

M. marinum orthologue of Rv0981

tcaggggtggcggttcgcgtagcagcgtaacccaccccgcgacgggtggtgatcagccggctcgccctcggttcggttttacgccgaggttagccacgttagacctcgagcggttgccggacgtgggaaagtcg
aagccccacacctcttcgaggatcgggctgcggtcagcaccgctcgcggttgccgatcagcatctccagcagggcgaaactcggttcgggtgagggctgatgcgccgcgcccggggtcacctcccgggtcacg
ggctccaggctcaggctcgggagaacgtcatggctaccgaatcgggcgcttcgctcgtcttcgggttggtgctggcgagcaaacgcgcacatccgcgccaaacagctcttcagcgcgaaacggcttcggcaggtagtcac
cgcccgggcatcgagccccgcgacccggttcgggagcggaaatcacggggcggtcagcagcagaatggcgagatcatcaccggtaactgcgaagttgacggcataacctccaagccatccagtcggcgatcatgacgtcc
agcaccacgcgctcaggccgatcactggcaatcatctcgagagcttcacacccatcgtgtgccagctcaaccgtgtagccattgaaggaaagcgacctgcgcagcgactcgcgaccgcgcatcgtcgtcgacga
caagtatccgcacggacat

tagtttcgtcctaaccgctgagagcggcctgagagggcgccgcaaaatgacgacagcgtcacaatttgatcgggatcaataaccaacgggttgccagcgcccgggcgagccggcatcgatgcaacggcaccggcctc
atgcctgtccgatcacaaccgccacattggccccaccgggaagggggccgggttgccctctcagcagcgacggcagtcgcccgaagaggacagagacaccaggcgcatggcccagggtaatcggg

M. marinum
orthologue of rpmF

ctatcgacggctcgagatcgatgagaccgagccggccgcttgagcagccggcgaggcaccttgcttctgacccggcaacgggtgacgcgagcagagttcggccttggtggccttcactcgcgagcgccggcttcga
gtattcgcgcgacatcctgcgcttggtgtggccat

ggctcgacctaactcctcggctcgggtttcgggttcaacatgtcgcacggcatggccaatcggcacagcggcgacgaatgacgtaaacgatagtcgggtgacctgctggttgccaaaaccgggaccgcccgatccg
ccgtgttacgtaccgagtgaggcgggtatcacaccgtggcaggcgtcccgtatgctgacctaccggttggttggttcaaccaccggcaagccctgccaccggtaaccccgatgaaggaggacgcggtggcgt
ctcgttctgatgcgtccggcgcc

M. marinum orthologue of Rv0976c

gtaacgatcggaactgttcgggttctacggggaccgtctctcggcgatgcgcgaaatgctcaccggcgggcaggtggactacctcaccggcgactacctcgccgaactgacctgatcctgggcgcgaccc
ggatgaaaaaccccgagcgcggctacgccaagaccttctggccagctcgaagactgctgggactggcccacgagcgcggagtgcgcatcgtcgccaacgcggcgccctcaatcccgcgggtggccgatgc
gatcagggccctaacggagcgttgggcatcggcgcccgcacatcgcccacgtggaaggcgacgatctggcgccccgcgcgccgaactcggcctgggcaacccgctgacagccaaacgcctacctgggcgctggggc
atcgtgatgctcaacagcggggcgacgtcgtggtcaccggccgggtcaccgacgctcgggtgatcgtcggatccgcggcgccacttcggctggggccgaccgactacaaccagctggccggcgccgtgg
tggccggccatgtcatcgaatgcggggctcaggccaccggcggaactacgcttctcaccgaggtcccgatctgacctacgcggcttcccgtggccgaggtcagcggcagggcaacctcgggtgatcaccaa
acccccggcaccggtgggtcagccccgacaccgtcaccgcacaactgctctacgagatatacggcgcccgtacgccaatccggacgtgacggcccggatggacacccatccaactgtccagcgatggcccg
gatcgggtgcgcatcagcggcgtgatcggcgaagccccccaccacctgaagggtgctcgtgaacagcatcggcggttcgcgaacccatgacgttcgtcttgacgggtctgaacatcgaggccaagggcgagc
tcgtgcaacgcagctcgaggccaccctgaccgtcaaaccgcggaactggaatggaccctggcccgcaccgaccagctcagcggcgaaccggaggaagccgagcgcctgctgcaactgctgggtcgtgaccc
cgaccccccaatgtgggcgcaagttctcctcggccgggtggaattggcgttgccagctatcccggattcaactcgaccgacccccgggcgacggccaggtgatgggggtgctcgtgcccgggtcactggac
ggcaagctggtgccacacatcgccgtgcaagccgacggcagcgcaccgatatcccctgcgccaccgagaccctggaactggaatcggctgatccccggccttgcccgatccgctgccaccggcccgcaccgac
gggtaccgctgggcctgatgcccggcccccgcagcggggacaagggcggtcgcccaacgtcggactatgggtgcgcaccgacgagcagtgccgctgggtggccaacacgctgacagtgagctgctcaaggaact
gctgcccgagggcgccgatctgcaagtcaccgctacgcttgcccaacctcggggcgctgaacttcgtcatcgaggggattctcgggtcagggcggtggcctatcaggcgcatcagaccgcaagcgaaggcgtg
ggcgaatggctgcgcagccgccacctcgatatcccggagagcctcctatga

