Classifying the lifestyle of metagenomically-derived phages sequences using alignment-free methods Supplementary Material

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Figure S1. The AUROC values of and for classifying the lifestyles of phage contigs using *k*-mer lengths from 6 to 10, Markov order from 0 to 3, and contig lengths 10,000bp (a), 1,000 bp (b) and 500 bp (c).



Figure S2. The distance of contigs from new phages to the temperate and lytic phages genomes. The black line represents the distance to temperate and lytic phages is equal.



Figure S3. Sensitivity of and to random mutations applied to evaluation contigs. Prediction results as evaluated by AUROCs were determined on contigs from temperate and lytic phage genomes with no mutations applied vs. when random mutations were applied to the contigs at three different rates (0.001, 0.005, and 0.01 substitutions per position). Bars represent averages of 30 replicate datasets tested, and error bars indicate standard deviations.



Table S1. The accession number of the 1,225 phages used for constructing the training models.

|  |  |  |  |
| --- | --- | --- | --- |
| Accession Number | Lifestyle | Accession Number | Lifestyle |
| NC\_009760 | Lytic | NC\_009737 | Temperate |
| NC\_022343 | Lytic | NC\_004615 | Temperate |
| NC\_001741 | Lytic | NC\_004617 | Temperate |
| NC\_012558 | Lytic | NC\_011103 | Temperate |
| NC\_003793 | Lytic | NC\_011357 | Temperate |
| NC\_001365 | Lytic | NC\_001317 | Temperate |
| NC\_020843 | Lytic | NC\_007047 | Temperate |
| NC\_007807 | Lytic | NC\_019512 | Temperate |
| NC\_006356 | Lytic | NC\_003291 | Temperate |
| NC\_015250 | Lytic | NC\_007051 | Temperate |
| NC\_011045 | Lytic | NC\_007061 | Temperate |
| NC\_011703 | Lytic | NC\_007055 | Temperate |
| NC\_010576 | Lytic | NC\_007052 | Temperate |
| NC\_002194 | Lytic | NC\_007054 | Temperate |
| NC\_022323 | Lytic | NC\_012753 | Temperate |
| NC\_010821 | Lytic | NC\_007062 | Temperate |
| NC\_008208 | Lytic | NC\_007049 | Temperate |
| NC\_015249 | Lytic | NC\_007060 | Temperate |
| NC\_007019 | Lytic | NC\_007048 | Temperate |
| NC\_007022 | Lytic | NC\_015938 | Temperate |
| NC\_021853 | Lytic | NC\_007059 | Temperate |
| NC\_007053 | Lytic | NC\_005356 | Temperate |
| NC\_003438 | Lytic | NC\_009526 | Temperate |
| NC\_007461 | Lytic | NC\_007050 | Temperate |
| NC\_004678 | Lytic | NC\_008464 | Temperate |
| NC\_005135 | Lytic | NC\_007063 | Temperate |
| NC\_022968 | Lytic | NC\_007064 | Temperate |
| NC\_015251 | Lytic | NC\_000924 | Temperate |
| NC\_007046 | Lytic | NC\_015263 | Temperate |
| NC\_021867 | Lytic | NC\_007057 | Temperate |
| NC\_019519 | Lytic | NC\_009815 | Temperate |
| NC\_008370 | Lytic | NC\_003216 | Temperate |
| NC\_002185 | Lytic | NC\_004112 | Temperate |
| NC\_007806 | Lytic | NC\_009810 | Temperate |
| NC\_010353 | Lytic | NC\_004827 | Temperate |
| NC\_016657 | Lytic | NC\_018283 | Temperate |
| NC\_018088 | Lytic | NC\_000935 | Temperate |
| NC\_009811 | Lytic | NC\_011551 | Temperate |
| NC\_015253 | Lytic | NC\_009812 | Temperate |
| NC\_021337 | Lytic | NC\_005887 | Temperate |
| NC\_013645 | Lytic | NC\_012743 | Temperate |
| NC\_021316 | Lytic | NC\_019917 | Temperate |
| NC\_014660 | Lytic | NC\_006557 | Temperate |
| NC\_019444 | Lytic | NC\_002666 | Temperate |
| NC\_014661 | Lytic | NC\_002667 | Temperate |
| NC\_014663 | Lytic | NC\_002668 | Temperate |
| NC\_022328 | Lytic | NC\_002669 | Temperate |
| NC\_019725 | Lytic | NC\_002670 | Temperate |
| NC\_005260 | Lytic | NC\_002671 | Temperate |
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| NC\_019543 | Lytic | NC\_015254 | Temperate |
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| NC\_005882 | Lytic | NC\_021774 | Temperate |
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| NC\_016161 | Lytic | NC\_019456 | Temperate |
| NC\_001825 | Lytic | NC\_021773 | Temperate |
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| NC\_027997 | Lytic | NC\_019931 | Temperate |
| NC\_018861 | Lytic | NC\_015266 | Temperate |
| NC\_002180 | Lytic | NC\_015273 | Temperate |
| NC\_027996 | Lytic | NC\_015265 | Temperate |
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| NC\_016656 | Lytic | NC\_009763 | Temperate |
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| NC\_005856 | Lytic | NC\_023007 | Temperate |
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| NC\_015208 | Lytic |  |  |
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| NC\_021794 | Lytic |  |  |
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| NC\_021796 | Lytic |  |  |
| NC\_021804 | Lytic |  |  |
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| NC\_021792 | Lytic |  |  |
| NC\_021793 | Lytic |  |  |
| NC\_021855 | Lytic |  |  |
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| NC\_019924 | Lytic |  |  |
| NC\_023693 | Lytic |  |  |
| NC\_004777 | Lytic |  |  |
| NC\_020081 | Lytic |  |  |
| NC\_019782 | Lytic |  |  |
| NC\_014635 | Lytic |  |  |
| NC\_014636 | Lytic |  |  |
| NC\_019528 | Lytic |  |  |
| NC\_020862 | Lytic |  |  |
| NC\_019405 | Lytic |  |  |
| NC\_017980 | Lytic |  |  |
| NC\_018083 | Lytic |  |  |
| NC\_014457 | Lytic |  |  |
| NC\_027353 | Lytic |  |  |
| NC\_009237 | Lytic |  |  |
| NC\_019926 | Lytic |  |  |
| NC\_015292 | Lytic |  |  |
| NC\_011811 | Lytic |  |  |
| NC\_019929 | Lytic |  |  |
| NC\_010106 | Lytic |  |  |
| NC\_009904 | Lytic |  |  |
| NC\_006953 | Lytic |  |  |
| NC\_022971 | Lytic |  |  |
| NC\_015264 | Lytic |  |  |
| NC\_006936 | Lytic |  |  |
| NC\_001730 | Lytic |  |  |
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| NC\_005045 | Lytic |  |  |
| NC\_019520 | Lytic |  |  |
| NC\_004629 | Lytic |  |  |
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| NC\_020083 | Lytic |  |  |
| NC\_005964 | Lytic |  |  |
| NC\_002643 | Lytic |  |  |
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| NC\_016163 | Lytic |  |  |
| NC\_019909 | Lytic |  |  |
| NC\_019919 | Lytic |  |  |
