Table X. KEGG orthologs involved in N cycling and the linked microbial taxa. NB. Genes that originate from species not present in Organic Lake come from rare species or candidate divisions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| gene | KEGG ortholog | KEGG genus | likely taxon |  |
| **Nitrogen fixation** | | | | |
| nitrogenase (*nif*D) | K02586 | *Arcobacter* (11) *Desulfatibacillum* (2)  *Clostridium* (2)  *Chlorobaculum* (1)  *Chlorobium* (1) | present  Deltaproteobacteria  present  ?  ? |  |
| nitrogenase (*nif*H) | K02588 | *Arcobacter* (6) | present |  |
| nitrogenase (*nif*K) | K02591 | *Arcobacter* (12)  *Geobacter* (1)  *Xanthobacter* (1) | present  Deltaproteobacteria  Alphaproteobacteria |  |
| **Denitrification** | | | | |
| nitric oxide reductase (*nor*C) | K02305 | *Marinobacter* (62)  *Alkalilimnicola* (7)  *Leptospira* (1)  *Nitrosomonas* (2)  *Planctomyces* (1)  *Starkeya* (1) | present  Gammaproteobacteria  *Spirochaeta*  ?  ?  Alphaproteobacteria |  |
| nitric oxide reductase (*nor*B) | K04561 | Marinobacter (121)  Alkalilimnicola (13)  Anaeromyxobacter (1)  Colwellia (3)  Hahella (1)  Magnetococcus (2)  Pseudomonas (3)  Paracoccus (1)  Thiobacillus (2)  Xanthobacter (2) | present  Gammaproteobacteria  Deltaproteobacteria  Gammaproteobacteria  Gammaproteobacteria  Alphaproteobacteria  present  Alphaproteobacteria  ?  Alphaproteobacteria |  |
| nitrous oxide reductase (*nos*Z) | K00376 | Marinobacter (130)  Alkalilimnicola (1)  Cellulophaga (7)  Dyadobacter (1)  Maribacter (17)  Gramella (12)  Hahella (36)  Haliscomenobacter (1)  Hydrogenobacter (3)  Opitutus (3)  Pseudomonas (37)  Psychromonas (12)  Persephonella (3)  Robiginitalea (20)  Shewanella (2) | present  Gammaproteobacteria  Flavobacteria  Cytophagia  Flavobacteria  Flavobacteria  Gammaproteobacteria  Sphingobacteria  ?  Opitutae  present  present  ?  Flavobacteria  Gammaproteobacteria |  |
| **Dissimilatory nitrate reduction to ammonia (DNRA)** | | | | |
| cytochrome C nitrite reductase  (*nrf*A) | K03385 | Marivirga (7)  Ammonifex (1)  Bdellovibrio (1)  Coraliomargarita (1)  Corynebacterium (1)  Planctomyces (2)  Pelobacter (1)  Parabacteroides (1)  Rhodopirellula (1)  Thermodesulfovibrio (1) | present  Clostridia  unclassified Bdellovibrionales  Opitutae  Actinobacteria  ?  Deltaproteobacteria  unclassified Bacteroidetes  ?  ? |  |
| **Anammox** | | | | |
| hydroxylamine oxidase (HAO) | K10535 | Desulfatibacillum (1)  Desulfohalobium (1)  Desulfococcus (2) | Deltaproteobacteria  Deltaproteobacteria  Deltaproteobacteria |  |
| **Assimilation/Mineralization** | | | | |
| glutamate dehydrogenase (*gdh*A) | K00260 | Bacillus (3)  Thermosediminibacter (1)  Staphylococcus (1)  Thermoanaerobacter (1)  Macrococcus (1) | Bacilli  Bacilli  Bacilli  Clostridia  Bacilli |  |
| glutamate dehydrogenase (*gdh*A) | K00261 | Amoebophilus (2)  Alteromonas (2)  Alkaliphilus (1)  Anaerolinea (1)  Bdellovibrio (1)  Blattabacterium (1)  Beijerinckia (1)  Coraliomargarita (10)  Cellulophaga (15)  Caldivirga (1)  Chloroherpeton (2)  Desulfotomaculum (1)  Acidovorax (1)  Ferroglobus (1)  Gramella (1)  Haliscomenobacter (4)  Haloarcula (1)  Haloterrigena (1)  Jannaschia (18)  Krokinobacter (29)  Monosiga (1)  Micrococcus (1)  Nitrospira (1)  Nematostella (3)  Opitutus (2)  Polymorphum (3)  Polaromonas (2)  Populus (1)  Physcomitrella (1)  Pyrococcus (1)  Roseiflexus (1)  Rhodothermus (2)  Rhodococcus (1)  Rhodobacter (45)  Syntrophus (1)  Syntrophobacter (1)  Silicibacter (100)  Ruegeria (106)  Salinibacter (7)  Sphaerobacter (1)  Syntrophomonas (3)  Thermobaculum (8)  Thermoplasma (2)  Vulcanisaeta (1)  Zunongwangia (3) | Bacteroidetes  Gammaproteobacteria  Clostridia  ?  