Alignment of *M. tuberculosis* Rv0981 and *M. marinum* orthologue of Rv0981

```
M. tuberculosis (H73Rv):          1 gtgtccgtgccaattcttgtcgttgacgacgatcgtgcgggtgcgcgagtcgctgcgccggt 61
    ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum (ATCC BAA-535): 5558332 atgtccgtgcccgaacttctgtcgtcgacgacgatcgcgcgggtgcgcgagtcgctgcgcaggt 5558272

M. tuberculosis:                62 cgctttccttcaatggctattcggctcgaactggcccacgacggggtgaggcgctcgaca 121
    ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5558271 cgctttccttcaatggctacacggttgagctggcacacgatggtgtggaagctctcgaga 5558212

M. tuberculosis:                122 tgattgccagcgatcgccccgacgcggttggctcctggatgtcatgatgcccgggtggacg 181
    ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5558211 tgattgccagtgatcgccctgacgcggttggctcctggatgtcatgatgcccggactggatg 5558152

M. tuberculosis:                182 gcctcgaggtgtgcgctcagctcccgccgaccggcgacgacctgccattctgggtgctga 241
    || || ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5558151 gcttggaggtatgcccgtcaacttcgcagtagcgggtgatgatctgccattctcgtgctga 5558092

M. tuberculosis:                242 ccgcgcgcgactcgggtgtccgagcgggtggcggggtggacgcccgggtgcccgacgactacc 301
    ||| || || || || || ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5558091 ccgcccgtgattcgtctccgaacgggtcgcggggctcgatgcccggcgggatgactacc 5558032

M. tuberculosis:                302 taccaaagccggttcgcacctcgaagagctgctggcacggatgccccgctgctgcgccgca 361
    || || ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5558031 tgccgaagccggttcgcgctggaagagctggtggcgcggatgcccgcggttctgctgcgccgca 5557972

M. tuberculosis:                362 ccaagcc-----cgaggatgccgccgagtcgatggccatgaggttctccgacctgacgc 415
    ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5557971 ccaagcccgaagacgacgaagccgccgatcggtagccatgacgttctccgacctgagcc 5557912

M. tuberculosis:                416 tggacccggttaacccgcgaagtcaaccgtggacagcgccggatcagcctgaccgcaccg 475
    ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5557911 tggacccggtgaccgggaggtgacccgcggggcgcggcgcacatcagcctcaccggaaccg 5557852

M. tuberculosis:                476 aatttgcatgctggagatgctgatcgccaatccgcggcgagtctgacgcgcagccgta 535
    || || || ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5557851 agttgcctgctggagatgctgatcgccaacccgcgacgggtgctgaccgcagccgca 5557792

M. tuberculosis:                536 tcctggaagaggtatggggattcgactttccacactcgggcaacgcgctggaagtctacg 595
    ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| ||| |||
M. marinum:                      5557791 tcctcgaagaggtgtgggcttcgactttccacgtccggcaacgcgctcgaggtctacg 5557732
```



```

m.tub      tggcgcggtttg|g|cctgcgcccaggcgtggaacggcagggatcgtccgaataaacggtt 296
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
mari      ----gaggacagag---acaccaggcgcg-atggcccagggtaatcggg----- 266

m.tub      acccaccgc|g|g|g|gtaacaggcgggtgggcccgcgcacatctcaacatcgt|g|cgggtcagga 356
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
mari      -----

m.tub      ggatttcga 365
mari      -----