| NC\_010807 | Lytic |  |  |
| NC\_019530 | Lytic |  |  |
| NC\_015586 | Lytic |  |  |
| NC\_020860 | Lytic |  |  |
| NC\_008265 | Lytic |  |  |
| NC\_021569 | Lytic |  |  |
| NC\_007189 | Lytic |  |  |
| NC\_020842 | Lytic |  |  |
| NC\_020201 | Lytic |  |  |
| NC\_013697 | Lytic |  |  |
| NC\_001422 | Lytic |  |  |
| NC\_001271 | Lytic |  |  |
| NC\_008584 | Lytic |  |  |
| NC\_018270 | Lytic |  |  |
| NC\_018084 | Lytic |  |  |
| NC\_020883 | Lytic |  |  |
| NC\_000867 | Lytic |  |  |
| NC\_022770 | Lytic |  |  |
| NC\_022751 | Lytic |  |  |
| NC\_019542 | Lytic |  |  |
| NC\_023005 | Lytic |  |  |
| NC\_019447 | Lytic |  |  |
| NC\_022987 | Lytic |  |  |
| NC\_001421 | Lytic |  |  |
| NC\_021331 | Lytic |  |  |
| NC\_011107 | Lytic |  |  |
| NC\_019529 | Lytic |  |  |
| NC\_016071 | Lytic |  |  |
| NC\_020863 | Lytic |  |  |
| NC\_020846 | Lytic |  |  |
| NC\_021534 | Lytic |  |  |
| NC\_021561 | Lytic |  |  |
| NC\_020849 | Lytic |  |  |
| NC\_008364 | Lytic |  |  |
| NC\_019490 | Lytic |  |  |
| NC\_012638 | Lytic |  |  |
| NC\_014467 | Lytic |  |  |
| NC\_008515 | Lytic |  |  |
| NC\_007023 | Lytic |  |  |
| NC\_005066 | Lytic |  |  |
| NC\_012635 | Lytic |  |  |
| NC\_004928 | Lytic |  |  |
| NC\_016165 | Lytic |  |  |
| NC\_018832 | Lytic |  |  |
| NC\_022765 | Lytic |  |  |
| NC\_021300 | Lytic |  |  |
| NC\_004735 | Lytic |  |  |
| NC\_019408 | Lytic |  |  |
| NC\_021560 | Lytic |  |  |
| NC\_021557 | Lytic |  |  |
| NC\_011201 | Lytic |  |  |
| NC\_022917 | Lytic |  |  |
| NC\_022915 | Lytic |  |  |
| NC\_010811 | Lytic |  |  |
| NC\_008574 | Lytic |  |  |
| NC\_011399 | Lytic |  |  |
| NC\_019548 | Lytic |  |  |
| NC\_008575 | Lytic |  |  |
| NC\_021866 | Lytic |  |  |
| NC\_021862 | Lytic |  |  |
| NC\_007603 | Lytic |  |  |
| NC\_011041 | Lytic |  |  |
| NC\_020837 | Lytic |  |  |
| NC\_021530 | Lytic |  |  |
| NC\_016164 | Lytic |  |  |
| NC\_015463 | Lytic |  |  |
| NC\_015465 | Lytic |  |  |
| NC\_016766 | Lytic |  |  |
| NC\_015569 | Lytic |  |  |
| NC\_021536 | Lytic |  |  |
| NC\_006820 | Lytic |  |  |
| NC\_020859 | Lytic |  |  |
| NC\_020486 | Lytic |  |  |
| NC\_020867 | Lytic |  |  |
| NC\_020838 | Lytic |  |  |
| NC\_013085 | Lytic |  |  |
| NC\_015281 | Lytic |  |  |
| NC\_020851 | Lytic |  |  |
| NC\_015282 | Lytic |  |  |
| NC\_015279 | Lytic |  |  |
| NC\_020875 | Lytic |  |  |
| NC\_015289 | Lytic |  |  |
| NC\_015287 | Lytic |  |  |
| NC\_019516 | Lytic |  |  |
| NC\_020869 | Lytic |  |  |
| NC\_020416 | Lytic |  |  |
| NC\_016565 | Lytic |  |  |
| NC\_022920 | Lytic |  |  |
| NC\_022918 | Lytic |  |  |
| NC\_019511 | Lytic |  |  |
| NC\_009875 | Lytic |  |  |
| NC\_023009 | Lytic |  |  |
| NC\_019549 | Lytic |  |  |
| NC\_019550 | Lytic |  |  |
| NC\_016763 | Lytic |  |  |
| NC\_022752 | Lytic |  |  |
| NC\_009232 | Lytic |  |  |
| NC\_022754 | Lytic |  |  |
| NC\_002214 | Lytic |  |  |
| NC\_000871 | Lytic |  |  |
| NC\_016073 | Lytic |  |  |
| NC\_015456 | Lytic |  |  |
| NC\_015457 | Lytic |  |  |
| NC\_016567 | Lytic |  |  |
| NC\_002519 | Lytic |  |  |
| NC\_001835 | Lytic |  |  |
| NC\_019910 | Lytic |  |  |
| NC\_009987 | Lytic |  |  |
| NC\_011756 | Lytic |  |  |
| NC\_013600 | Lytic |  |  |
| NC\_019487 | Lytic |  |  |
| NC\_014595 | Lytic |  |  |
| NC\_004831 | Lytic |  |  |
| NC\_015269 | Lytic |  |  |
| NC\_019417 | Lytic |  |  |
| NC\_011421 | Lytic |  |  |
| NC\_022763 | Lytic |  |  |
| NC\_004166 | Lytic |  |  |
| NC\_021868 | Lytic |  |  |
| NC\_006940 | Lytic |  |  |
| NC\_012223 | Lytic |  |  |
| NC\_018843 | Lytic |  |  |
| NC\_012868 | Lytic |  |  |
| NC\_021343 | Lytic |  |  |
| NC\_019455 | Lytic |  |  |
| NC\_001270 | Lytic |  |  |
| NC\_019411 | Lytic |  |  |
| NC\_015288 | Lytic |  |  |
| NC\_015286 | Lytic |  |  |
| NC\_021072 | Lytic |  |  |
| NC\_015285 | Lytic |  |  |
| NC\_008296 | Lytic |  |  |
| NC\_005833 | Lytic |  |  |
| NC\_003298 | Lytic |  |  |
| NC\_000866 | Lytic |  |  |
| NC\_005859 | Lytic |  |  |
| NC\_001604 | Lytic |  |  |
| NC\_019446 | Lytic |  |  |
| NC\_017971 | Lytic |  |  |
| NC\_019442 | Lytic |  |  |
| NC\_009540 | Lytic |  |  |
| NC\_015937 | Lytic |  |  |
| NC\_022088 | Lytic |  |  |
| NC\_007021 | Lytic |  |  |
| NC\_020414 | Lytic |  |  |
| NC\_018850 | Lytic |  |  |
| NC\_001998 | Lytic |  |  |
| NC\_021532 | Lytic |  |  |
| NC\_019527 | Lytic |  |  |
| NC\_020873 | Lytic |  |  |
| NC\_019398 | Lytic |  |  |
| NC\_019400 | Lytic |  |  |
| NC\_019401 | Lytic |  |  |
| NC\_020078 | Lytic |  |  |
| NC\_019504 | Lytic |  |  |
| NC\_019510 | Lytic |  |  |
| NC\_019514 | Lytic |  |  |
| NC\_019399 | Lytic |  |  |
| NC\_019517 | Lytic |  |  |
| NC\_014792 | Lytic |  |  |
| NC\_019403 | Lytic |  |  |
| NC\_015933 | Lytic |  |  |
| NC\_019404 | Lytic |  |  |
| NC\_019718 | Lytic |  |  |
| NC\_019526 | Lytic |  |  |
| NC\_020871 | Lytic |  |  |
| NC\_021063 | Lytic |  |  |
| NC\_017864 | Lytic |  |  |
| NC\_017865 | Lytic |  |  |
| NC\_019918 | Lytic |  |  |
| NC\_019813 | Lytic |  |  |
| NC\_022090 | Lytic |  |  |
| NC\_020877 | Lytic |  |  |
| NC\_019518 | Lytic |  |  |
| NC\_019713 | Lytic |  |  |
| NC\_017981 | Lytic |  |  |
| NC\_020850 | Lytic |  |  |
| NC\_020868 | Lytic |  |  |
| NC\_020848 | Lytic |  |  |
| NC\_016162 | Lytic |  |  |
| NC\_012757 | Lytic |  |  |
| NC\_005948 | Lytic |  |  |
| NC\_021562 | Lytic |  |  |
| NC\_002362 | Lytic |  |  |
| NC\_002363 | Lytic |  |  |
| NC\_004736 | Lytic |  |  |
| NC\_010495 | Lytic |  |  |
| NC\_015271 | Lytic |  |  |
| NC\_015296 | Lytic |  |  |
| NC\_007149 | Lytic |  |  |
| NC\_012662 | Lytic |  |  |
| NC\_021776 | Lytic |  |  |
| NC\_003907 | Lytic |  |  |
| NC\_003327 | Lytic |  |  |
| NC\_020488 | Lytic |  |  |
| NC\_016563 | Lytic |  |  |
| NC\_007821 | Lytic |  |  |
| NC\_007734 | Lytic |  |  |
| NC\_022094 | Lytic |  |  |
| NC\_019505 | Lytic |  |  |
| NC\_012749 | Lytic |  |  |
| NC\_009543 | Lytic |  |  |
| NC\_004902 | Lytic |  |  |
| NC\_011038 | Lytic |  |  |
| NC\_018087 | Lytic |  |  |

Table S2. The accession number of 337 phages used for testing.