unclassified Bdellovibrionales  Flavobacteria  Alphaproteobacteria  Opitutae  Flavobacteria  ?  Chlorobia  Clostridia  ?  Euryarchaeota  Flavobacteria  Sphingobacteria  Halobacteria  Euryarchaeota  Alphaproteobacteria  Flavobacteria  Choanoflagellida  Actinobacteria  ?  Metazoa  Opitutae  Alphaproteobacteria  ?  Viridiplantae  Viridiplantae  Euryarchaeota  ?  Bacteroidetes  Actinobacteria  Alphaproteobacteria  Deltaproteobacteria  Deltaproteobacteria  Alphaproteobacteria  Alphaproteobacteria  Bacteroidetes  Chloroflexi  Clostridia  ?  Euryarchaeota  ?  Flavobacteria |  |
| glutamate dehydrogenase (*gdh*A) | K00262 | Coccidioides posadasii 1  Paludibacter propionicigenes 1  Maribacter sp. HTCC2170 3  Psychrobacter sp. PRwf-1 8  Actinobacillus pleuropneumoniae AP76 (serotype 7) 1  Sinorhizobium meliloti 1021 1  Kangiella koreensis 1  Plasmodium chabaudi 1  Marinobacter aquaeolei 129  Psychrobacter cryohalolentis 1  Mobiluncus curtisii 1  Aciduliprofundum boonei 1  Marivirga tractuosa 2  Clostridium novyi 1  Giardia lamblia 1  Alteromonas macleodii 149  Mycobacterium abscessus ATCC 19977 1  Lactobacillus rhamnosus Lc 705 1  Gramella forsetii 30  Pseudomonas mendocina ymp 1  Pedobacter heparinus 1  Haemophilus influenzae 86-028NP (nontypeable) 1  Bacteroides fragilis NCTC9343 2  Gallibacterium anatis 1  Leifsonia xyli xyli CTCB07 2  Croceibacter atlanticus 16  Thiomicrospira crunogena 55  Bacillus clausii 2  Odoribacter splanchnicus 3  Robiginitalea biformata 2  Nematostella vectensis (sea anemone) 3  Legionella pneumophila Paris 2  Cellulophaga lytica 3  Neisseria meningitidis 053442 (serogroup C) 1  Ochrobactrum anthropi 2  Dinoroseobacter shibae 1  Flavobacterium psychrophilum 1  Idiomarina loihiensis 2  Desulfovibrio salexigens 1  Dyadobacter fermentans 5  Actinobacillus pleuropneumoniae L20 (serotype 5b) 5  Thalassiosira pseudonana 1  Halanaerobium hydrogeniformans 4  Pseudomonas putida KT2440 1  Geobacillus thermodenitrificans 15  Parabacteroides distasonis 3  Pseudoalteromonas atlantica 3  Alcanivorax borkumensis 1  Arthrobacter chlorophenolicus 1  Prochlorococcus marinus MIT 9313 5  Acetohalobium arabaticum 1  Plasmodium yoelii 6  Streptococcus equi subsp. zooepidemicus MGCS10565 1  Desulfurivibrio alkaliphilus 1  Candidatus Koribacter versatilis 7  Desulfurispirillum indicum 1  Plasmodium knowlesi 1  Pseudonocardia dioxanivorans 2  Trichodesmium erythraeum 1  Sphingomonas wittichii 2  Cellulophaga algicola 6  Roseobacter denitrificans 1  Phaeodactylum tricornutum 1  Methanococcus vannielii 1  Gamma proteobacterium HdN1 3  Thermobifida fusca 1  Spirochaeta coccoides 1  Fluviicola taffensis 7  Streptomyces coelicolor 1  Pseudoalteromonas sp. SM9913 3  Francisella tularensis subsp. mediasiatica FSC147 1  Plasmodium falciparum HB3 Broad 2  Deinococcus radiodurans 1  Syntrophothermus lipocalidus 6  Porphyromonas asaccharolytica 1  Krokinobacter sp. 4H-3-7-5 32  Novosphingobium aromaticivorans 1  Methanosphaera stadtmanae 2  Wolinella succinogenes 2  Bifidobacterium longum subsp. longum JCM 1217 1  Streptococcus suis ST3 1  Cyanothece sp. PCC 7424 6  Lactobacillus casei BL23 1  Clostridium cellulovorans 1  Nocardia farcinica 1  Bacteroides salanitronis 3  Desulfovibrio desulfuricans ATCC 27774 6  Clostridium sticklandii 1  Streptococcus mutans UA159 1  Treponema brennaborense 1  Haliangium ochraceum 6  Parvularcula bermudensis 2  Akkermansia muciniphila 2  Cyanothece sp. PCC 8802 1  