```

Alignment of *M. tuberculosis* rpmF and *M. marinum* orthologue of rpmF (Rv0979A)

```

M. tuberculosis (H37Rv):          1 atggctgtgccc
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
M. marinum (ATCC RAA-535): 5558772 atggccacacca

M. tuberculosis:                13 aagcgcagaaagtgcgctcgaatacccgaaagccggcgctcgcagtggaaggccgccaag 72
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
M. marinum:                      5558760 aagcgcaggatgtcgcgcgcaataactcgaagccggcgctcgcagtggaaggccaccaag 5558701

M. tuberculosis:                73 accgagctggtcggtgtgaccgtcgccggtcacgcccacaaggtgcctcggcgcttgctc 132
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
M. marinum:                      5558700 gccgaactcgtcggcgctcaccggtgcccggtcagaagcacaaggtgcctcggcgcttgctc 5558641

M. tuberculosis:               133 aaggccgccccggctcggcctcatcgatttcgataaagcgctga 174
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
M. marinum:                      5558640 aaggcggccccggctcggctctcatcgatctcgaccgtcgatag 5558599

```

Intergenic region between *M. marinum* orthologue of rpmF and *M. marinum* orthologue of Rv0976c (295bp)

```

ggtcggacctaactcctcggtcgggggtttcgggttcaacatgtcgcacggcatggccaatcggcacagcggcgacgaatgacgtaaacgatagtcggtgacctgctggttgccaaaaccgg
gcaccgccggatccgccgtgttcacgtaccgagtgaggcgggtatcacaccgtggcaggcgtcccgcctatgctgacctaccggttggttggttcacccaccggcaagccctgccaccggt
aaccctgatgaaggaggacgaggatggcgtctcgttctgatgcgtccggcgcc

```

Alignment of Intergenic region between *M. marinum* orthologue of rpmF and *M. marinum* orthologue of Rv0976c (295 bp) with Intergenic region between *M. tuberculosis* Rv0976c and Rv0977 (199 bp).

```

M.tub      -----tggcgtgacctc 13
              ||| |||
mari      ggtcggacctaaactcctcggtcgggggttcgggttcaacatgtcgcacggca-tggccaa 59

m.tub      ctggggc--cggcaaagcaccggcgctcccgtagc--gaaacggactctactccaatgga 69
              || | ||| | | | | | | | | | | | | | | | | | | | | | | | | |
mari      tcggcacagcggcgacgaatgacgtaaacgatagtcggtgacctgctggttgccaaaacc 119

m.tub      cggcgcagaccgggcccgttcg-----actcag-gaagcgatctccgtcgcgaaacag 121
              ||| | | | | | ||| | | | | | | | | | | | | | | | | | | |
mari      gggcaccgccggatccgccgtgttcacgtaccgagtgaggcgggtatcacaccgtggcag 179

m.tub      g-----gcagtgctaacctaccggttggttggg-----agcgtcgcc---- 158
              | | | | | | | | | | | | | | | | | | | | | | | | | | | |
mari      gcgtcccgctatgctgacctaccggttggttgggttcacccaccggcaagccctgccacc 239 } 27 bp
                                           } homologous
                                           } region

m.tub      ---gatcccaa---gggaggaatcgcatggc-cctgactgtggtgccg----- 199
              | | | | | | | | | | | | | | | | | | | | | | | |
mari      ggtaaccccgatgaaggaggacgcggatggcgtctcgttctgatgcgtccggcgcc 295
    
```

