

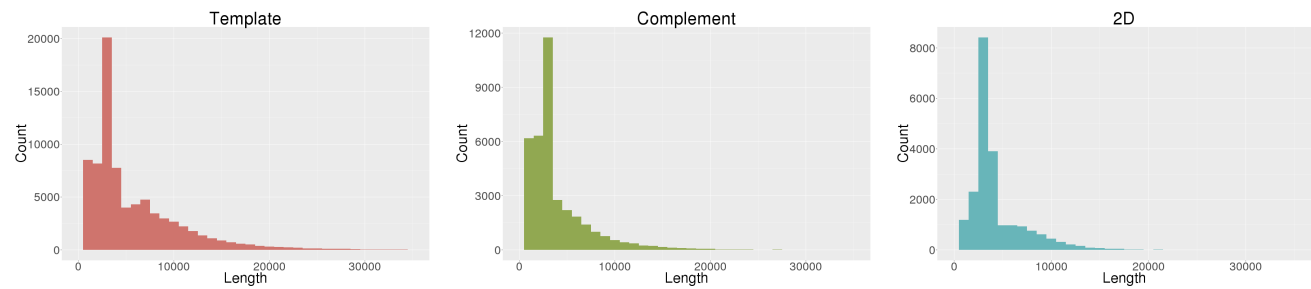
NanoOK report for UBC\_MARC\_2D\_R9\_107\_Called

Pass and fail counts

| Type       | Pass | Fail  |
|------------|------|-------|
| Template   | 0    | 84957 |
| Complement | 0    | 47422 |
| 2D         | 0    | 21885 |

Read lengths

| Type       | NumReads | TotalBases | Mean    | Longest | Shortest | N50  | N50Count | N90  | N90Count |
|------------|----------|------------|---------|---------|----------|------|----------|------|----------|
| Template   | 84957    | 460038194  | 5414.95 | 119036  | 5        | 8605 | 16794    | 3209 | 54642    |
| Complement | 47422    | 151429691  | 3193.24 | 403748  | 5        | 5280 | 8075     | 2172 | 26505    |
| 2D         | 21885    | 94109976   | 4300.20 | 34218   | 98       | 4410 | 5818     | 2856 | 16826    |



Template alignments

|                                    |                |
|------------------------------------|----------------|
| Number of reads                    | 84957          |
| Number of reads with alignments    | 61718 (72.65%) |
| Number of reads without alignments | 23239 (27.35%) |

| ID               | Size    | Number of Reads | % of Reads | Mean read length | Aligned bases | Mean coverage | Longest Perf Kmer |
|------------------|---------|-----------------|------------|------------------|---------------|---------------|-------------------|
| Control sequence | 3560    | 23527           | 27.69      | 3528.09          | 75858727      | 21308.63      | 217               |
| Escherichia coli | 4641652 | 38191           | 44.95      | 8367.61          | 262952330     | 56.65         | 275               |

Complement alignments

|                                    |                |
|------------------------------------|----------------|
| Number of reads                    | 47422          |
| Number of reads with alignments    | 29159 (61.49%) |
| Number of reads without alignments | 18263 (38.51%) |

| ID               | Size    | Number of Reads | % of Reads | Mean read length | Aligned bases | Mean coverage | Longest Perf Kmer |
|------------------|---------|-----------------|------------|------------------|---------------|---------------|-------------------|
| Control sequence | 3560    | 12670           | 26.72      | 2702.54          | 33833561      | 9503.81       | 169               |
| Escherichia coli | 4641652 | 16489           | 34.77      | 5696.12          | 61219855      | 13.19         | 161               |

