## Legend Groups Paulinella Archaea Bacteria Eukaryota Viruses Other/Misc Nodes BS ≥ 95% BS: ultrafast bootstrap support Organelle targeting peptides

Chromatophore (≥100aa)

Paulinella\_chromatophora\_CCAC0185\_nuclear\_\_\_scaffold10292-m73797 Eukaryota-Entamoebidae-NA-NA-NA-Entamoeba\_invadens\_XP\_004261648.1 Eukaryota-Entamoebidae-NA-NA-Entamoeba\_nuttalli\_XP\_008860217.1 —— Eukaryota-Euglenida-NA-Eutreptiales-NA-Eutreptiella\_gymnastica\_MMETSP0039\_c21372\_g1\_i1.p1 —— Eukaryota-Kinetoplastida-Kinetoplastida-Kinetoplastida-Trypanosomatidae-Trypanosoma\_theileri\_XP\_028880163.1 ———— Bacteria-Proteobacteria-Gammaproteobacteria-Enterobacterales-Erwiniaceae-Pantoea\_vagans\_WP\_147790162.1 ———— Eukaryota-Chordata-Actinopteri-Tetraodontiformes-Tetraodontidae-Takifugu\_rubripes\_XP\_011608547.2 Eukaryota-Nematoda-Chromadorea-Rhabditida-Onchocercidae-Loa\_loa\_XP\_020307504.1 100 Eukaryota-Nematoda-Chromadorea-Rhabditida-Rhabditidae-Caenorhabditis\_elegans\_NP\_001040752.2 Eukaryota-Nematoda-Chromadorea-Strongylida-Ancylostomatidae-Necator\_americanus\_XP\_013305661.1 Eukaryota-Arthropoda-Hexanauplia-Calanoida-Temoridae-Eurytemora\_affinis\_XP\_023322405.1 —— Eukaryota-Arthropoda-Insecta-Coleoptera-Buprestidae-Agrilus\_planipennis\_XP\_018333886.1 Eukaryota-Arthropoda-Insecta-Diptera-Drosophilidae-Drosophila\_arizonae\_XP\_017871207.1 100 Eukaryota-Arthropoda-Insecta-Hemiptera-Cimicidae-Cimex\_lectularius\_XP\_014246157.1 Eukaryota-Arthropoda-Insecta-Hymenoptera-Apidae-Ceratina\_calcarata\_XP\_017887421.1 
Eukaryota-Arthropoda-Insecta-Hymenoptera-Cephidae-Cephus\_cinctus\_XP\_015609694.1 Eukaryota-Priapulida-Priapulimorpha-Priapulimorphida-Priapulidae-Priapulidae-Priapulus\_caudatus\_XP\_014673024.1 Eukaryota-Apicomplexa-Aconoidasida-Piroplasmida-Theileriidae-Theileria\_orientalis\_XP\_009691426.1 Eukaryota-Chordata-Mammalia-Perissodactyla-Equidae-Equus\_asinus\_XP\_014690625.1 Leukaryota-Chordata-Mammalia-Primates-Tarsiidae-Carlito syrichta XP 021569633.1 Eukaryota-Chordata-Chondrichthyes-Chimaeriformes-Callorhinchidae-Callorhinchus\_milii\_XP\_007897682.1 Eukaryota-Hemichordata-Enteropneusta-NA-Harrimaniidae-Saccoglossus kowalevskii XP 002735956.1 Eukaryota-Echinodermata-Asteroidea-Valvatida-Acanthasteridae-Acanthaster\_planci\_XP\_022107454.1