Alignment of *M. tuberculosis* Rv0976c and *M. marinum* orthologue of Rv0976c

```

M. tuberculosis (H37Rv):          1 gtgcgtatcgga 12
                                  || || |||
M. marinum (ATCC BAA-535): 5559068 gtacgcatcgcg 5559079

M. tuberculosis:                  13 aactgctcgggcttctacggcgaccgctctccgccatgdcgagatgctgaccggcggc 72
                                  ||||| | | ||| | | | | | | | | | | | | | | | | | |
M. marinum:                        5559080 aactggtccggcttctacggggaccgtctctcggcgatgdcgcaaatgctcaccggcggc 5559139

M. tuberculosis:                  73 gagctggactatctcaccggcgactacctggccgagctgacctgattctcggtcgc 132
                                  ||| ||| | | | | | | | | | | | | | | | | | | | | | | | | |
M. marinum:                        5559140 gagtggactacctcaccggcgactacctcgccgaactgacctgctgatcctgggcccgc 5559199

M. tuberculosis:                  133 gaccgcatgaaaaaccccgatcgcggtacgcgaagaccttctggcccagctcgaggac 192
                                  ||||| | | | | | | | | | | | | | | | | | | | | | | | | |
M. marinum:                        5559200 gaccgatgaaaaaccccgagcgcggctacgcgaagaccttctggcccagctcgaagac 5559259
    
```


M. marinum: 1381 taaccccgatgaaggaggacgcggatggcgtctcgttctgatgcgtccggcgccgtacgc 1440
|||||
M. ulcerans: [5206110](#) taaccccgatgaaggaggacgcggatggcgtctcgttctgatgcgtccggcgccgtacgc 5206169

M. marinum: 1441 atcgcgaactggtccggcttctacggggaccgtctctcggcgatgcgcgaaatgctcacc 1500
|||||
M. ulcerans: [5206170](#) atcgcgaactggtccggcttctacggggaccgtctctcggcgatgcgcgaaatgctcacc 5206229

M. marinum: 1501 ggcggcgaggtggactacctcaccggcgactacctcgccgaactgaccatgctgatcctg 1560
|||||
M. ulcerans: [5206230](#) ggcggcgaggtggactacctcaccggcgactacctggccgaactgaccatgctgatcctg 5206289

M. marinum: 1561 ggcgcgacccggatgaaaaaccccgagcgcggctacgccaagacctcctggcccagctc 1620
|||||
M. ulcerans: [5206290](#) ggcgcgacccggatgaaagaaccccgagcgcggctacgccaagacctcctggcccagctc 5206349

M. marinum: 1621 gaagactgcctgggactggcccacgagcgcggagtgcgcatcgtcgccaacgcggcgcc 1680
|||||
M. ulcerans: [5206350](#) gaagactgcctgggactggcccacgagcgcggagtgcgcatcgtcgccaacgcggcgcc 5206409

M. marinum: 1681 ctcaatcccgcgggctggccgatgcgatcagggccctaaccgagcgttgggcatcggc 1740
|||||
M. ulcerans: [5206410](#) ctcaatcccgcgggctggccgatgcgatcagggccctagccgagtgctgggcatcggc 5206469

M. marinum: 1741 gcccgcacgcccacgtggaaggcgacgatctggcgccccgcggccgaactcggcctg 1800
|||||
M. ulcerans: [5206470](#) gcccgcacgcccacgtggaaggcgacgatctggcgccccgcggccgaactcggcctg 5206529

M. marinum: 1801 ggcacaccgctgacagccaacgcctacctgggcgctggggcatcgtcgattgcctcaac 1860
|||||
M. ulcerans: [5206530](#) ggcacatcgtgacagccaacgcctacctgggcgctggggcatcgtcgattgcctcaac 5206589

M. marinum: 1861 agcggggccgacgtcgtggtcaccggggcgggtcaccgacgcctcggatcgtcggatcc 1920
|||||
M. ulcerans: [5206590](#) agcggggccgacgtcgtggtcaccggggcgggtcaccgacgcctcggatcgtcggatcc 5206649

M. marinum: 1921 gcggcgcgcaacttcggctggggccgcaccgactacaaccagctggccggcgccgtggtg 1980
|||||
M. ulcerans: [5206650](#) gcggcgcgcaacttcggctggggccgcaccgactacaaccagctggccggcgccgtggtg 5206709