Mycobacterium sp. JLS 1  Prevotella ruminicola 1  Erythrobacter litoralis 2  Brachybacterium faecium 1  Marinomonas sp. MWYL1 9  Comamonas testosteroni 1  Leadbetterella byssophila 2  Spirochaeta smaragdinae 2  Physcomitrella patens subsp. patens 1  Synechocystis sp. PCC 6803 4  Sulfurimonas autotrophica 2  Pedobacter saltans 3  Clostridium thermocellum ATCC 27405 1  Legionella pneumophila Corby 1  Intrasporangium calvum 3  Propionibacterium freudenreichii 2  Opitutus terrae 4  Spirochaeta sp. Buddy 3  Listeria seeligeri 1  Sphingopyxis alaskensis 1  Fusarium graminearum 2  Zunongwangia profunda 48 |  |  |
| **Nitrogen assimilation** | | | | |
| assimilatory nitrate reductase | K00360 | Azorhizobium (1)  Herminiimonas (6)  Nitrobacter (15)  Spirosoma (1) | Alphaproteobacteria  Betaproteobacteria?  Alphaproteobacteria  Cytophagia |  |
| glutamine synthetase (*gln*A) | K01915 | Achromobacter  Acidimicrobium  Acidithiobacillus  Acinetobacter  Aeromonas  Agrobacterium  Alicyclobacillus  Aliivibrio  Allochromatium  Arcobacter  Arthrobacter  Azobacteroides  Azospirillum  Azotobacter  Bacillus  Bacteroides  Bartonella  Bradyrhizobium  Brevibacillus  Burkholderia  Caenorhabditis  Capnocytophaga  Carnobacterium  Cellulomonas  Cellvibrio  Chitinophaga  Chlamydomonas  Chromohalobacter  Clavibacter  Clostridium  Dehalococcoides  Desulfobacterium  Desulfococcus  Desulfotalea  Desulfotomaculum  Desulfovibrio  Enterococcus  Eubacterium  Exiguobacterium  Fibrobacter  Flavobacteriaceae sp.  Flavobacterium  Francisella  Glaciecola  Gordonia  Granulibacter  Halomonas  Halorhabdus  Halorhodospira  Halothiobacillus  Ilyobacter  Ketogulonicigenium  Kineococcus  Kyrpidia  Lactobacillus  Lactococcus  Legionella  Lysinibacillus  Mahella  Maricaulis  Marinomonas  Meiothermus  Mesorhizobium  Methanocella  Methanoculleus  Methanopyrus  Methanosaeta  Methanosarcina  Microbacterium  Microcystis  Moorella  Mycobacterium  Nakamurella  Nitratifractor  Nitrosococcus  Oceanobacillus  Parvibaculum  Pediococcus  Pelodictyon  Pelotomaculum  Photobacterium  Prosthecochloris  Pseudoalteromonas  Pseudomonas  Puniceispirillum  Rahnella  Rhizobium  Rhodobacter  Rhodococcus  Rhodomicrobium  Rhodopseudomonas  Rhodospirillum  Ricinus  Riemerella  Rothia  Ruthia  Saccharophagus  Sanguibacter  Shewanella  Sinorhizobium  Sorangium  Spirochaeta  Staphylococcus  Streptococcus  Streptomyces  Streptosporangium  Sulfuricurvum  Sulfurimonas  Sulfurovum  Syntrophobotulus  Teredinibacter  Thermomonospora  Thermoplasma  Truepera  Variovorax  Vesicomyosocius  Weeksella  Xanthomonas  Yarrowia |  |  |
| glutamate synthase (*glt*B) | K00265 | Accumulibacter  Acidothermus cellulolyticus  Acidovorax  Acinetobacter  Aeromonas  Alicycliphilus  Amycolatopsis  Apis  Aromatoleum  Asticcacaulis  Azobacteroides  Bacillus  Beutenbergia  Bordetella  Burkholderia  Campylobacter  Cellulomonas  Chromobacterium  Clostridium  Corynebacterium  Dechloromonas  Delftia  Desulfarculus  Desulfobulbus  Desulfovibrio  Gallionella  Haemophilus  Herbaspirillum  Hirschia  Hydra  Laribacter  Leptothrix  Listeria  Magnetospirillum  Methylibium  Methylotenera  Methylovorus  Minibacterium  Nautilia  Nitratiruptor  Nocardiopsis  Phenylobacterium  Photorhabdus  Pirellula  Planctomyces  Polynucleobacter  Psychrobacter  Puniceispirillum  Pusillimonas  Ralstonia  Renibacterium  Rhodospirillum  Rubrobacter  Saccharopolyspora  Segniliparus  Selaginella  Serratia  Solibacter usitatus  Sphingobium  Streptomyces  Thioalkalivibrio  Tolumonas  Vesicomyosocius  Vibrio |  |  |
| glutamate synthase (*glt*S) | K00284 |  |  |  |