*Highly sensitive and specific detection of rare variants in mixed viral populations from massively parallel sequence data*

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**Table S1**. V-Phaser variant calls in experimental WNV mixed population.

| Variant | Strain1 | Strain2 | Strain3 | Strain4 | Strain5 | Strain6 | Strain7 | Strain8 | Expected Frequency* | Observed Frequency | V-Phaser | No Phase | No Composite Bernoulli (i.e. Uniform) | No NQS Filter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4674C | . | . | . | . | . | . | . | T | 0.007 | 0.000 | None | None | None | None |
| 6433C | . | . | . | . | . | . | . | T | 0.007 | 0.000 | None | None | None | None |
| 8079C | . | . | . | . | . | . | . | T | 0.007 | 0.000 | None | None | None | None |
| 8295A | G | . | . | . | . | . | . | . | 0.137 | 0.000 | None | None | None | Variant |
| 8301C | . | . | . | . | . | . | . | T | 0.007 | 0.000 | None | None | None | None |
| 8751C | . | . | . | . | . | . | . | T | 0.007 | 0.000 | None | None | None | None |
| 9360T | . | . | . | . | . | . | . | A | 0.007 | 0.000 | None | None | None | None |
| 9537C | . | . | . | . | . | . | . | T | 0.007 | 0.000 | None | None | None | None |
| 3774C | . | . | . | . | . | . | . | T | 0.007 | 0.003 | Error | Error | Error | Error |
| 3625A | . | . | . | . | . | . | . | T | 0.007 | 0.004 | Error | Error | Error | Error |
| 7938C | . | . | . | . | . | . | . | T | 0.007 | 0.006 | Variant | Error | Variant | Variant |
| 1442C | . | . | . | . | . | . | . | T | 0.007 | 0.006 | Variant | Variant | Variant | Variant |
| 4146G | . | . | . | . | . | . | . | A | 0.007 | 0.007 | Variant | Variant | Variant | Variant |
| 7785C | . | . | . | . | . | . | . | T | 0.007 | 0.007 | Variant | Error | Variant | Variant |
| 6243A | . | . | . | . | . | . | . | G | 0.007 | 0.008 | Variant | Variant | Variant | Variant |
| 2872G | . | . | . | . | . | . | . | A | 0.007 | 0.008 | Variant | Error | Variant | Variant |
| 1492T | . | . | . | . | . | . | . | C | 0.007 | 0.008 | Variant | Variant | Variant | Variant |
| 9352T | . | . | . | . | . | . | . | C | 0.007 | 0.009 | Variant | Error | Variant | Variant |
| 5709C | . | . | . | . | . | . | . | T | 0.007 | 0.009 | Variant | Error | Variant | Error |
| 7380G | . | . | . | . | . | . | . | A | 0.007 | 0.010 | Variant | Variant | Variant | Variant |
| 6426T | . | . | . | . | . | . | . | C | 0.007 | 0.011 | Variant | Variant | Variant | Variant |
| 2466T | . | . | . | . | . | . | . | C | 0.007 | 0.013 | Variant | Variant | Variant | Variant |
| 4803T | . | . | . | . | . | . | . | C | 0.007 | 0.013 | Variant | Variant | Variant | Variant |
| 6996T | . | . | . | . | . | . | . | C | 0.007 | 0.013 | Variant | Error | Variant | Variant |
| 3270A | . | . | . | . | . | . | . | G | 0.007 | 0.014 | Variant | Variant | Variant | Variant |
| 10341C | . | . | . | . | . | . | . | T | 0.007 | 0.016 | Variant | Error | Variant | Variant |
| 7270T | . | . | . | . | . | . | . | C | 0.007 | 0.024 | Variant | Error | Variant | Variant |
| 6741C | . | T | . | . | . | . | . | . | 0.086 | 0.030 | Variant | Variant | Variant | Variant |
| 4164C | . | . | . | . | . | . | T | . | 0.070 | 0.034 | Variant | Variant | Variant | Variant |
| 2674G | . | . | . | . | . | . | A | . | 0.070 | 0.037 | Variant | Variant | Variant | Variant |
| 3300C | . | . | . | . | . | . | T | . | 0.070 | 0.045 | Variant | Variant | Variant | Variant |
| 2904T | . | . | . | . | . | . | C | . | 0.070 | 0.055 | Variant | Variant | Variant | Variant |
| 6780C | . | . | . | . | T | . | . | . | 0.096 | 0.057 | Variant | Variant | Variant | Variant |
| 7518G | . | . | . | . | . | . | A | . | 0.070 | 0.058 | Variant | Variant | Variant | Variant |
| 6060C | . | . | . | . | T | . | . | . | 0.096 | 0.060 | Variant | Variant | Variant | Variant |
| 5544G | . | . | . | . | . | . | T | . | 0.070 | 0.063 | Variant | Variant | Variant | Variant |
| 999C | T | . | . | . | . | . | . | . | 0.137 | 0.064 | Variant | Variant | Variant | Variant |