M. marinum: 1981 **gccggccatgtcatcgaatgcgggggtccaggccaccggcggcaactacgccttcttcacc** 2040
 |||
 M. ulcerans: [5206710](#) gccggccatgtcatcgaatgcgggggtccaggccaccggcggcaactacgccttcttcacc 5206769

M. marinum: 2041 **gaggtccccgatctgacctacgccggttcccgtggccgaggtcagcgcgacggcacc** 2100
 |||
 M. ulcerans: [5206770](#) gaggtccccgatctgacctacgccggttcccgtggccgaggtcagcgcgacggcacc 5206829

M. marinum: 2101 **tcggtgatcaccaaacaccccggcaccggtgggctggtcagccccgacaccgtcaccgca** 2160
 |||
 M. ulcerans: [5206830](#) tcggtgatcaccaaacaccccggcaccggtgggctggtcagcccagacaccgtcaccgca 5206889

M. marinum: 2161 **caactgctctacgagatatccggcgcccgtacgccaatccggacgtgacggcccggatg** 2220
 |||
 M. ulcerans: [5206890](#) caactgctctacgagatatccggcgcccgtacgccaatccggacgtgacggcccggatg 5206949

M. marinum: 2221 **gacaccatccaactgtccagcgatggcccggatcgggtgcgcatcagcggcgatcggc** 2280
 |||
 M. ulcerans: [5206950](#) gacaccatccaactgtccagcgatggcccggatcgggtgcgcatcagcggcgatcggc 5207009

M. marinum: 2281 **gaagnnnnnnaccacacctgaaggtgtcgctgaacagcatcggcgggttccgcaacgcc** 2340
 |||
 M. ulcerans: [5207010](#) gaagcgcacccacagaccctgaaggtgtcgctgaacagcatcggcgggttccgcaacgcc 5207069

M. marinum: 2341 **atgacgttcgtcttgacgggtctgaacatcgaggccaaggccgagctcgtgcaacgccag** 2400
 |||
 M. ulcerans: [5207070](#) atgacgttcgtcttgacgggtctgaacatcgaggccaaggccgagctcgtgcaacgccag 5207129

M. marinum: 2401 **ctcgaggccaccctgaccgtcaaaccgcccgaactggaatggaccctggcccgcaccgac** 2460
 |||
 M. ulcerans: [5207130](#) ctcgaggccaccctgaccgtcaaaccgcccgaactggaatggaccctggcccgcaccgac 5207189

M. marinum: 2461 **cacgtcgacgcgacaccgaggaagccgcccagcgcctgctgcactgcgtggtccgtgac** 2520
 |||
 M. ulcerans: [5207190](#) cacgtcgacgcgacaccgaggaagccgcccagcgcctgctgcactgcgtggtccgtgac 5207249

M. marinum: 2521 **cccgaccccgccaatgtgggcccgaagtctcctcggccgcggtggaattggcgttggcc** 2580
 |||
 M. ulcerans: [5207250](#) cccgaccccgccaatgtgggcccgaattctcctcggccgcggtggaattggcgttggcc 5207309