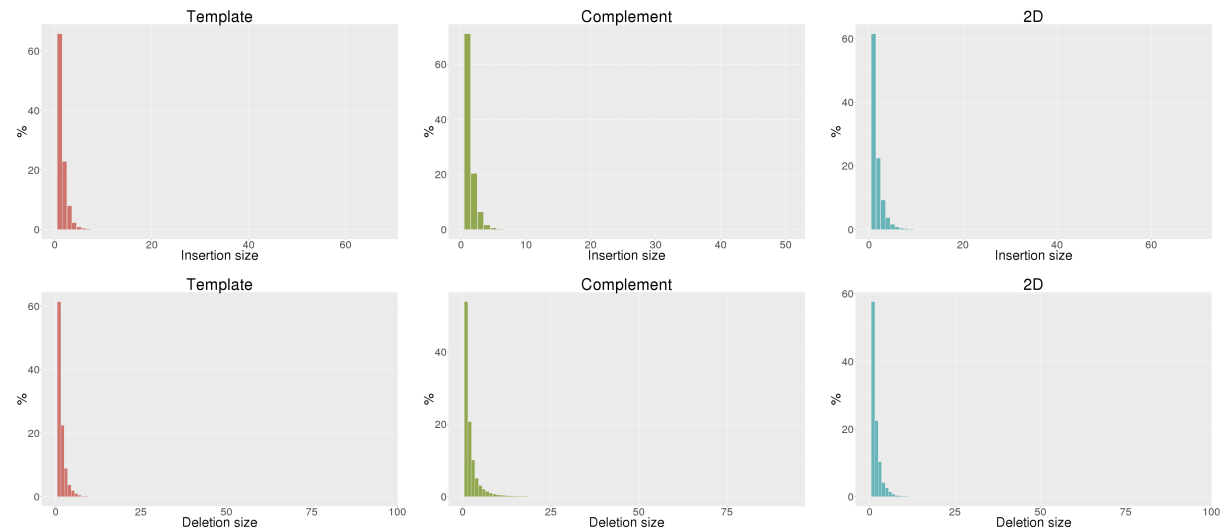
2D alignments

|                                    |                |
|------------------------------------|----------------|
| Number of reads                    | 21885          |
| Number of reads with alignments    | 18320 (83.71%) |
| Number of reads without alignments | 3565 (16.29%)  |

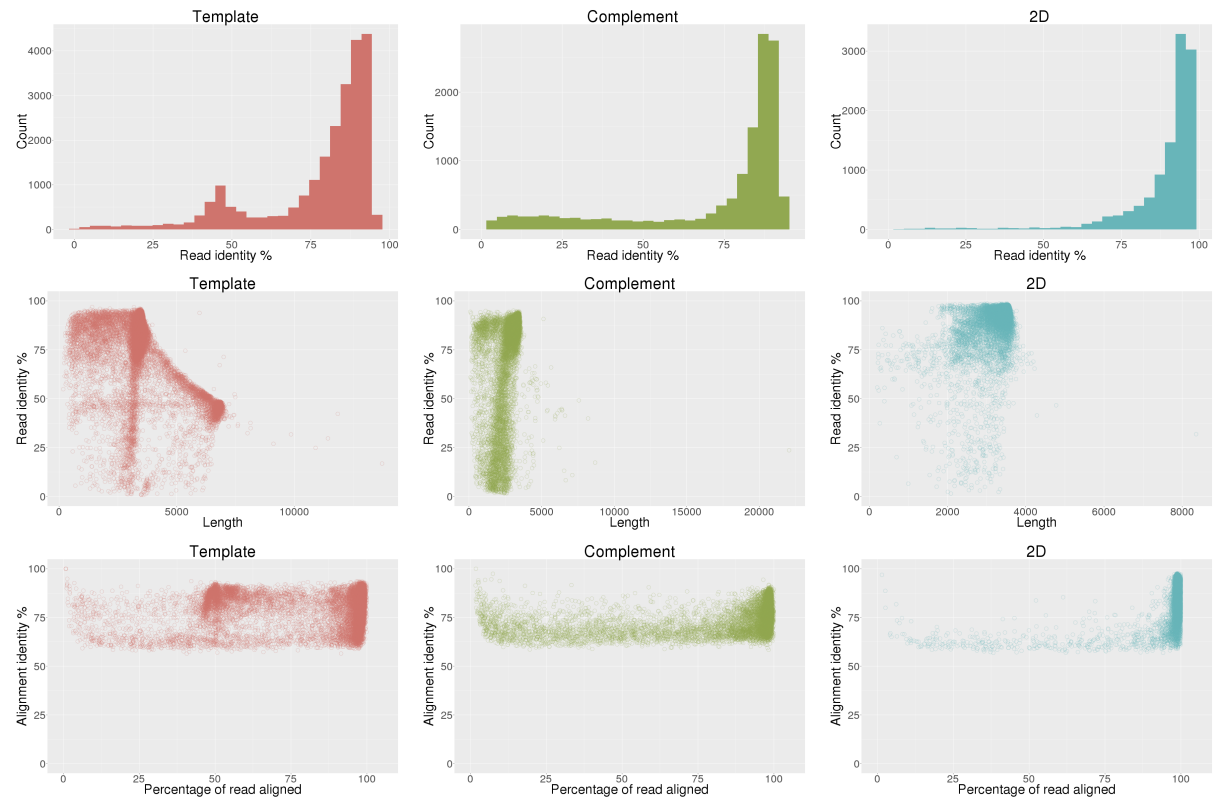
| ID               | Size    | Number of Reads | % of Reads | Mean read length | Aligned bases | Mean coverage | Longest Perf Kmer |
|------------------|---------|-----------------|------------|------------------|---------------|---------------|-------------------|
| Control sequence | 3560    | 11050           | 50.49      | 3229.66          | 36789483      | 10334.12      | 696               |
| Escherichia coli | 4641652 | 7270            | 33.22      | 6514.23          | 43787384      | 9.43          | 263               |