|  |  |  |  |
| --- | --- | --- | --- |
| Accession Number | Lifestyle | Accession Number | Lifestyle |
| NC\_028651 | Lytic | NC\_028903 | Temperate |
| NC\_023586 | Lytic | NC\_023503 | Temperate |
| NC\_025436 | Lytic | NC\_028775 | Temperate |
| NC\_025470 | Lytic | NC\_028917 | Temperate |
| NC\_025458 | Lytic | NC\_024355 | Temperate |
| NC\_025463 | Lytic | NC\_029120 | Temperate |
| NC\_027987 | Lytic | NC\_028834 | Temperate |
| NC\_025447 | Lytic | NC\_029029 | Temperate |
| NC\_027120 | Lytic | NC\_023591 | Temperate |
| NC\_028786 | Lytic | NC\_027334 | Temperate |
| NC\_029072 | Lytic | NC\_028859 | Temperate |
| NC\_024217 | Lytic | NC\_028915 | Temperate |
| NC\_025439 | Lytic | NC\_029069 | Temperate |
| NC\_029050 | Lytic | NC\_028748 | Temperate |
| NC\_029024 | Lytic | NC\_024144 | Temperate |
| NC\_025466 | Lytic | NC\_025422 | Temperate |
| NC\_029071 | Lytic | NC\_022980 | Temperate |
| NC\_029045 | Lytic | NC\_024361 | Temperate |
| NC\_029042 | Lytic | NC\_025428 | Temperate |
| NC\_029080 | Lytic | NC\_024391 | Temperate |
| NC\_024146 | Lytic | NC\_029073 | Temperate |
| NC\_025443 | Lytic | NC\_025453 | Temperate |
| NC\_024358 | Lytic | NC\_028851 | Temperate |
| NC\_028697 | Lytic | NC\_026611 | Temperate |
| NC\_027130 | Lytic | NC\_028758 | Temperate |
| NC\_026928 | Lytic | NC\_028830 | Temperate |
| NC\_023587 | Lytic | NC\_024370 | Temperate |
| NC\_027132 | Lytic | NC\_028783 | Temperate |
| NC\_029091 | Lytic | NC\_029025 | Temperate |
| NC\_029030 | Lytic | NC\_004462 | Temperate |
| NC\_027983 | Lytic | NC\_027393 | Temperate |
| NC\_025830 | Lytic | NC\_029104 | Temperate |
| NC\_028887 | Lytic | NC\_028768 | Temperate |
| NC\_024137 | Lytic | NC\_024357 | Temperate |
| NC\_027355 | Lytic | NC\_023593 | Temperate |
| NC\_024792 | Lytic | NC\_027990 | Temperate |
| NC\_027633 | Lytic | NC\_026609 | Temperate |
| NC\_027634 | Lytic | NC\_024384 | Temperate |
| NC\_027635 | Lytic | NC\_024387 | Temperate |
| NC\_027636 | Lytic | NC\_027299 | Temperate |
| NC\_027637 | Lytic | NC\_028969 | Temperate |
| NC\_027638 | Lytic | NC\_026014 | Temperate |
| NC\_024142 | Lytic | NC\_028449 | Temperate |
| NC\_029121 | Lytic | NC\_028980 | Temperate |
| NC\_023501 | Lytic | NC\_028770 | Temperate |
| NC\_024793 | Lytic | NC\_024206 | Temperate |
| NC\_024784 | Lytic | NC\_028660 | Temperate |
| NC\_024789 | Lytic | NC\_028886 | Temperate |
| NC\_028652 | Lytic | NC\_029008 | Temperate |
| NC\_028776 | Lytic | NC\_021190 | Temperate |
| NC\_024216 | Lytic | NC\_023559 | Temperate |
| NC\_025442 | Lytic | NC\_026016 | Temperate |
| NC\_023863 | Lytic | NC\_028905 | Temperate |
| NC\_027387 | Lytic | NC\_028958 | Temperate |
| NC\_028888 | Lytic | NC\_029048 | Temperate |
| NC\_028835 | Lytic | NC\_028951 | Temperate |
| NC\_025423 | Lytic | NC\_028764 | Temperate |
| NC\_023576 | Lytic | NC\_028838 | Temperate |
| NC\_023548 | Lytic | NC\_029001 | Temperate |
| NC\_024354 | Lytic | NC\_029116 | Temperate |
| NC\_023717 | Lytic | NC\_028996 | Temperate |
| NC\_024711 | Lytic | NC\_023599 | Temperate |
| NC\_015209 | Lytic | NC\_029022 | Temperate |
| NC\_027988 | Lytic | NC\_022775 | Temperate |
| NC\_027119 | Lytic | NC\_028669 | Temperate |
| NC\_029070 | Lytic | NC\_023574 | Temperate |
| NC\_023558 | Lytic | NC\_029046 | Temperate |
| NC\_024367 | Lytic | NC\_028883 | Temperate |
| NC\_028788 | Lytic | NC\_028959 | Temperate |
| NC\_028919 | Lytic | NC\_028913 | Temperate |
| NC\_028745 | Lytic | NC\_028864 | Temperate |
| NC\_028836 | Lytic | NC\_024365 | Temperate |
| NC\_028885 | Lytic | NC\_027982 | Temperate |
| NC\_028971 | Lytic | NC\_023571 | Temperate |
| NC\_027356 | Lytic | NC\_023560 | Temperate |
| NC\_029102 | Lytic | NC\_025460 | Temperate |
| NC\_028795 | Lytic | NC\_027118 | Temperate |
| NC\_024125 | Lytic | NC\_025434 | Temperate |
| NC\_024210 | Lytic | NC\_028896 | Temperate |
| NC\_023557 | Lytic | NC\_028943 | Temperate |
| NC\_023579 | Lytic | NC\_029066 | Temperate |
| NC\_023743 | Lytic | NC\_023734 | Temperate |
| NC\_027369 | Lytic | NC\_027397 | Temperate |
| NC\_027330 | Lytic | NC\_029084 | Temperate |
| NC\_025441 | Lytic | NC\_028954 | Temperate |
| NC\_025449 | Lytic | NC\_029107 | Temperate |
| NC\_025446 | Lytic | NC\_025115 | Temperate |
| NC\_027335 | Lytic | NC\_025456 | Temperate |
| NC\_025465 | Lytic | NC\_025455 | Temperate |
| NC\_029009 | Lytic | NC\_025461 | Temperate |
| NC\_029026 | Lytic | NC\_029031 | Temperate |
| NC\_023555 | Lytic | NC\_013597 | Temperate |
| NC\_024783 | Lytic | NC\_029010 | Temperate |
| NC\_029067 | Lytic | NC\_029078 | Temperate |
| NC\_024207 | Lytic | NC\_029003 | Temperate |
| NC\_028944 | Lytic | NC\_028696 | Temperate |
| NC\_028698 | Lytic | NC\_028699 | Temperate |
| NC\_023567 | Lytic | NC\_029015 | Temperate |
| NC\_027125 | Lytic | NC\_028701 | Temperate |
| NC\_025824 | Lytic | NC\_027398 | Temperate |
| NC\_027639 | Lytic | NC\_028952 | Temperate |
| NC\_027640 | Lytic | NC\_027339 | Temperate |
| NC\_027641 | Lytic | NC\_028854 | Temperate |