Partial alignment of *M. marinum* region from the end of the *M. marinum* orthologue of Rv0981 (green) to the end of *M. marinum* orthologue of Rv0976c (light blue) with the orthologous region in *M. avium paratuberculosis*, showing high percentage of homology and a similar absence of the PE_PGRS16, -17 and -18 in *M. avium paratuberculosis*.

```

M. marinum (ATCC BAA-535):                20 agcacgtaaccacccccgcgcacagtgatcagccggctcgccctcgccctcggtt 79
M. avium paratuberculosis (Map K-10): 2399073 agcacgtaaccacccccgcgcacagtgatcagccggctcgccctcgccctcggtt 2399014

M. marinum:                               80 ttaagccgcaggtagcccacgtagacctcgagcgcggttgccggacgtgggaaagtcaag 139
M. avium paratuberculosis:                2399013 ttgccccgcaggtagccgacgtacacctccagcgcattgcccgaggtgggaaagtcaag 2398954

M. marinum:                               140 cccacacctcttcgaggatgcggtgccccggtcagcaccgctcgccgggtggcgatcagc 199
M. avium paratuberculosis:                2398953 cccagacctcttcgaggatgcggtgccccggtgagcaccgctcgccgggtggcgatcagc 2398894

M. marinum:                               200 atctccagcagggcgaactcgggtcgccggtgaggtgatgccccgccccgccccggtcacc 259
M. avium paratuberculosis:                2398893 atttccagcagtgccaactcgggtgccccggtgaggtgatgccccgccccgccccggtgacc 2398834

M. marinum:                               260 tcccgggtcaccgggtccaggctcaggctcgggagacgtcatggctaccgaatcggcggtc 319
M. avium paratuberculosis:                2398833 tcccgggtcaccgggtccaggctcaggctcgggagacgtcatggctaccgaatcggcggtc 2398777

M. marinum:                               320 tctgctcttcgggcttggtgccccgagcaacgccccgcatccgcccccaacagctcttcc 379
M. avium paratuberculosis:                2398776 ---tctgctcttcgggcttggtgccccgagcaacgccccgcatccgcccccaacagctcttcc 2398720

M. marinum:                               380 agcgcgaacggcttcggcaggtagtcacccgccccgcatcagccccgccccggttcg 439
M. avium paratuberculosis:                2398719 agggcgaacggcttcggcaggtagtcacccgccccgcatcagccccgccccggttcg 2398660

M. marinum:                               440 gagacggaatcacgggctcagcaccgagaatgggcagatcaccgggtactgccaagt 499
M. avium paratuberculosis:                2398659 gagaccgaatcacgggctcagcaccgagaatgggcaggtcaccgggtactgccaagt 2398600

M. marinum:                               500 tgacggcatacctccaagccatccagtcgccccgcatcatgacgtccagcaccacgcgtca 559

```

M. avium paratuberculosis: 2398599 `tgacggcacacctcgaggccatccagtcgcgccatcatcacatccaggacgagcgcgctcg` 2398540

M. marinum: 560 `ggccgatcactggcaatcatctcgagagcttccacaccatcgtgtgccagctcaaccgtg` 619

M. avium paratuberculosis: 2398539 `ggcgatcgctcgcgatcatgtcgagagcctcgaccccgatgggccaactcgacggag` 2398480

M. marinum: 620 `tagccattgaaggaaagcgacctgcccagcgactcgcgccaccgcgcatcgtcgtcgacc` 679

M. avium paratuberculosis: 2398479 `tagccgttgaaggacaacgacctgcgtaacgactcgcgccaccgcgcatcgtcgtcgacc` 2398420

M. marinum: 680 `acaagtatccgcacggacat` tagtttcgtcctaacgcctgagagcggcctgagagggcgcg 739

M. avium paratuberculosis: 2398419 `accagtattcgacggcccctagtttcgtcccaccgacctgagactgacctgagagggcgcg` 2398360

M. marinum: 740 ccg 742
 |||
 M. avium paratuberculosis: 2398359 ccg 2398357

Score = 168 bits (85), Expect = 3e-041
 Identities = 166/193 (86%)
 Strand = Plus / Minus