| 666T | . | . | . | . | . | . | C | . | 0.070 | 0.065 | Variant | Variant | Variant | Variant |
| 7320C | . | . | . | . | T | . | . | . | 0.096 | 0.067 | Variant | Variant | Variant | Variant |
| 6964T | . | . | . | . | C | . | . | . | 0.096 | 0.070 | Variant | Variant | Variant | Variant |
| 1599C | . | . | . | . | T | . | . | . | 0.096 | 0.073 | Variant | Variant | Variant | Variant |
| 4882G | . | . | . | . | . | . | A | . | 0.070 | 0.075 | Variant | Variant | Variant | Variant |
| 3556T | . | . | . | . | . | . | C | . | 0.070 | 0.076 | Variant | Variant | Variant | Variant |
| 2922T | . | . | C | . | . | . | . | . | 0.098 | 0.079 | Variant | Variant | Variant | Variant |
| 6871G | . | . | . | . | A | . | . | . | 0.096 | 0.079 | Variant | Variant | Variant | Variant |
| 5940C | . | . | . | . | . | . | T | . | 0.070 | 0.081 | Variant | Variant | Variant | Variant |
| 2934G | . | . | A | . | . | . | . | . | 0.098 | 0.082 | Variant | Variant | Variant | Variant |
| 7548G | . | T | . | . | . | . | . | . | 0.086 | 0.083 | Variant | Variant | Variant | Variant |
| 8766C | . | . | T | . | . | . | . | . | 0.098 | 0.089 | Variant | Variant | Variant | Variant |
| 1779T | . | C | . | . | . | . | . | . | 0.086 | 0.091 | Variant | Variant | Variant | Variant |
| 6228G | . | . | . | . | . | . | A | . | 0.070 | 0.092 | Variant | Variant | Variant | Variant |
| 4017C | . | . | . | . | . | . | T | . | 0.070 | 0.093 | Variant | Variant | Variant | Variant |
| 6162A | . | . | G | . | . | . | . | . | 0.098 | 0.094 | Variant | Variant | Variant | Variant |
| 6183C | . | . | T | . | . | . | . | . | 0.098 | 0.095 | Variant | Variant | Variant | Variant |
| 1728A | . | . | . | . | G | . | . | . | 0.096 | 0.099 | Variant | Variant | Variant | Variant |
| 10408C | . | . | . | . | . | . | T | T | 0.077 | 0.100 | Variant | Variant | Variant | Variant |
| 9151C | T | . | . | . | . | . | . | . | 0.137 | 0.100 | Variant | Variant | Variant | Variant |
| 6993T | . | . | . | . | . | . | C | . | 0.070 | 0.103 | Variant | Variant | Variant | Variant |
| 10347T | C | . | . | . | . | . | . | . | 0.137 | 0.103 | Variant | Variant | Variant | Variant |
| 5814T | . | . | C | . | . | . | . | . | 0.098 | 0.103 | Variant | Variant | Variant | Variant |
| 7917C | . | . | . | . | T | . | . | . | 0.096 | 0.104 | Variant | Variant | Variant | Variant |
| 5628G | . | . | . | . | A | . | . | . | 0.096 | 0.105 | Variant | Variant | Variant | Variant |
| 3234T | . | . | . | . | C | . | . | . | 0.096 | 0.107 | Variant | Variant | Variant | Variant |
| 573C | . | . | . | . | T | . | . | . | 0.096 | 0.112 | Variant | Variant | Variant | Variant |
| 9687C | . | . | . | . | T | . | . | . | 0.096 | 0.115 | Variant | Variant | Variant | Variant |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 562C | . | . | . | . | T | . | . | . | 0.096 | 0.116 | Variant | Variant | Variant | Variant |
| 2253A | G | . | . | . | . | . | . | . | 0.137 | 0.117 | Variant | Variant | Variant | Variant |
| 9960T | . | . | . | . | C | . | . | . | 0.096 | 0.121 | Variant | Variant | Variant | Variant |
| 5135T | . | . | . | . | C | . | . | . | 0.096 | 0.125 | Variant | Variant | Variant | Variant |
| 6234A | . | G | . | . | . | . | . | . | 0.086 | 0.125 | Variant | Variant | Variant | Variant |
| 3810C | . | . | . | . | T | . | . | . | 0.096 | 0.128 | Variant | Variant | Variant | Variant |
| 3346C | . | . | . | A | . | . | C | . | 0.146 | 0.132 | Variant | Variant | Variant | Variant |
| 6210C | T | . | . | . | . | . | . | . | 0.137 | 0.133 | Variant | Variant | Variant | Variant |
| 9603A | . | . | G | . | . | . | . | . | 0.098 | 0.133 | Variant | Variant | Variant | Variant |
| 9123C | . | . | . | T | . | . | . | . | 0.146 | 0.134 | Variant | Variant | Variant | Variant |
| 1293C | . | . | . | . | . | T | . | . | 0.146 | 0.135 | Variant | Variant | Variant | Variant |
| 6820C | . | . | . | T | . | . | . | . | 0.146 | 0.136 | Variant | Variant | Variant | Variant |
| 5805T | . | . | . | C | . | . | . | . | 0.146 | 0.136 | Variant | Variant | Variant | Variant |