| NC\_027642 | Lytic | NC\_022774 | Temperate |
| NC\_027643 | Lytic | NC\_023588 | Temperate |
| NC\_027644 | Lytic | NC\_029119 | Temperate |
| NC\_027645 | Lytic | NC\_027396 | Temperate |
| NC\_027646 | Lytic | NC\_028685 | Temperate |
| NC\_027647 | Lytic | NC\_023499 | Temperate |
| NC\_027648 | Lytic | NC\_023500 | Temperate |
| NC\_028848 | Lytic | NC\_028700 | Temperate |
| NC\_023719 | Lytic | NC\_028930 | Temperate |
| NC\_028993 | Lytic | NC\_027984 | Temperate |
| NC\_023612 | Lytic | NC\_027395 | Temperate |
| NC\_029118 | Lytic | NC\_028671 | Temperate |
| NC\_025425 | Lytic | NC\_028871 | Temperate |
| NC\_028994 | Lytic | NC\_028929 | Temperate |
| NC\_023550 | Lytic | NC\_028898 | Temperate |
| NC\_029094 | Lytic | NC\_028956 | Temperate |
| NC\_028819 | Lytic | NC\_028853 | Temperate |
| NC\_027384 | Lytic | NC\_028743 | Temperate |
| NC\_024213 | Lytic | NC\_025431 | Temperate |
| NC\_028746 | Lytic | NC\_023575 | Temperate |
| NC\_027329 | Lytic | NC\_026594 | Temperate |
| NC\_024205 | Lytic | NC\_025427 | Temperate |
| NC\_027349 | Lytic | NC\_028862 | Temperate |
| NC\_028872 | Lytic | NC\_023582 | Temperate |
| NC\_024791 | Lytic | NC\_028767 | Temperate |
| NC\_028911 | Lytic | NC\_028656 | Temperate |
| NC\_023590 | Lytic | NC\_025424 | Temperate |
| NC\_023595 | Lytic | NC\_027341 | Temperate |
| NC\_026013 | Lytic | NC\_024369 | Temperate |
| NC\_029013 | Lytic | NC\_028657 | Temperate |
| NC\_028702 | Lytic |  |  |
| NC\_023551 | Lytic |  |  |
| NC\_024356 | Lytic |  |  |
| NC\_028826 | Lytic |  |  |
| NC\_029000 | Lytic |  |  |
| NC\_025445 | Lytic |  |  |
| NC\_027352 | Lytic |  |  |
| NC\_024330 | Lytic |  |  |
| NC\_028686 | Lytic |  |  |
| NC\_029021 | Lytic |  |  |
| NC\_029028 | Lytic |  |  |
| NC\_028997 | Lytic |  |  |
| NC\_028805 | Lytic |  |  |
| NC\_029023 | Lytic |  |  |
| NC\_028982 | Lytic |  |  |
| NC\_023556 | Lytic |  |  |
| NC\_029075 | Lytic |  |  |
| NC\_027994 | Lytic |  |  |
| NC\_027993 | Lytic |  |  |
| NC\_028800 | Lytic |  |  |
| NC\_027399 | Lytic |  |  |
| NC\_028817 | Lytic |  |  |
| NC\_028760 | Lytic |  |  |
| NC\_029099 | Lytic |  |  |
| NC\_029017 | Lytic |  |  |
| NC\_024123 | Lytic |  |  |
| NC\_024329 | Lytic |  |  |
| NC\_025420 | Lytic |  |  |
| NC\_025415 | Lytic |  |  |
| NC\_025421 | Lytic |  |  |
| NC\_029058 | Lytic |  |  |
| NC\_029068 | Lytic |  |  |
| NC\_028841 | Lytic |  |  |
| NC\_024364 | Lytic |  |  |
| NC\_024360 | Lytic |  |  |
| NC\_024787 | Lytic |  |  |
| NC\_027377 | Lytic |  |  |
| NC\_027358 | Lytic |  |  |
| NC\_024375 | Lytic |  |  |
| NC\_024359 | Lytic |  |  |
| NC\_024383 | Lytic |  |  |
| NC\_024392 | Lytic |  |  |
| NC\_026017 | Lytic |  |  |
| NC\_028984 | Lytic |  |  |
| NC\_029002 | Lytic |  |  |
| NC\_022768 | Lytic |  |  |
| NC\_025416 | Lytic |  |  |
| NC\_024211 | Lytic |  |  |
| NC\_030476 | Lytic |  |  |
| NC\_025414 | Lytic |  |  |
| NC\_027331 | Lytic |  |  |
| NC\_024782 | Lytic |  |  |
| NC\_025418 | Lytic |  |  |
| NC\_028663 | Lytic |  |  |
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| NC\_025426 | Lytic |  |  |
| NC\_024208 | Lytic |  |  |
| NC\_028924 | Lytic |  |  |
| NC\_028763 | Lytic |  |  |
| NC\_024214 | Lytic |  |  |
| NC\_013197 | Lytic |  |  |
| NC\_023614 | Lytic |  |  |
| NC\_029061 | Lytic |  |  |
| NC\_028822 | Lytic |  |  |
| NC\_028863 | Lytic |  |  |
| NC\_029047 | Lytic |  |  |
| NC\_028694 | Lytic |  |  |
| NC\_023700 | Lytic |  |  |
| NC\_027345 | Lytic |  |  |
| NC\_028967 | Lytic |  |  |
| NC\_027371 | Lytic |  |  |
| NC\_022764 | Lytic |  |  |
| NC\_025459 | Lytic |  |  |
| NC\_028926 | Lytic |  |  |
| NC\_028931 | Lytic |  |  |
| NC\_028879 | Lytic |  |  |
| NC\_028809 | Lytic |  |  |
| NC\_029083 | Lytic |  |  |
| NC\_028782 | Lytic |  |  |
| NC\_027364 | Lytic |  |  |
| NC\_028672 | Lytic |  |  |
| NC\_024379 | Lytic |  |  |
| NC\_029081 | Lytic |  |  |
| NC\_028683 | Lytic |  |  |
| NC\_026665 | Lytic |  |  |
| NC\_023570 | Lytic |  |  |
| NC\_027292 | Lytic |  |  |
| NC\_023561 | Lytic |  |  |
| NC\_025450 | Lytic |  |  |
| NC\_028799 | Lytic |  |  |
| NC\_028895 | Lytic |  |  |
| NC\_025822 | Lytic |  |  |
| NC\_025471 | Lytic |  |  |
| NC\_028675 | Lytic |  |  |
| NC\_028995 | Lytic |  |  |
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| NC\_029106 | Lytic |  |  |
| NC\_028880 | Lytic |  |  |
| NC\_028933 | Lytic |  |  |
| NC\_029006 | Lytic |  |  |
| NC\_027340 | Lytic |  |  |
| NC\_023610 | Lytic |  |  |
| NC\_028772 | Lytic |  |  |
| NC\_028695 | Lytic |  |  |
| NC\_028962 | Lytic |  |  |
| NC\_028765 | Lytic |  |  |
| NC\_022762 | Lytic |  |  |
| NC\_024390 | Lytic |  |  |
| NC\_024385 | Lytic |  |  |
| NC\_024386 | Lytic |  |  |
| NC\_024388 | Lytic |  |  |
| NC\_024380 | Lytic |  |  |
| NC\_024389 | Lytic |  |  |
| NC\_024378 | Lytic |  |  |
| NC\_027204 | Lytic |  |  |
| NC\_028676 | Lytic |  |  |
| NC\_028945 | Lytic |  |  |
| NC\_028999 | Lytic |  |  |
| NC\_024362 | Lytic |  |  |
| NC\_023601 | Lytic |  |  |
| NC\_023718 | Lytic |  |  |