M. marinum (ATCC BAA-535): 973 `cggtcgagatcgatgagaccgagccgggccccttgagcagccggcgaggcaccttgtgc` 1032

M. avium paratuberculosis (Map K-10): 2398283 `cggtcgagatcgatcaggccgagacgggccccttgagcagcctgcgcgccaccttgtgc` 2398224

M. marinum: 1033 `ttctgaccggcaacgggtgacgcccagcaggttcggccttgggtggccttccactgcgagcgc` 1092

M. avium paratuberculosis: 2398223 `cgctgacctgccaccgtcacaccgacgagctcggctcttccgccttccactgcgcgcgcc` 2398164

M. marinum: 1093 `cggttcgagatattcgcgcgcgacatcctgcgcttgggtgtggccat` ggtcggacctaac 1152

M. avium paratuberculosis: 2398163 `cggttacgggtgttcgcgcgcgacattctgcgcttgggttacggccatggtcgggcctaac` 2398104

M. marinum: 1153 `tcctcggtcgggg` 1165

M. avium paratuberculosis: 2398103 `tcctcggtcgggg` 2398091

Score = 311 bits (157), Expect = 3e-084
Identities = 244/273 (89%)
Strand = Plus / Minus

```
M. marinum (ATCC BAA-535):          1438  cgcacgcggaactgttccggcttctacggggaccgtctctcggcgatgcgcgaaatgctc 1497
|||||
M. avium paratuberculosis (Map K-10): 2397844  cgcacgcggaactgctccgggttctacggcgaccgggtgtcggccatgcgcgagatgctg 2397785

M. marinum:                          1498  accggcggcgaggaggactacctcaccggcgactacctcgccgaactgaccatgctgatc 1557
|||||
M. avium paratuberculosis:          2397784  accggcggcaaggtggactacctcaccggcgactacctggccgaactgaccatgctgatc 2397725

M. marinum:                          1558  ctgggcccgcgaccggatgaaaaaccccgagcgcggctacgccaagaccttctggcccag 1617
|||||
M. avium paratuberculosis:          2397724  ctgggcccgcgatcggatgaagcaccgccgagcgcggctacgccaagaccttctgacccaa 2397665

M. marinum:                          1618  ctcgaagactgcctgggactggcccacgagcgcggagtgcgcatcgtcgccaacgccggc 1677
|||||
M. avium paratuberculosis:          2397664  ctcgaggactgcctgggcgaggcccgaccgcgggtccgcatcgctggccaacgccggc 2397605

M. marinum:                          1678  ggactcaatcccgcgggctggccgatgcgatc 1710
|||||
M. avium paratuberculosis:          2397604  ggactcaaccggccggcctggccgacgcgatc 2397572
```

Score = 880 bits (444), Expect = 0.0
Identities = 1112/1332 (83%), Gaps = 2/1332 (0%)
Strand = Plus / Minus

```
M. marinum (ATCC BAA-535):          1780  cgcgcggccgaactcggcctgggcacaccgctgacagccaacgcctacctgggcgctgg 1839
|||||
M. avium paratuberculosis (Map K-10): 2397502  cgcgcggccgagctggggctgggcagcccgctgaccgccaacgcctacctgggcgctgg 2397443

M. marinum:                          1840  ggcatcgtcgattgcctcaacagcggggccgacgtcgtggtcaccggccgggtcaccgac 1899
|||||
M. avium paratuberculosis:          2397442  ggcatcgtcgactgcctgggcgacggcgccgacgtcgtcgtcaccggccgggtcaccgac 2397383
```


M. marinum: 1900 gcctcggatgatcgatcgatccgccccggcgacttcggctggggccgaccgactacaac 1959
 |||||
 M. avium paratuberculosis: 2397382 gcctcggatgatcgatcgatccgccccggcgacttcggctgggaacgcagcgactacgac 2397323

M. marinum: 1960 cagctggccggcgccgtggggccgcacatgcatcgaatgcggggtccaggccaccggc 2019
 |||||
 M. avium paratuberculosis: 2397322 cggtcgcggggcggtggggccgcacatcgagtcggggtgcaggccaccggc 2397263

M. marinum: 2020 ggcaactacgccttcttcaccgagggtccccgatctgacctaccgaggttcccgtggcc 2079
 |||||
 M. avium paratuberculosis: 2397262 ggcaactattccttcttcaccgagggtccccgatctgacctaccgaggttcccgtggcc 2397203

M. marinum: 2080 gaggtcagcgcgaccgacacctcggtgatcaccaaacaccccgccaccggtgggtggtc 2139
 |||||
 M. avium paratuberculosis: 2397202 gaggtgcagcgcgaccgacacctcggtgatcaccaaacaccccgccaccggtgggtggtc 2397143

M. marinum: 2140 agccccgacaccgtcaccgcacaactgctctacgagatatccggcgccccgtaccgcaat 2199
 |||||
 M. avium paratuberculosis: 2397142 agcgtcagaccgtcaccgcacaactgctctacgagatatccggcgccccgtaccgcaat 2397083

M. marinum: 2200 ccggacgtgacggccccggatggacaccatccaactgtccagcgatggccccgatcgggtg 2259
 |||||
 M. avium paratuberculosis: 2397082 ccggacgtgacggccccggatggacaccatccaactgtccagcgatggccccgatcgggtg 2397023

M. marinum: 2260 cgcatcagcggcgatcgggcaagccccccaccaccctgaaggtgtcgctgaacagc 2319
 |||||
 M. avium paratuberculosis: 2397022 cgcatcagcggcgatcgggcaagccccccaccaccctgaaggtgtcgctgaacagc 2396963