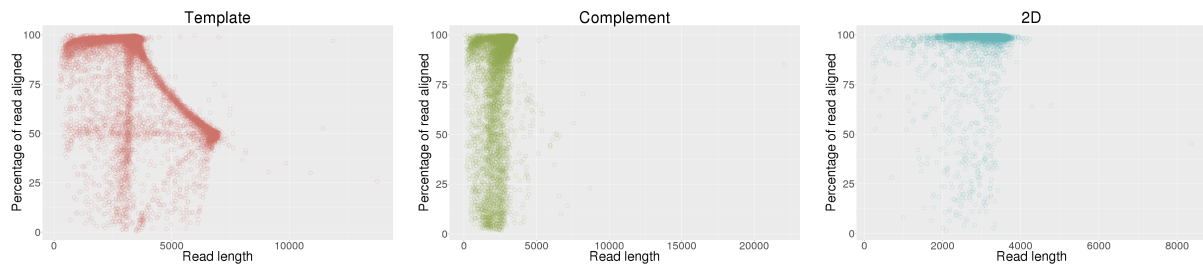
Control sequence error analysis

|                                                          | Template | Complement | 2D     |
|----------------------------------------------------------|----------|------------|--------|
| Overall base identity (excluding indels)                 | 74.49%   | 75.66%     | 89.62% |
| Aligned base identity (excluding indels)                 | 90.91%   | 90.62%     | 94.75% |
| Identical bases per 100 aligned bases (including indels) | 81.50%   | 76.57%     | 86.93% |
| Inserted bases per 100 aligned bases (including indels)  | 2.73%    | 2.10%      | 2.69%  |
| Deleted bases per 100 aligned bases (including indels)   | 7.61%    | 13.40%     | 5.56%  |
| Substitutions per 100 aligned bases (including indels)   | 8.15%    | 7.93%      | 4.81%  |
| Mean insertion size                                      | 1.52     | 1.41       | 1.68   |
| Mean deletion size                                       | 1.70     | 2.28       | 1.84   |