| NC\_023573 | Lytic |  |  |
| NC\_029005 | Lytic |  |  |
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| NC\_028935 | Lytic |  |  |
| NC\_027336 | Lytic |  |  |
| NC\_027357 | Lytic |  |  |
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| NC\_027400 | Lytic |  |  |
| NC\_027333 | Lytic |  |  |
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| NC\_027361 | Lytic |  |  |
| NC\_027385 | Lytic |  |  |
| NC\_027401 | Lytic |  |  |
| NC\_027362 | Lytic |  |  |
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| NC\_027389 | Lytic |  |  |
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| NC\_023592 | Lytic |  |  |
| NC\_027363 | Lytic |  |  |
| NC\_027379 | Lytic |  |  |
| NC\_027390 | Lytic |  |  |
| NC\_023865 | Lytic |  |  |
| NC\_027342 | Lytic |  |  |
| NC\_028940 | Lytic |  |  |
| NC\_027381 | Lytic |  |  |
| NC\_028812 | Lytic |  |  |
| NC\_028661 | Lytic |  |  |
| NC\_029100 | Lytic |  |  |
| NC\_023581 | Lytic |  |  |
| NC\_024121 | Lytic |  |  |
| NC\_023589 | Lytic |  |  |
| NC\_026010 | Lytic |  |  |
| NC\_025829 | Lytic |  |  |
| NC\_027404 | Lytic |  |  |
| NC\_027368 | Lytic |  |  |
| NC\_023605 | Lytic |  |  |
| NC\_023688 | Lytic |  |  |
| NC\_029057 | Lytic |  |  |
| NC\_028847 | Lytic |  |  |
| NC\_025448 | Lytic |  |  |
| NC\_025419 | Lytic |  |  |
| NC\_027979 | Lytic |  |  |
| NC\_025452 | Lytic |  |  |
| NC\_029097 | Lytic |  |  |
| NC\_027348 | Lytic |  |  |
| NC\_027296 | Lytic |  |  |
| NC\_024788 | Lytic |  |  |
| NC\_025454 | Lytic |  |  |
| NC\_023736 | Lytic |  |  |
| NC\_028899 | Lytic |  |  |
| NC\_028988 | Lytic |  |  |
| NC\_029007 | Lytic |  |  |
| NC\_028950 | Lytic |  |  |
| NC\_025464 | Lytic |  |  |
| NC\_023584 | Lytic |  |  |
| NC\_028773 | Lytic |  |  |
| NC\_027991 | Lytic |  |  |
| NC\_028807 | Lytic |  |  |
| NC\_027382 | Lytic |  |  |
| NC\_028983 | Lytic |  |  |
| NC\_025437 | Lytic |  |  |
| NC\_028754 | Lytic |  |  |
| NC\_023569 | Lytic |  |  |
| NC\_028900 | Lytic |  |  |
| NC\_028831 | Lytic |  |  |
| NC\_028927 | Lytic |  |  |
| NC\_028901 | Lytic |  |  |
| NC\_028780 | Lytic |  |  |
| NC\_028840 | Lytic |  |  |
| NC\_028448 | Lytic |  |  |
| NC\_028248 | Lytic |  |  |
| NC\_027402 | Lytic |  |  |
| NC\_023594 | Lytic |  |  |
| NC\_027351 | Lytic |  |  |
| NC\_028821 | Lytic |  |  |
| NC\_027350 | Lytic |  |  |
| NC\_027344 | Lytic |  |  |
| NC\_026607 | Lytic |  |  |
| NC\_028666 | Lytic |  |  |
| NC\_028749 | Lytic |  |  |
| NC\_028774 | Lytic |  |  |
| NC\_025417 | Lytic |  |  |
| NC\_028865 | Lytic |  |  |
| NC\_028966 | Lytic |  |  |
| NC\_023583 | Lytic |  |  |
| NC\_028890 | Lytic |  |  |
| NC\_027360 | Lytic |  |  |
| NC\_028829 | Lytic |  |  |
| NC\_025462 | Lytic |  |  |
| NC\_025457 | Lytic |  |  |
| NC\_028987 | Lytic |  |  |
| NC\_028684 | Lytic |  |  |
| NC\_028679 | Lytic |  |  |
| NC\_028825 | Lytic |  |  |
| NC\_027995 | Lytic |  |  |
| NC\_024134 | Lytic |  |  |
| NC\_024124 | Lytic |  |  |
| NC\_024794 | Lytic |  |  |
| NC\_028894 | Lytic |  |  |
| NC\_028925 | Lytic |  |  |
| NC\_028957 | Lytic |  |  |
| NC\_028881 | Lytic |  |  |
| NC\_025430 | Lytic |  |  |
| NC\_027337 | Lytic |  |  |
| NC\_024786 | Lytic |  |  |
| NC\_024790 | Lytic |  |  |
| NC\_024139 | Lytic |  |  |
| NC\_025467 | Lytic |  |  |
| NC\_028693 | Lytic |  |  |
| NC\_028990 | Lytic |  |  |
| NC\_029016 | Lytic |  |  |
| NC\_028688 | Lytic |  |  |
| NC\_028664 | Lytic |  |  |
| NC\_028659 | Lytic |  |  |
| NC\_028977 | Lytic |  |  |
| NC\_028670 | Lytic |  |  |
| NC\_028816 | Lytic |  |  |
| NC\_028870 | Lytic |  |  |
| NC\_028766 | Lytic |  |  |
| NC\_023859 | Lytic |  |  |
| NC\_028939 | Lytic |  |  |
| NC\_026600 | Lytic |  |  |
| NC\_026587 | Lytic |  |  |
| NC\_026586 | Lytic |  |  |
| NC\_028882 | Lytic |  |  |
| NC\_024140 | Lytic |  |  |
| NC\_026599 | Lytic |  |  |
| NC\_026602 | Lytic |  |  |
| NC\_027375 | Lytic |  |  |
| NC\_026601 | Lytic |  |  |
| NC\_028667 | Lytic |  |  |
| NC\_024381 | Lytic |  |  |
| NC\_026608 | Lytic |  |  |
| NC\_028762 | Lytic |  |  |
| NC\_028916 | Lytic |  |  |
| NC\_023566 | Lytic |  |  |
| NC\_025429 | Lytic |  |  |
| NC\_023502 | Lytic |  |  |
| NC\_023856 | Lytic |  |  |
| NC\_024122 | Lytic |  |  |
| NC\_023608 | Lytic |  |  |
| NC\_024204 | Lytic |  |  |
| NC\_029019 | Lytic |  |  |
| NC\_028820 | Lytic |  |  |
| NC\_028655 | Lytic |  |  |
| NC\_025451 | Lytic |  |  |
| NC\_028850 | Lytic |  |  |
| NC\_029065 | Lytic |  |  |
| NC\_024212 | Lytic |  |  |
| NC\_023568 | Lytic |  |  |
| NC\_028789 | Lytic |  |  |
| NC\_026610 | Lytic |  |  |
| NC\_025440 | Lytic |  |  |
| NC\_024149 | Lytic |  |  |
| NC\_026582 | Lytic |  |  |
| NC\_026612 | Lytic |  |  |
| NC\_026613 | Lytic |  |  |
| NC\_028837 | Lytic |  |  |
| NC\_027383 | Lytic |  |  |
| NC\_023715 | Lytic |  |  |
| NC\_029101 | Lytic |  |  |
| NC\_027388 | Lytic |  |  |
| NC\_024785 | Lytic |  |  |
| NC\_028855 | Lytic |  |  |
| NC\_027332 | Lytic |  |  |
| NC\_029012 | Lytic |  |  |
| NC\_029014 | Lytic |  |  |

Table S3. The accession number of 325 phages used for novel phages for testing.