M. marinum: 2320 atcggcggggtccgcaacgccatgacgttcgtcttgacgggtctgaacatcgaggccaag 2379
 |||||
 M. avium paratuberculosis: 2396962 atcggcgggatccgcaacgccatgacgttcgtcttgacgggtctgaacatcgaggccaag 2396903

M. marinum: 2380 gccgagctcgtgcaacgccagctcgaggccacctgacctcaaacccgcccgaactggaa 2439
 |||||
 M. avium paratuberculosis: 2396902 gccgagctcgtgcaacgccagctcgaggccacctgacctcaaacccgcccgaactggaa 2396843

M. marinum: 2440 tggaccctggcccgcaccgaccacgtcgacgccgacaccgaggaagccgaccgaccctg 2499
 |||||
 M. avium paratuberculosis: 2396842 tggtcgctggcccgcaccgaccacgtcgacgccgacaccgaggaagccgaccgaccctg 2396783

M. marinum: 2500 ctgcactgcgtggtccgtgaccccgaccccgccaatgtgggcccgaagtctcctcggcc 2559
|||
M. avium paratuberculosis: 2396782 ctgcactgcgtcgtccgcgatcccgacccggccaatgtcgggcgccaattctcctcggcc 2396723

M. marinum: 2560 gcggtggaattggcgttggccagctatcccgga-ttcacctcgaccgcacccccgggcga 2618
||
M. avium paratuberculosis: 2396722 gcagtccaattggcactcgccagctatccgggatttcacgtc-accgccccgcggccga 2396664

M. marinum: 2619 cggccaggtgtatgggggttcgtgccccggctacgtggacgccaagctggtgccacacat 2678
|||
M. avium paratuberculosis: 2396663 cggccaggtgtacggcgtgttcaccgcccggctatgtcgacgccgataaggtgccgcacat 2396604

M. marinum: 2679 cgccgtgcacgccgacggcacgcgaccgatatcccctgcgccaccgagaccctggaact 2738
|||
M. avium paratuberculosis: 2396603 cgcggtgcacgccgacggcggccgggtcgacattccttgcgccaccgatacttggagct 2396544

M. marinum: 2739 ggaatcggtcgatccccggccttgcccgatccgctgcccaccggcccgcaccgacgggt 2798
|||
M. avium paratuberculosis: 2396543 ggcgccggtcgatgaccggcgtgcccgaaccgctgcccggacggcccgggtgcgccgcg 2396484

M. marinum: 2799 accgctgggcctgatgcccggcggcggcagcggggacaagggcgggtcggccaacgtcgg 2858
|||
M. avium paratuberculosis: 2396483 gccgctgggtactatcgccggggccccagcggagacaagggcgggtcggccaacgtcgg 2396424

M. marinum: 2859 actatgggtgcgcaccgacgagcagtgccgctggctggccaacacgctgacagtggagct 2918
|||
M. avium paratuberculosis: 2396423 ggtctgggtccgcaccgacgagcagtgccgctggctggccaacacgctgacagtggagct 2396364

M. marinum: 2919 gctcaaggaactgctgcccaggcggccgatctgcaagtaccgctacgcgttgcccaa 2978
|||
M. avium paratuberculosis: 2396363 gctcaccgagctgctgcccaggcggccgatctgcaagtaccgctacgcgttgcccaa 2396304

M. marinum: 2979 cctgccccgcgtgaacttcgtcatcgaggggattctcggtcagggcgtggcctatcaggc 3038
|||
M. avium paratuberculosis: 2396303 cctgccccgcgtgaacttcgtcatcgaggggattctcggtcagggcgtggcctatcaggc 2396244

M. marinum: 3039 cggattcgaccgcaagccaagggctgggcgaatggctgcgcagccgccacctcgatat 3098
|||
M. avium paratuberculosis: 2396243 ccggttcgaccgcaagccaagggctgggcgaatggctgcgcagccgccacctcgatat 2396184

M. marinum: 3099 **ccggagagcct** 3110
 |||
M. avium paratuberculosis: 2396183 cccggagagcct 2396172