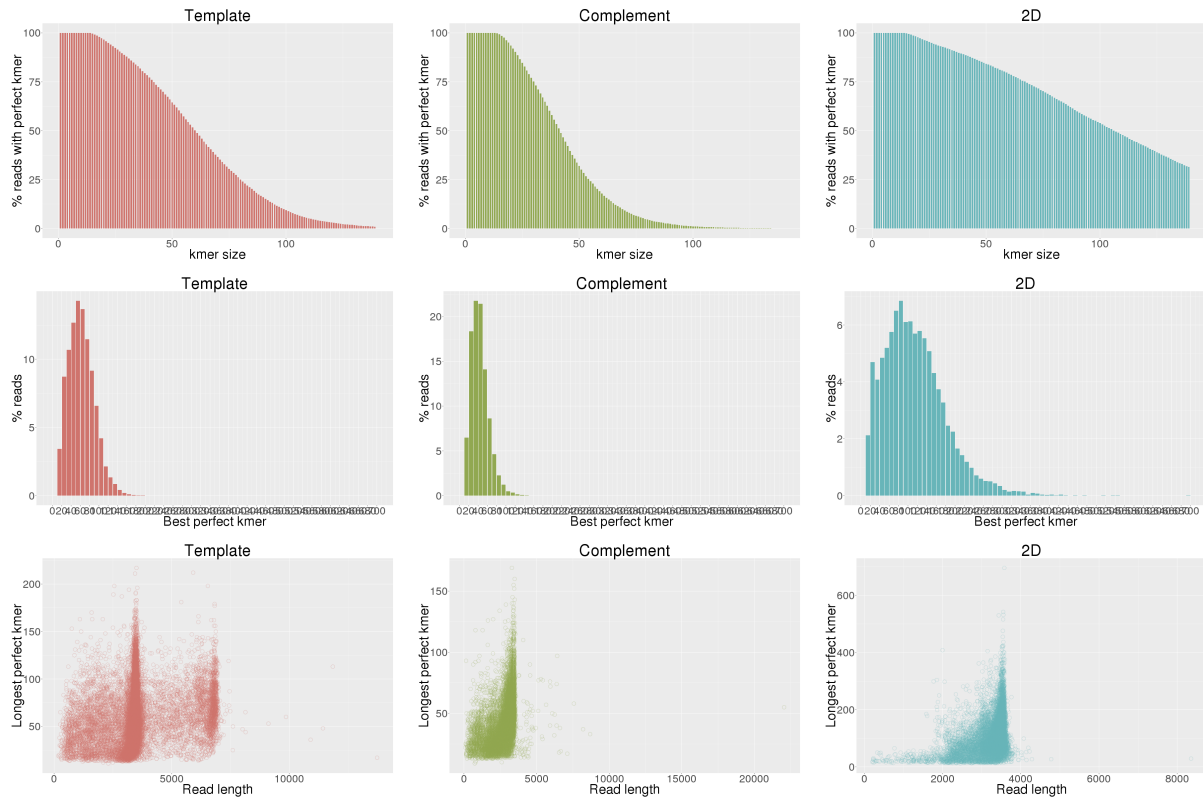


Control sequence read identity

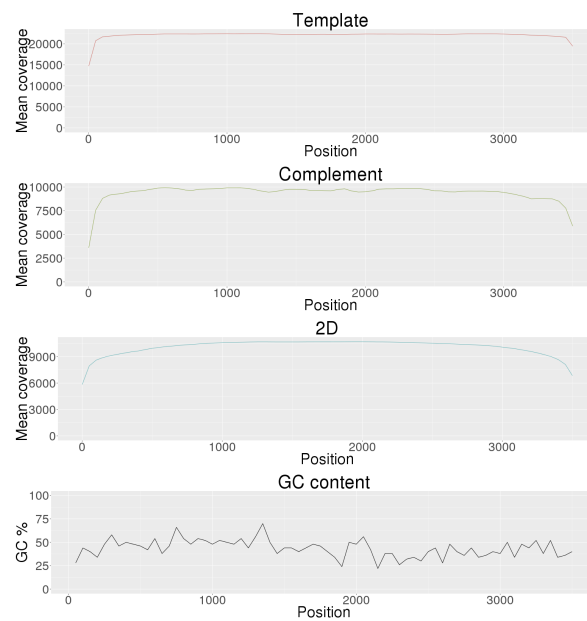




## Control sequence perfect kmers



## Control sequence coverage



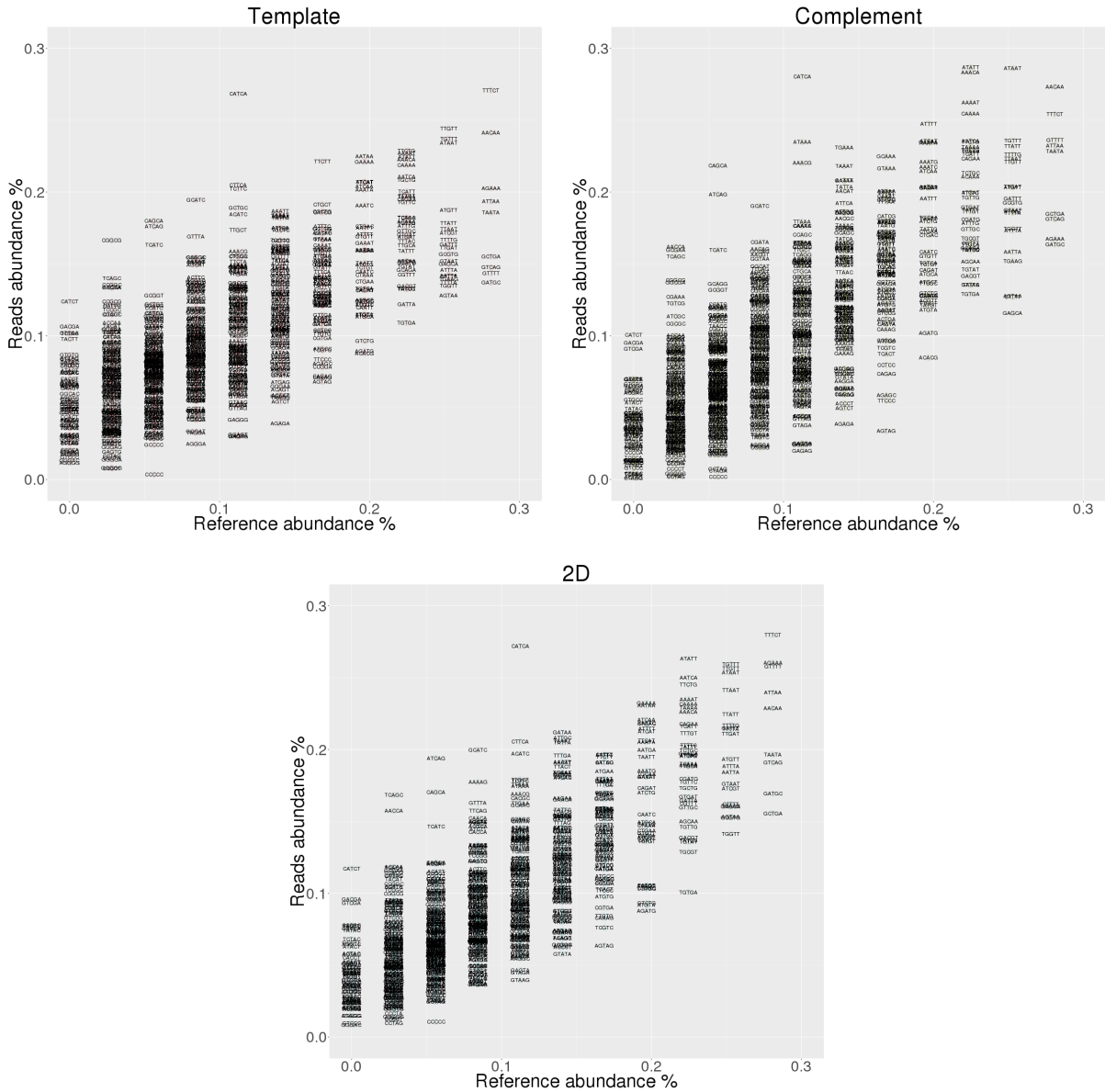
Control sequence 5-mer analysis

Under-represented 5-mers

| Rank | Template |       |        |        | Complement |       |        |        | 2D    |       |        |        |
|------|----------|-------|--------|--------|------------|-------|--------|--------|-------|-------|--------|--------|
|      | kmer     | Ref % | Read % | Diff % | kmer       | Ref % | Read % | Diff % | kmer  | Ref % | Read % | Diff % |
| 1    | TTTTT    | 0.759 | 0.099  | -0.660 | TTTTT      | 0.759 | 0.135  | -0.624 | TTTTT | 0.759 | 0.205  | -0.554 |
| 2    | AAAAA    | 0.478 | 0.171  | -0.306 | AAAAA      | 0.478 | 0.176  | -0.302 | AAAAA | 0.478 | 0.222  | -0.255 |
| 3    | TGATG    | 0.393 | 0.207  | -0.186 | GAGCA      | 0.253 | 0.116  | -0.137 | TGATG | 0.393 | 0.235  | -0.158 |