|  |  |  |  |
| --- | --- | --- | --- |
| Accession Number | Lifestyle | Accession Number | Lifestyle |
| NC\_041997 | Lytic | NC\_041866 | Temperate |
| NC\_042028 | Lytic | NC\_041876 | Temperate |
| NC\_041998 | Lytic | NC\_042002 | Temperate |
| NC\_041857 | Lytic | NC\_042139 | Temperate |
| NC\_041905 | Lytic | NC\_041846 | Temperate |
| NC\_041966 | Lytic | NC\_041850 | Temperate |
| NC\_041924 | Lytic | NC\_041853 | Temperate |
| NC\_041967 | Lytic | NC\_041855 | Temperate |
| NC\_041884 | Lytic | NC\_041859 | Temperate |
| NC\_041915 | Lytic | NC\_041882 | Temperate |
| NC\_041914 | Lytic | NC\_041883 | Temperate |
| NC\_042003 | Lytic | NC\_041888 | Temperate |
| NC\_042004 | Lytic | NC\_041969 | Temperate |
| NC\_042005 | Lytic | NC\_041970 | Temperate |
| NC\_042124 | Lytic | NC\_041971 | Temperate |
| NC\_042006 | Lytic | NC\_041982 | Temperate |
| NC\_042007 | Lytic | NC\_041983 | Temperate |
| NC\_042019 | Lytic | NC\_041984 | Temperate |
| NC\_042037 | Lytic | NC\_041985 | Temperate |
| NC\_042013 | Lytic | NC\_041986 | Temperate |
| NC\_040350 | Lytic | NC\_041987 | Temperate |
| NC\_040342 | Lytic | NC\_041988 | Temperate |
| NC\_040328 | Lytic | NC\_041989 | Temperate |
| NC\_040374 | Lytic | NC\_042031 | Temperate |
| NC\_040373 | Lytic | NC\_042036 | Temperate |
| NC\_040349 | Lytic | NC\_042055 | Temperate |
| NC\_040375 | Lytic | NC\_042308 | Temperate |
| NC\_041912 | Lytic | NC\_042310 | Temperate |
| NC\_042020 | Lytic | NC\_042311 | Temperate |
| NC\_041949 | Lytic | NC\_042312 | Temperate |
| NC\_041999 | Lytic | NC\_042313 | Temperate |
| NC\_041938 | Lytic | NC\_042316 | Temperate |
| NC\_041930 | Lytic | NC\_042317 | Temperate |
| NC\_041951 | Lytic | NC\_042319 | Temperate |
| NC\_041948 | Lytic | NC\_042320 | Temperate |
| NC\_042000 | Lytic | NC\_042321 | Temperate |
| NC\_041939 | Lytic | NC\_042322 | Temperate |
| NC\_041940 | Lytic | NC\_042326 | Temperate |
| NC\_041952 | Lytic | NC\_042327 | Temperate |
| NC\_041941 | Lytic | NC\_042328 | Temperate |
| NC\_041875 | Lytic | NC\_042331 | Temperate |
| NC\_041931 | Lytic | NC\_042332 | Temperate |
| NC\_041942 | Lytic | NC\_042333 | Temperate |
| NC\_041943 | Lytic | NC\_042336 | Temperate |
| NC\_041947 | Lytic | NC\_042337 | Temperate |
| NC\_041932 | Lytic | NC\_042338 | Temperate |
| NC\_042001 | Lytic | NC\_042339 | Temperate |
| NC\_042014 | Lytic | NC\_041844 | Temperate |
| NC\_041944 | Lytic | NC\_041847 | Temperate |
| NC\_042053 | Lytic | NC\_041852 | Temperate |
| NC\_041945 | Lytic | NC\_041867 | Temperate |
| NC\_042015 | Lytic | NC\_041890 | Temperate |
| NC\_041933 | Lytic | NC\_041891 | Temperate |
| NC\_041961 | Lytic | NC\_041892 | Temperate |
| NC\_041946 | Lytic | NC\_041893 | Temperate |
| NC\_041879 | Lytic | NC\_041894 | Temperate |
| NC\_042140 | Lytic | NC\_041895 | Temperate |
| NC\_043027 | Lytic | NC\_041958 | Temperate |
| NC\_041858 | Lytic | NC\_042027 | Temperate |
| NC\_041976 | Lytic | NC\_042030 | Temperate |
| NC\_041896 | Lytic | NC\_042051 | Temperate |
| NC\_042067 | Lytic | NC\_042315 | Temperate |
| NC\_041977 | Lytic | NC\_042323 | Temperate |
| NC\_042085 | Lytic | NC\_042324 | Temperate |
| NC\_042086 | Lytic | NC\_042325 | Temperate |
| NC\_042087 | Lytic | NC\_042329 | Temperate |
| NC\_042354 | Lytic | NC\_042341 | Temperate |
| NC\_042355 | Lytic | NC\_042342 | Temperate |
| NC\_041921 | Lytic | NC\_042349 | Temperate |
| NC\_042029 | Lytic | NC\_041849 | Temperate |
| NC\_042122 | Lytic | NC\_041860 | Temperate |
| NC\_041980 | Lytic | NC\_042052 | Temperate |
| NC\_042057 | Lytic |  |  |
| NC\_041959 | Lytic |  |  |
| NC\_042125 | Lytic |  |  |
| NC\_042101 | Lytic |  |  |
| NC\_041960 | Lytic |  |  |
| NC\_042021 | Lytic |  |  |
| NC\_042022 | Lytic |  |  |
| NC\_042023 | Lytic |  |  |
| NC\_042127 | Lytic |  |  |
| NC\_042126 | Lytic |  |  |
| NC\_041978 | Lytic |  |  |
| NC\_041972 | Lytic |  |  |
| NC\_042098 | Lytic |  |  |
| NC\_042056 | Lytic |  |  |
| NC\_041973 | Lytic |  |  |
| NC\_042018 | Lytic |  |  |
| NC\_041974 | Lytic |  |  |
| NC\_041975 | Lytic |  |  |
| NC\_041979 | Lytic |  |  |
| NC\_041863 | Lytic |  |  |
| NC\_041864 | Lytic |  |  |
| NC\_041869 | Lytic |  |  |
| NC\_042046 | Lytic |  |  |
| NC\_041919 | Lytic |  |  |
| NC\_041906 | Lytic |  |  |
| NC\_041936 | Lytic |  |  |
| NC\_041920 | Lytic |  |  |
| NC\_041874 | Lytic |  |  |
| NC\_041873 | Lytic |  |  |
| NC\_041898 | Lytic |  |  |
| NC\_041897 | Lytic |  |  |
| NC\_041871 | Lytic |  |  |
| NC\_041935 | Lytic |  |  |
| NC\_042043 | Lytic |  |  |
| NC\_041990 | Lytic |  |  |
| NC\_041937 | Lytic |  |  |
| NC\_042084 | Lytic |  |  |
| NC\_041926 | Lytic |  |  |
| NC\_042307 | Lytic |  |  |
| NC\_041845 | Lytic |  |  |
| NC\_041872 | Lytic |  |  |
| NC\_041918 | Lytic |  |  |
| NC\_042083 | Lytic |  |  |
| NC\_042108 | Lytic |  |  |
| NC\_042088 | Lytic |  |  |
| NC\_041950 | Lytic |  |  |
| NC\_042045 | Lytic |  |  |
| NC\_042089 | Lytic |  |  |
| NC\_042132 | Lytic |  |  |
| NC\_041886 | Lytic |  |  |
| NC\_042102 | Lytic |  |  |
| NC\_042123 | Lytic |  |  |
| NC\_041981 | Lytic |  |  |
| NC\_042093 | Lytic |  |  |
| NC\_041900 | Lytic |  |  |
| NC\_042041 | Lytic |  |  |
| NC\_041899 | Lytic |  |  |
| NC\_042024 | Lytic |  |  |
| NC\_040341 | Lytic |  |  |
| NC\_041862 | Lytic |  |  |
| NC\_040329 | Lytic |  |  |
| NC\_042099 | Lytic |  |  |
| NC\_042109 | Lytic |  |  |