Eukaryota-Porifera-Demospongiae-Haplosclerida-Niphatidae-Amphimedon\_queenslandica\_XP\_003387106.1 Eukaryota-Mollusca-Bivalvia-Ostreoida-Ostreidae-Crassostrea\_virginica\_XP\_022320813.1 Eukaryota-Mollusca-Bivalvia-Pectinoida-Pectinidae-Mizuhopecten\_yessoensis\_XP\_021362568.1 \_\_\_\_\_\_ 1d0\_\_\_\_\_\_ Eukaryota-Mollusca-Gastropoda-Aplysiida-Aplysiidae-Aplysia\_californica\_XP\_012935114.1 Eukaryota-Mollusca-Gastropoda-NA-Lottiidae-Lottia\_gigantea\_jgi137775 Eukaryota-Annelida-Clitellata-Hirudinida-Glossiphoniidae-Helobdella\_robusta\_jgi104268 Eukaryota-Cnidaria-Anthozoa-Alcyonacea-Nephtheidae-Dendronephthya\_gigantea\_XP\_028401670.1 Eukaryota-Cnidaria-Anthozoa-Scleractinia-Acroporidae-Acropora\_millepora\_XP\_029206091.1 100 Eukaryota-Chidaria-Anthozoa-Scleractinia-Pocilloporidae-Pocillopora\_damicornis\_XP\_027051415.1 —————100 2 Eukaryota-Cnidaria-Anthozoa-Scleractinia-Pocilloporidae-Stylophora\_pistillata\_XP\_022788959.1 84\_\_\_\_\_\_Eukaryota-Cnidaria-Hydrozoa-Anthoathecata-Hydridae-Hydra\_magnipapillata\_jgiHma2213804 Eukaryota-Placozoa-NA-NA-Trichoplacidae-Trichoplax\_adhaerens\_XP\_002117951.1 Eukaryota-Choanoflagellata-Choanoflagellata-Choanoflagellata-NA-Acanthoeca\_sp\_MMETSP0105\_c762\_g1\_i1.p1 Eukaryota-Choanoflagellata-Choanoflagellata-Choanoflagellata-Salpingoecidae-Monosiga\_brevicollis\_XP\_001749767.1 Eukaryota-Choanoflagellata-Choanoflagellata-Choanoflagellata-Salpingoecidae-Salpingoeca\_rosetta\_XP\_004992756.1 Eukaryota-Mesomycetozoea-Ichthyosporea-Ichthyophonida-NA-Sphaeroforma\_arctica\_XP\_014161517.1 — 66 Eukaryota-Mesomycetozoea-Ichthyosporea-NA-NA-Capsaspora\_owczarzaki\_XP\_004342384.2 Eukaryota-Ascomycota-Dothideomycetes-Pleosporales-Pleosporaceae-Bipolaris maydis XP 014081437.1 Eukaryota-Ascomycota-Dothideomycetes-Undefined-Undefined-Cochliobolus\_heterostrophus\_C5\_jgi81933 Eukaryota-Ascomycota-Eurotiomycetes-Eurotiales-Aspergillaceae-Aspergillus\_fumigatus\_XP\_746921.1 Eukaryota-Ascomycota-Eurotiomycetes-Eurotiales-Aspergillaceae-Penicillium\_expansum\_XP\_016597699.1 Eukaryota-Ascomycota-Orbiliomycetes-Orbiliales-Orbiliaceae-Arthrobotrys\_oligospora\_XP\_011127844.1 Eukaryota-Ascomycota-Saccharomycetes-Saccharomycetales-Pichiaceae-Ogataea\_parapolymorpha\_XP\_013936969.1 Eukaryota-Ascomycota-Saccharomycetes-Saccharomycetales-Pichiaceae-Pichia\_kudriavzevii\_XP\_029321309.1 Eukaryota-Basidiomycota-Exobasidiomycetes-Ceraceosorales-Ceraceosoraceae-Ceraceosorus\_guamensis\_XP\_025372663 Eukaryota-Basidiomycota-Ustilaginomycetes-Ustilaginales-Ustilaginaceae-Moesziomyces antarcticus XP 014655292.1 -- 10d\_\_\_\_\_\_ Eukaryota-Basidiomycota-Exobasidiomycetes-Microstromatales-NA-Pseudomicrostroma\_glucosiphilum\_XP\_025348945.1 94 Lukaryota-Basidiomycota-Wallemiomycetes-Wallemiales-Wallemiaceae-Wallemia\_mellicola\_XP\_006958315.1 ———— Eukaryota-Chytridiomycota-Chytridiomycetes-Rhizophydiales-NA-Batrachochytrium\_dendrobatidis\_jgi599 Eukaryota-Mucoromycota-Glomeromycetes-Glomerales-Glomeraceae-Rhizophagus\_irregularis\_XP\_025183713.1 Eukaryota-Mucorales-Mucoraceae-Undefined-Undefined-Mucor\_circinelloides\_jgi92434

Eukaryota-Mucoromycota-Mucoromycetes-Mucorales-Rhizopodaceae-Rhizopus\_microsporus\_XP\_023471158.1 Eukaryota-Mucoromycota-Mucoromycetes-Mucorales-Phycomycetaceae-Phycomyces\_blakesleeanus\_igi10512 Eukaryota-Mucoromycota-Mortierellomycetes-Mortierellales-Mortierellaceae-Lobosporangium transversale XP 021883326.1 Eukaryota-Fonticulida-Fonticulida-Fonticulida-Fonticulida-Fonticulaceae-Fonticula\_alba\_XP\_009497770.1 Eukaryota-Microsporidia-NA-NA-NA-Mitosporidium\_daphniae\_XP\_013236442.1 Eukaryota-Microsporidia-NA-NA-NA-Nematocida\_parisii\_XP\_013058166.1 Eukaryota-Microsporidia-NA-NA-Pleistophoridae-Vavraia culicis XP 008075518.1 Eukaryota-Acytosteliales-Acytosteliales-Acytosteliales-Acytosteliaceae-Acytostelium\_subglobosum\_XP\_012756304.1 Eukaryota-Acytosteliales-Acytosteliales-Acytosteliales-Acytosteliaceae-Acytostelium\_subglobosum\_XP 012759553.1 \_\_\_\_\_\_49- Eukaryota-Acytosteliales-Acytosteliales-Acytosteliales-Acytosteliaceae-Heterostelium\_album\_XP\_020428242.1 100 Eukaryota-Acytosteliales-Acytosteliales-Acytosteliales-Cavenderiaceae-Cavenderia fasciculata XP 004359294.1 Eukaryota-Amoebozoa-NA-NA-Paramoebidae-Filamoeba\_nolandi\_MMETSP0413\_c11963\_g1\_i1.p1 —————————————————————Eukaryota-Amoebozoa-NA-NA-Paramoebidae-Pessonella\_sp\_MMETSP0420\_c7118\_g1\_i1.p1 Eukaryota-Ciliophora-NA-Unranked-NA-Tiarina\_fusus\_MMETSP0472\_c12663\_g1\_i1.p1

Eukaryota-Haptophyta-NA-Prymnesiales-NA-Imantonia\_sp\_MMETSP1474\_c32704\_g1\_i1.p1 Eukaryota-Cryptophyta-NA-Cryptomonadales-Cryptomonadaceae-Cryptomonas\_paramecium\_MMETSP0038\_c41415\_g1\_i1.p1 Eukaryota-Cryptophyta-NA-Cryptomonadales-Hemiselmidaceae-Hemiselmis\_andersenii\_MMETSP1042\_c12532\_g1\_i1.p1 Eukaryota-Cryptophyta-NA-Pyrenomonadales-Pyrenomonadaceae-Rhodomonas\_lens\_MMETSP0484\_c52539\_g1\_i1.p1 Eukaryota-Stramenopiles-NA-NA-NA-Chrysocystis\_fragilis\_MMETSP1165\_c19760\_g1\_i1.p1 — 100 Lucaryota-Stramenopiles-Oomycetes-Saprolegniales-Saprolegniaceae-Saprolegnia\_parasitica\_XP\_012196959.1 Lucione