| 7182C | . | . | . | T | . | . | . | . | 0.146 | 0.136 | Variant | Variant | Variant | Variant |
| 4536G | . | . | . | A | . | . | . | . | 0.146 | 0.141 | Variant | Variant | Variant | Variant |
| 7161C | . | . | . | T | . | . | . | . | 0.146 | 0.142 | Variant | Variant | Variant | Variant |
| 7158A | . | . | . | G | . | . | . | . | 0.146 | 0.142 | Variant | Variant | Variant | Variant |
| 7110C | . | . | . | T | . | . | . | . | 0.146 | 0.143 | Variant | Variant | Variant | Variant |
| 7134C | T | . | . | . | . | . | . | . | 0.137 | 0.146 | Variant | Variant | Variant | Variant |
| 6288C | . | . | . | T | . | . | . | . | 0.146 | 0.148 | Variant | Variant | Variant | Variant |
| 1533C | T | . | . | . | . | . | . | . | 0.137 | 0.149 | Variant | Variant | Variant | Variant |
| 8808C | T | . | . | . | . | . | . | . | 0.137 | 0.150 | Variant | Variant | Variant | Variant |
| 6721G | . | . | . | A | . | . | . | . | 0.146 | 0.150 | Variant | Variant | Variant | Variant |
| 6007C | . | . | . | T | . | . | . | . | 0.146 | 0.151 | Variant | Variant | Variant | Variant |
| 1117G | . | . | . | A | . | . | . | . | 0.146 | 0.157 | Variant | Variant | Variant | Variant |
| 7977A | G | . | . | . | . | . | . | . | 0.137 | 0.157 | Variant | Variant | Variant | Variant |
| 3138T | . | . | . | C | . | . | . | . | 0.146 | 0.160 | Variant | Variant | Variant | Variant |
| 6246T | . | . | . | C | . | . | . | . | 0.146 | 0.169 | Variant | Variant | Variant | Variant |
| 3111G | A | . | . | . | . | . | . | . | 0.137 | 0.173 | Variant | Variant | Variant | Variant |
| 7893C | . | . | . | . | . | T | . | . | 0.146 | 0.175 | Variant | Variant | Variant | Variant |
| 9439G | A | . | . | . | . | . | . | . | 0.137 | 0.178 | Variant | Variant | Variant | Variant |
| 4129C | T | . | . | . | . | . | . | . | 0.137 | 0.179 | Variant | Variant | Variant | Variant |
| 3120G | A | . | . | . | . | . | . | . | 0.137 | 0.186 | Variant | Variant | Variant | Variant |
| 5211A | . | . | . | . | G | . | . | . | 0.096 | 0.186 | Variant | Variant | Variant | Variant |
| 7959C | . | . | . | . | T | . | . | . | 0.096 | 0.193 | Variant | Variant | Variant | Variant |
| 5134A | . | . | G | . | G | . | . | . | 0.194 | 0.233 | Variant | Variant | Variant | Variant |
| 6238C | T | . | T | . | . | . | . | . | 0.235 | 0.236 | Variant | Variant | Variant | Variant |
| 9912C | . | T | . | . | . | T | . | . | 0.232 | 0.239 | Variant | Variant | Variant | Variant |
| 483C | . | T | . | . | . | T | . | . | 0.232 | 0.250 | Variant | Variant | Variant | Variant |
| 8283G | . | A | . | . | . | A | . | . | 0.232 | 0.282 | Variant | Variant | Variant | Variant |
| 7221C | . | T | . | . | . | T | . | . | 0.232 | 0.284 | Variant | Variant | Variant | Variant |
| 4389G | . | A | . | . | . | A | . | . | 0.232 | 0.315 | Variant | Variant | Variant | Variant |
| 10400T | . | . | C | . | . | . | . | . | 0.098 | 0.410 | Variant | Variant | Variant | Variant |
| 7878C | . | T | . | . | . | T | . | . | 0.232 | 0.427 | Variant | Variant | Variant | Variant |
| 660T | . | C | . | . | . | C | C | C | 0.309 | 0.475 | Variant | Variant | Variant | Variant |

* The eight parental strains were mixed at equal proportions and then infected into mosquito cells and allowed to proliferate, resulting in a final mixture with ratios set by the relative replicative success of the strains. Thus, we have not set the true proportion of the parental strains in the sequenced mixture. However, since we know the strain or strains of origin for all of the variants, we can infer the mix of parental strain proportions that maximizes the likelihood of observing the actual counts (including zero) of all parental alleles in the sequencing data. The resultant frequencies are presented in the "expected" column to provide a most likely measure of the true frequency of the variants in the population. This allow us to capture the full effects of stochastic variation in the sequencing process on our ability to detect variants of given population frequency.