| 4    | GCAAT    | 0.309 | 0.156  | -0.154 | TGATG      | 0.393 | 0.258  | -0.136 | CTGAT | 0.309 | 0.171  | -0.138 |
| 5    | CTGAT    | 0.309 | 0.157  | -0.152 | AGTAG      | 0.169 | 0.034  | -0.135 | GATGT | 0.309 | 0.177  | -0.132 |
| 6    | GATGC    | 0.281 | 0.137  | -0.144 | CTGAT      | 0.309 | 0.178  | -0.131 | GCAAT | 0.309 | 0.182  | -0.127 |
| 7    | GATGT    | 0.309 | 0.169  | -0.140 | GATGT      | 0.309 | 0.181  | -0.128 | GCTGA | 0.281 | 0.156  | -0.125 |
| 8    | GTTTT    | 0.281 | 0.144  | -0.137 | CTTTT      | 0.253 | 0.127  | -0.126 | TGTGA | 0.225 | 0.101  | -0.124 |
| 9    | TTATC    | 0.309 | 0.172  | -0.137 | AGTAA      | 0.253 | 0.128  | -0.125 | TGGTT | 0.253 | 0.141  | -0.112 |
| 10   | GTCAG    | 0.281 | 0.148  | -0.133 | GATGC      | 0.281 | 0.164  | -0.117 | GATGC | 0.281 | 0.170  | -0.111 |

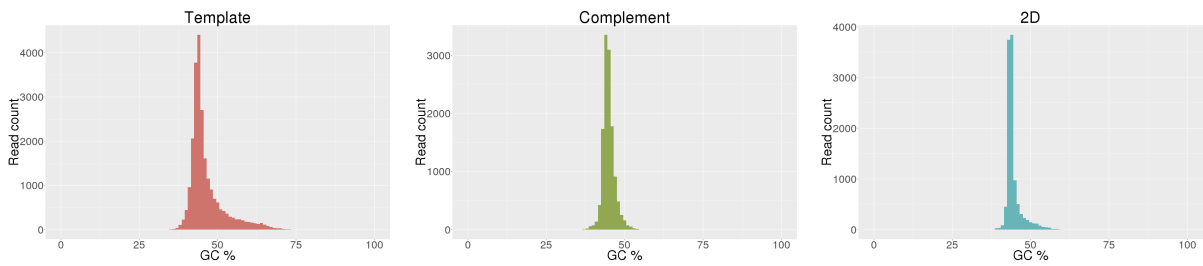
Over-represented 5-mers