| NC\_042117 | Lytic |  |  |
| NC\_042110 | Lytic |  |  |
| NC\_042111 | Lytic |  |  |
| NC\_042118 | Lytic |  |  |
| NC\_042119 | Lytic |  |  |
| NC\_041965 | Lytic |  |  |
| NC\_042034 | Lytic |  |  |
| NC\_042050 | Lytic |  |  |
| NC\_041901 | Lytic |  |  |
| NC\_042032 | Lytic |  |  |
| NC\_041993 | Lytic |  |  |
| NC\_042033 | Lytic |  |  |
| NC\_042035 | Lytic |  |  |
| NC\_042330 | Lytic |  |  |
| NC\_042309 | Lytic |  |  |
| NC\_042340 | Lytic |  |  |
| NC\_042318 | Lytic |  |  |
| NC\_042334 | Lytic |  |  |
| NC\_042314 | Lytic |  |  |
| NC\_042335 | Lytic |  |  |
| NC\_043767 | Lytic |  |  |
| NC\_042058 | Lytic |  |  |
| NC\_041909 | Lytic |  |  |
| NC\_042120 | Lytic |  |  |
| NC\_041868 | Lytic |  |  |
| NC\_044940 | Lytic |  |  |
| NC\_041878 | Lytic |  |  |
| NC\_041854 | Lytic |  |  |
| NC\_042131 | Lytic |  |  |
| NC\_041954 | Lytic |  |  |
| NC\_041955 | Lytic |  |  |
| NC\_041956 | Lytic |  |  |
| NC\_041957 | Lytic |  |  |
| NC\_042090 | Lytic |  |  |
| NC\_041925 | Lytic |  |  |
| NC\_041913 | Lytic |  |  |
| NC\_042121 | Lytic |  |  |
| NC\_042103 | Lytic |  |  |
| NC\_041934 | Lytic |  |  |
| NC\_042107 | Lytic |  |  |
| NC\_041994 | Lytic |  |  |
| NC\_041903 | Lytic |  |  |
| NC\_041907 | Lytic |  |  |
| NC\_041902 | Lytic |  |  |
| NC\_041953 | Lytic |  |  |
| NC\_042343 | Lytic |  |  |
| NC\_042104 | Lytic |  |  |
| NC\_042081 | Lytic |  |  |
| NC\_041877 | Lytic |  |  |
| NC\_041885 | Lytic |  |  |
| NC\_041904 | Lytic |  |  |
| NC\_042091 | Lytic |  |  |
| NC\_041881 | Lytic |  |  |
| NC\_041865 | Lytic |  |  |
| NC\_041880 | Lytic |  |  |
| NC\_041964 | Lytic |  |  |
| NC\_042092 | Lytic |  |  |
| NC\_041870 | Lytic |  |  |
| NC\_042080 | Lytic |  |  |
| NC\_042079 | Lytic |  |  |
| NC\_041968 | Lytic |  |  |
| NC\_042054 | Lytic |  |  |
| NC\_041851 | Lytic |  |  |
| NC\_041911 | Lytic |  |  |
| NC\_041908 | Lytic |  |  |
| NC\_034248 | Lytic |  |  |
| NC\_042049 | Lytic |  |  |
| NC\_041963 | Lytic |  |  |
| NC\_042040 | Lytic |  |  |
| NC\_041887 | Lytic |  |  |
| NC\_042350 | Lytic |  |  |
| NC\_042096 | Lytic |  |  |
| NC\_042097 | Lytic |  |  |
| NC\_042044 | Lytic |  |  |
| NC\_041923 | Lytic |  |  |
| NC\_042025 | Lytic |  |  |
| NC\_041922 | Lytic |  |  |
| NC\_041991 | Lytic |  |  |
| NC\_041992 | Lytic |  |  |
| NC\_042346 | Lytic |  |  |
| NC\_041917 | Lytic |  |  |
| NC\_041996 | Lytic |  |  |
| NC\_042047 | Lytic |  |  |
| NC\_042017 | Lytic |  |  |
| NC\_042075 | Lytic |  |  |
| NC\_042076 | Lytic |  |  |
| NC\_042077 | Lytic |  |  |
| NC\_042039 | Lytic |  |  |
| NC\_042078 | Lytic |  |  |
| NC\_041995 | Lytic |  |  |
| NC\_041929 | Lytic |  |  |
| NC\_041927 | Lytic |  |  |
| NC\_041928 | Lytic |  |  |
| NC\_042082 | Lytic |  |  |
| NC\_042105 | Lytic |  |  |
| NC\_042106 | Lytic |  |  |
| NC\_042016 | Lytic |  |  |
| NC\_042008 | Lytic |  |  |
| NC\_042009 | Lytic |  |  |
| NC\_042010 | Lytic |  |  |
| NC\_042011 | Lytic |  |  |
| NC\_041889 | Lytic |  |  |
| NC\_042012 | Lytic |  |  |
| NC\_042042 | Lytic |  |  |
| NC\_041856 | Lytic |  |  |
| NC\_041962 | Lytic |  |  |
| NC\_042100 | Lytic |  |  |
| NC\_042094 | Lytic |  |  |
| NC\_042074 | Lytic |  |  |
| NC\_041910 | Lytic |  |  |
| NC\_042095 | Lytic |  |  |
| NC\_041916 | Lytic |  |  |
| NC\_043028 | Lytic |  |  |
| NC\_030928 | Lytic |  |  |
| NC\_030937 | Lytic |  |  |
| NC\_042345 | Lytic |  |  |
| NC\_042344 | Lytic |  |  |
| NC\_042116 | Lytic |  |  |

Table S4. The AUROC values of different dissimilarity measures for classifying the lifestyles of phage contigs using *k*-mer lengths from 6 to 10 and contig lengths 500bp, 1,000bp and 5,000 bp. The background sequence Markov orders for and are fixed to three.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Contig Length 500 bp | | | | | |
| K | 6 | 7 | 8 | 9 | 10 |
| d2\* | 0.684 | 0.715 | 0.747 | 0.783 | 0.817 |
| d2S | 0.635 | 0.676 | 0.725 | 0.773 | 0.824 |
| d2 | 0.728 | 0.745 | 0.762 | 0.785 | 0.815 |
| Hao | 0.626 | 0.594 | 0.604 | 0.573 | 0.571 |
| Manhattan | 0.692 | 0.741 | 0.766 | 0.791 | 0.823 |
| Chebyshev | 0.640 | 0.624 | 0.612 | 0.618 | 0.636 |
| Euclidean | 0.733 | 0.750 | 0.767 | 0.793 | 0.824 |
| Teeling | 0.625 | 0.600 | 0.607 | 0.574 | 0.577 |
| EuF | 0.640 | 0.648 | 0.720 | 0.774 | 0.845 |
| Contig Length 1,000 bp | | | | | |
| K | 6 | 7 | 8 | 9 | 10 |
| d2\* | 0.728 | 0.764 | 0.798 | 0.832 | 0.862 |
| d2S | 0.670 | 0.726 | 0.781 | 0.825 | 0.866 |
| d2 | 0.750 | 0.766 | 0.786 | 0.809 | 0.837 |
| Hao | 0.682 | 0.641 | 0.654 | 0.630 | 0.616 |
| Manhattan | 0.680 | 0.748 | 0.785 | 0.814 | 0.848 |
| Chebyshev | 0.663 | 0.654 | 0.645 | 0.643 | 0.642 |
| Euclidean | 0.753 | 0.772 | 0.788 | 0.816 | 0.847 |
| Teeling | 0.684 | 0.645 | 0.653 | 0.632 | 0.620 |
| EuF | 0.684 | 0.668 | 0.755 | 0.816 | 0.875 |
| Contig Length 10,000 bp | | | | | |
| K | 6 | 7 | 8 | 9 | 10 |
| d2\* | 0.866 | 0.873 | 0.901 | 0.928 | 0.939 |
| d2S | 0.827 | 0.857 | 0.895 | 0.922 | 0.937 |
| d2 | 0.780 | 0.803 | 0.826 | 0.846 | 0.868 |
| Hao | 0.868 | 0.806 | 0.864 | 0.858 | 0.834 |
| Manhattan | 0.713 | 0.729 | 0.760 | 0.840 | 0.884 |
| Chebyshev | 0.753 | 0.749 | 0.738 | 0.716 | 0.718 |
| Euclidean | 0.791 | 0.813 | 0.836 | 0.854 | 0.881 |
| Teeling | 0.861 | 0.814 | 0.863 | 0.863 | 0.845 |
| EuF | 0.846 | 0.814 | 0.873 | 0.895 | 0.906 |

Table S5. The accession number of the 18 temperate phages and 108 lytic phages used for novel phages.