Eukaryota-Stramenopiles-NA-Bicosoecida-Cafeteriaceae-Cafeteria\_sp\_MMETSP1104\_c5828\_g1\_i1.p1 Eukaryota-Chlorophyta-Mamiellophyceae-Mamiellales-Mamiellaceae-Micromonas\_sp\_MMETSP0802\_c2217\_g1\_i2.p1 Eukaryota-Chlorophyta-NA-NA-Unidentifiedeukaryote\_sp\_MMETSP1326\_c15735\_g1\_i1.p1 Eukaryota-Streptophyta-Liliopsida-Arecales-Arecaceae-Elaeis\_guineensis\_XP\_010937877.2 Eukaryota-Streptophyta-Liliopsida-Poales-Poaceae-Brachypodium\_distachyon\_XP\_024316097.1 Eukaryota-Streptophyta-Liliopsida-Asparagales-Orchidaceae-Phalaenopsis\_equestris\_XP\_020578908.1 ukaryota-Streptophyta-NA-Fagales-Juglandaceae-Juglans\_regia\_XP\_018825849.1 00 Eukaryota-Streptophyta-NA-Malpighiales-Euphorbiaceae-Hevea\_brasiliensis\_XP\_021691049.1 Eukaryota-Streptophyta-NA-Caryophyllales-Chenopodiaceae-Beta\_vulgaris\_XP\_010683284.1 Eukaryota-Streptophyta-NA-Rosales-Rosaceae-Malus\_domestica\_XP\_008350928.1 Eukaryota-Chlorophyta-NA-NA-NA-Tetraselmis\_chuii\_MMETSP0491\_c33743\_g1\_i1.p1 Eukaryota-Chlorophyta-NA-Pyramimonadales-NA-Pyramimonas\_sp\_MMETSP1445\_c11083\_g1\_i1.p1 Eukaryota-Chlorophyta-NA-NA-NA-Picocystis\_salinarum\_MMETSP0807\_c2583\_g1\_i1.p1 Eukaryota-Glaucophyta-Glaucophyta-Gloeochaetales-Gloeochaetaceae-Gloeochaete\_witrockiana\_MMETSP0308\_c37940\_g1\_i1.p1

Eukaryota-Glaucophyta-Glaucophyta-NA-Cyanophoraceae-Cyanophora\_paradoxa\_tig00001694\_g9567.t1 Eukaryota-Cercozoa-Chlorarachniophyceae-NA-NA-Chlorarachnion\_reptans\_MMETSP0109\_c9079\_g1\_i1.p1

Eukaryota-Cercozoa-Chlorarachniophyceae-NA-NA-Partenskyella\_glossopodia\_MMETSP1318\_c4066\_g1\_i1.p1 —— Fukaryota-Cercozoa-Chlorarachniophyceae-NA-NA-Lotharella\_globosa\_MMETSP0111\_c15135\_g2\_i1.p1 Eukaryota-Cercozoa-Chlorarachniophyceae-NA-NA-Gymnochlora\_sp\_MMETSP0110\_c8109\_g1\_i1.p1 Paulinella\_chromatophora\_CCAC0185\_nuclear\_\_\_scaffold39510-m160032 Paulinella\_ovalis\_nuclear\_SingleCell\_\_\_SAG1\_utg7180000005380.g2498.t1 Eukaryota-Retaria-NA-NA-NA-Ammonia\_sp\_MMETSP1384\_c19984\_g2\_i1.p1 Eukaryota-Retaria-NA-NA-NA-Elphidium\_margaritaceum\_MMETSP1385\_c18364\_g1\_i1.p1 Eukaryota-Retaria-NA-NA-NA-Ammonia\_sp\_MMETSP1384\_c20023\_g1\_i1.p1 Eukaryota-Retaria-NA-NA-NA-Rosalina\_sp\_MMETSP0190\_c62429\_g1\_i1.p1 \_\_\_\_\_\_ Eukaryota-Retaria-NA-NA-NA-Sorites\_sp\_MMETSP0191\_c27907\_g1\_i1.p1 Eukaryota-Haptophyta-NA-Phaeocystales-Phaeocystaceae-Phaeocystis\_cordata\_MMETSP1465\_c6077\_g1\_i1.p2 Eukaryota-Apicomplexa-Conoidasida-Eucoccidiorida-Eimeriidae-Cyclospora\_cayetanensis\_XP\_026192261.1 —— Eukaryota-Apicomplexa-Conoidasida-Eucoccidiorida-Sarcocystidae-Besnoitia besnoiti XP\_029219836.1 100\_ Eukaryota-Apicomplexa-Conoidasida-Eucoccidiorida-Sarcocystidae-Neospora\_caninum\_XP\_003884547.1 Eukaryota-Chromeraceae-NA-NA-NA-Chromera\_velia\_MMETSP0290\_c4161\_g1\_i1.p1 Eukaryota-Chromeraceae-NA-NA-NA-Vitrella\_brassicaformis\_MMETSP1451\_c14462\_g1\_i1.p1 Eukaryota-Ciliophora-NA-Unranked-NA-Climacostomum\_virens\_MMETSP1397\_c7720\_g1\_i1.p1 - Eukaryota-Ciliophora-Oligohymenophorea-Peniculida-Parameciidae-Paramecium tetraurelia XP 001456308.1 Eukaryota-Apusomonadidae-NA-NA-NA-Thecamonas\_trahens\_XP\_013758574.1 —— Paulinella\_ovalis\_nuclear\_SingleCell\_\_\_SAG1\_utg7180000013589.g6291.t1 Eukaryota-Heterolobosea-NA-NA-NA-Percolomonas\_cosmopolitus\_MMETSP0759\_c7490\_g1\_i1.p1 karyota-Palpitomonas-NA-NA-NA-Palpitomonas\_bilix\_MMETSP0780\_c13795\_g1\_i1.p1 —— Eukaryota-Alveolata-Dinophyceae-NA-Unranked-Alexandrium\_monilatum\_MMETSP0095\_c8307\_g1\_i1.p1 Eukaryota-Alveolata-Dinophyceae-NA-Unranked-Gymnodinium\_catenatum\_MMETSP0784\_c52356\_g1\_i1.p1 ıkaryota-Haptophyta-NA-Isochrysidales-Noelaerhabdaceae-Emiliania huxleyi MMETSP0995 c9359 g1 i1.p1 ota-Haptophyta-NA-Prymnesiales-NA-Gephyrocapsa\_oceanica\_MMETSP1364\_c5275\_g1\_i1.p1 -Haptophyta-NA-Prymnesiales-NA-Gephyrocapsa\_oceanica\_MMETSP1366\_c7504\_g1\_i1.p1 Eukaryota-Haptophyta-NA-Prymnesiales-NA-Chrysochromulina polylepis MMETSP0143 c42361 g1 i1.p1 Jukaryota-Amoebozoa-NA-NA-Paramoebidae-Mayorella\_sp\_MMETSP0417\_c3250\_g1\_i1.p1 ota-Amoebozoa-NA-NA-Paramoebidae-Stygamoeba\_regulata\_MMETSP0447\_c36045\_g1\_i1.p1 - Eukaryota-Amoebozoa-NA-NA-Paramoebidae-Trichosphaerium sp MMETSP0405 c9057 g1 i1.p1 karyota-Longamoebia-Longamoebia-Longamoebia-Acanthamoebidae-Acanthamoeba\_castellanii\_XP\_004339845.1 Bacteria-Actinobacteria-Actinobacteria-Streptosporangiales-Streptosporangiaceae-Nonomuraea\_sp.\_KC333\_WP\_1111830. Eukaryota-Alveolata-Dinophyceae-NA-Unranked-Amoebophrya sp MMETSP0795 c2738 g1 i1.p1 - Eukaryota-Cryptophyta-NA-Goniomondales-NA-Goniomonas\_pacifica\_MMETSP0108\_c10285\_g1\_i1.p1 Eukaryota-Stramenopiles-Raphidophyceae-Chattonellales-Chattonellaceae-Chattonella\_subsalsa\_MMETSP0947\_c26690\_g1\_i1.p1 Eukaryota-Stramenopiles-Raphidophyceae-Chattonellales-Chattonellaceae-Heterosigma\_akashiwo\_MMETSP0294\_c5736\_g1\_i1.p1 ----- MSTRG.9371.1.p1 — Paulinella\_chromatophora\_CCAC0185\_nuclear\_\_\_scaffold2383-m27282 1.21