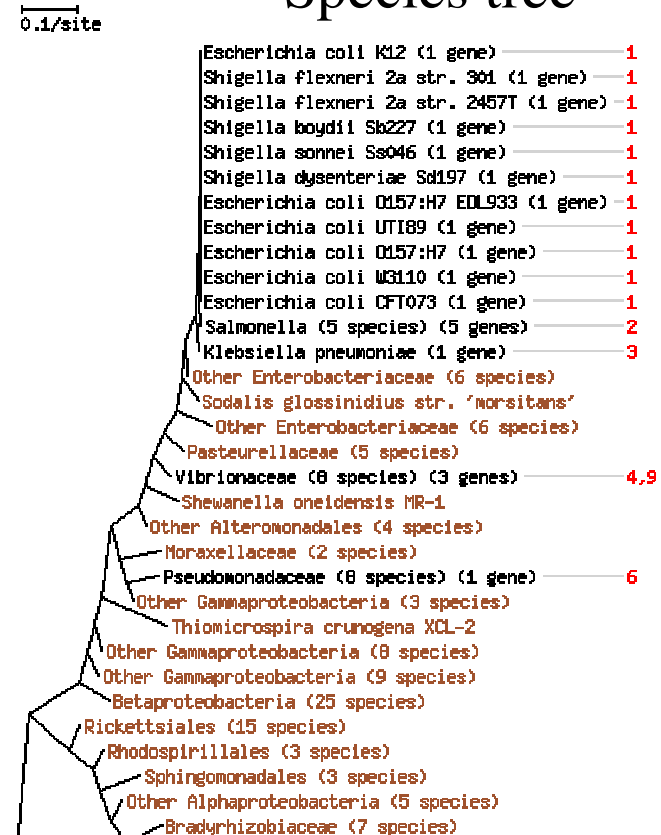


mela

Gene tree

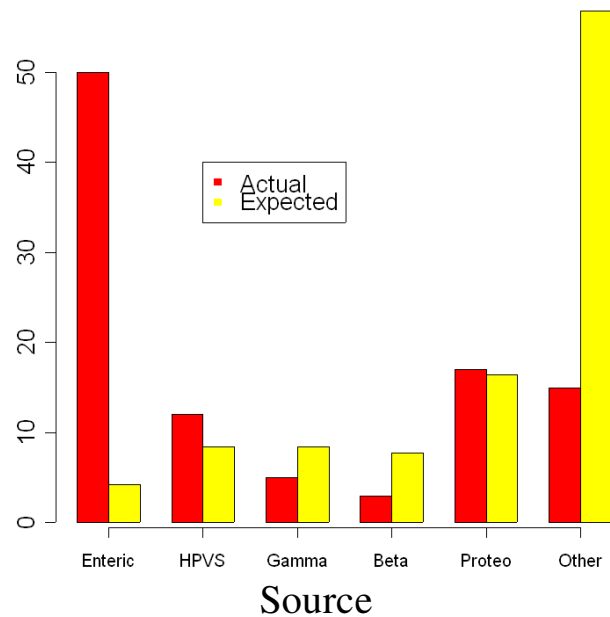


Species tree

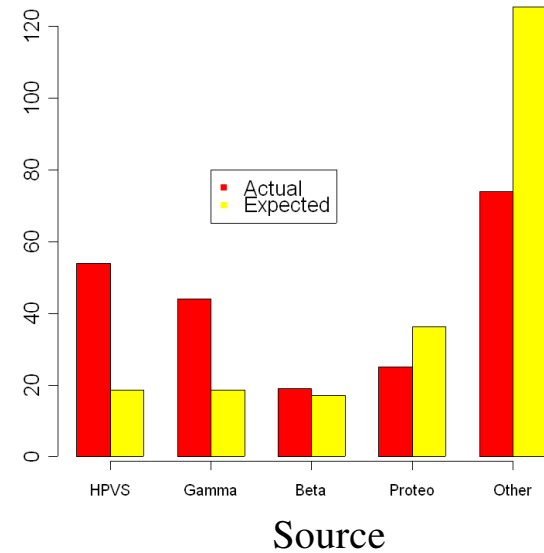


Frequent HGT Between Related Genomes

HGT into *E. coli* K12



HGT into *E. coli* species



- HGT not multiple loss
- Many losses required
 - Low GC content