|  |  |  |  |
| --- | --- | --- | --- |
| Accession Number | Lifestyle | Accession Number | Lifestyle |
| NC\_013197 | Lytic | NC\_004462 | Temperate |
| NC\_023502 | Lytic | NC\_023559 | Temperate |
| NC\_023557 | Lytic | NC\_023560 | Temperate |
| NC\_023566 | Lytic | NC\_023571 | Temperate |
| NC\_023569 | Lytic | NC\_023591 | Temperate |
| NC\_023590 | Lytic | NC\_023734 | Temperate |
| NC\_023592 | Lytic | NC\_024369 | Temperate |
| NC\_023594 | Lytic | NC\_025422 | Temperate |
| NC\_023610 | Lytic | NC\_025428 | Temperate |
| NC\_023614 | Lytic | NC\_025431 | Temperate |
| NC\_023718 | Lytic | NC\_027334 | Temperate |
| NC\_023859 | Lytic | NC\_028743 | Temperate |
| NC\_023863 | Lytic | NC\_028768 | Temperate |
| NC\_024149 | Lytic | NC\_028834 | Temperate |
| NC\_024329 | Lytic | NC\_028954 | Temperate |
| NC\_024358 | Lytic | NC\_029046 | Temperate |
| NC\_024711 | Lytic | NC\_029078 | Temperate |
| NC\_025429 | Lytic | NC\_029119 | Temperate |
| NC\_025436 | Lytic |  |  |
| NC\_025439 | Lytic |  |  |
| NC\_025458 | Lytic |  |  |
| NC\_025459 | Lytic |  |  |
| NC\_025462 | Lytic |  |  |
| NC\_025463 | Lytic |  |  |
| NC\_025466 | Lytic |  |  |
| NC\_025467 | Lytic |  |  |
| NC\_025470 | Lytic |  |  |
| NC\_025471 | Lytic |  |  |
| NC\_025822 | Lytic |  |  |
| NC\_026013 | Lytic |  |  |
| NC\_026582 | Lytic |  |  |
| NC\_026610 | Lytic |  |  |
| NC\_026612 | Lytic |  |  |
| NC\_026613 | Lytic |  |  |
| NC\_026665 | Lytic |  |  |
| NC\_027120 | Lytic |  |  |
| NC\_027125 | Lytic |  |  |
| NC\_027294 | Lytic |  |  |
| NC\_027295 | Lytic |  |  |
| NC\_027296 | Lytic |  |  |
| NC\_027333 | Lytic |  |  |
| NC\_027336 | Lytic |  |  |
| NC\_027342 | Lytic |  |  |
| NC\_027346 | Lytic |  |  |
| NC\_027348 | Lytic |  |  |
| NC\_027354 | Lytic |  |  |
| NC\_027357 | Lytic |  |  |
| NC\_027358 | Lytic |  |  |
| NC\_027359 | Lytic |  |  |
| NC\_027361 | Lytic |  |  |
| NC\_027362 | Lytic |  |  |
| NC\_027363 | Lytic |  |  |
| NC\_027367 | Lytic |  |  |
| NC\_027370 | Lytic |  |  |
| NC\_027371 | Lytic |  |  |
| NC\_027373 | Lytic |  |  |
| NC\_027377 | Lytic |  |  |
| NC\_027385 | Lytic |  |  |
| NC\_027386 | Lytic |  |  |
| NC\_027389 | Lytic |  |  |
| NC\_027391 | Lytic |  |  |
| NC\_027400 | Lytic |  |  |
| NC\_027401 | Lytic |  |  |
| NC\_027633 | Lytic |  |  |
| NC\_027634 | Lytic |  |  |
| NC\_027635 | Lytic |  |  |
| NC\_027636 | Lytic |  |  |
| NC\_027637 | Lytic |  |  |
| NC\_027638 | Lytic |  |  |
| NC\_027639 | Lytic |  |  |
| NC\_027640 | Lytic |  |  |
| NC\_027641 | Lytic |  |  |
| NC\_027642 | Lytic |  |  |
| NC\_027643 | Lytic |  |  |
| NC\_027644 | Lytic |  |  |
| NC\_027645 | Lytic |  |  |
| NC\_027646 | Lytic |  |  |
| NC\_027647 | Lytic |  |  |
| NC\_027648 | Lytic |  |  |
| NC\_027987 | Lytic |  |  |
| NC\_028651 | Lytic |  |  |
| NC\_028676 | Lytic |  |  |
| NC\_028693 | Lytic |  |  |
| NC\_028694 | Lytic |  |  |
| NC\_028776 | Lytic |  |  |
| NC\_028805 | Lytic |  |  |
| NC\_028831 | Lytic |  |  |
| NC\_028865 | Lytic |  |  |
| NC\_028899 | Lytic |  |  |
| NC\_028950 | Lytic |  |  |
| NC\_028966 | Lytic |  |  |
| NC\_028967 | Lytic |  |  |
| NC\_028993 | Lytic |  |  |
| NC\_028994 | Lytic |  |  |
| NC\_029005 | Lytic |  |  |
| NC\_029006 | Lytic |  |  |
| NC\_029012 | Lytic |  |  |
| NC\_029014 | Lytic |  |  |
| NC\_029021 | Lytic |  |  |
| NC\_029028 | Lytic |  |  |
| NC\_029047 | Lytic |  |  |
| NC\_029061 | Lytic |  |  |
| NC\_029065 | Lytic |  |  |
| NC\_029068 | Lytic |  |  |
| NC\_029075 | Lytic |  |  |
| NC\_029106 | Lytic |  |  |
| NC\_029118 | Lytic |  |  |
| NC\_030476 | Lytic |  |  |

Table S6. The True Positive Rates (TPR) for classifying the lifestyles for contigs of 3,000bp from the 325 phage genomes identified after 1 January 2017 using different dissimilarity measures. The TPRs for temperate and lytic phage contigs were both larger than 60% are shown in this Table. TPR1 is the Ture Positive Rate for temperate phage contigs. TPR2 is the True Positive Rate for lytic phage contigs. TPR is the Ture Positive Rate for all the phage contigs.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | K | Markov Order | TPR1 | TPR1 | TPR |
| d2s | 7 | 1 | 0.680 | 0.720 | 0.713 |
| d2s | 8 | 2 | 0.732 | 0.625 | 0.642 |
| d2s | 8 | 3 | 0.639 | 0.694 | 0.685 |
| d2s | 9 | 1 | 0.835 | 0.697 | 0.718 |
| d2s | 9 | 2 | 0.770 | 0.626 | 0.649 |
| d2s | 9 | 3 | 0.612 | 0.750 | 0.728 |
| d2s | 10 | 1 | 0.774 | 0.776 | 0.776 |
| d2s | 10 | 2 | 0.673 | 0.781 | 0.764 |
| d2s | 10 | 3 | 0.755 | 0.793 | 0.787 |
| d2 | 7 |  | 0.966 | 0.639 | 0.690 |
| d2 | 8 |  | 0.961 | 0.653 | 0.701 |
| d2 | 9 |  | 0.954 | 0.670 | 0.714 |
| d2 | 10 |  | 0.943 | 0.700 | 0.738 |
| Manhattan | 6 |  | 0.962 | 0.686 | 0.729 |
| Chebyshev | 10 |  | 0.654 | 0.627 | 0.631 |
| Euclidean | 7 |  | 0.956 | 0.646 | 0.695 |
| Euclidean | 8 |  | 0.939 | 0.663 | 0.706 |
| Euclidean | 9 |  | 0.917 | 0.686 | 0.722 |
| Euclidean | 10 |  | 0.873 | 0.724 | 0.748 |

Table S7. The True Positive Rates (TPR) for classifying the lifestyles for contigs of 1,000bp from the 325 phage genomes identified after 1 January 2017 using different dissimilarity measures. The TPRs for temperate and lytic phage contigs were both larger than 60% are shown in this Table. TPR1 is the Ture Positive Rate for temperate phage contigs. TPR2 is the True Positive Rate for lytic phage contigs. TPR is the Ture Positive Rate for all the phage contigs.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | K | Markov Order | TPR1 | TPR1 | TPR |
| d2s | 6 | 2 | 0.710 | 0.613 | 0.628 |
| d2s | 7 | 2 | 0.784 | 0.636 | 0.659 |
| d2s | 8 | 2 | 0.820 | 0.687 | 0.708 |
| d2s | 8 | 3 | 0.692 | 0.757 | 0.747 |
| d2s | 9 | 1 | 0.914 | 0.737 | 0.764 |
| d2s | 9 | 2 | 0.864 | 0.670 | 0.700 |
| d2s | 9 | 3 | 0.649 | 0.809 | 0.784 |
| d2s | 10 | 1 | 0.847 | 0.799 | 0.806 |
| d2s | 10 | 2 | 0.743 | 0.815 | 0.804 |
| d2s | 10 | 3 | 0.819 | 0.812 | 0.813 |
| d2 | 6 |  | 0.978 | 0.652 | 0.703 |
| d2 | 7 |  | 0.975 | 0.665 | 0.713 |
| d2 | 8 |  | 0.971 | 0.684 | 0.728 |
| d2 | 9 |  | 0.965 | 0.712 | 0.751 |
| d2 | 10 |  | 0.954 | 0.754 | 0.785 |
| CVTree | 7 |  | 0.722 | 0.674 | 0.682 |
| Teeling | 8 |  | 0.613 | 0.640 | 0.636 |
| Manhattan | 6 |  | 0.975 | 0.656 | 0.706 |
| Manhattan | 7 |  | 0.982 | 0.675 | 0.723 |
| Chebyshev | 10 |  | 0.683 | 0.630 | 0.638 |
| Euclidean | 7 |  | 0.968 | 0.655 | 0.704 |
| Euclidean | 8 |  | 0.955 | 0.675 | 0.718 |
| Euclidean | 9 |  | 0.941 | 0.697 | 0.735 |
| Euclidean | 10 |  | 0.919 | 0.738 | 0.766 |