| Rank | Template |       |        |        | Complement |       |        |        | 2D    |       |        |        |
|------|----------|-------|--------|--------|------------|-------|--------|--------|-------|-------|--------|--------|
|      | kmer     | Ref % | Read % | Diff % | kmer       | Ref % | Read % | Diff % | kmer  | Ref % | Read % | Diff % |
| 1    | CATCA    | 0.112 | 0.268  | 0.156  | CATCA      | 0.112 | 0.280  | 0.168  | CATCA | 0.112 | 0.272  | 0.160  |
| 2    | CGGCG    | 0.028 | 0.166  | 0.138  | CAGCA      | 0.056 | 0.218  | 0.162  | TCAGC | 0.028 | 0.168  | 0.140  |
| 3    | CATCT    | 0.000 | 0.124  | 0.124  | ATCAG      | 0.056 | 0.199  | 0.142  | ATCAG | 0.056 | 0.194  | 0.138  |
| 4    | CAGCA    | 0.056 | 0.180  | 0.124  | AACCA      | 0.028 | 0.162  | 0.134  | AACCA | 0.028 | 0.157  | 0.129  |
| 5    | ATCAG    | 0.056 | 0.176  | 0.120  | GCGAA      | 0.028 | 0.160  | 0.132  | CATCT | 0.000 | 0.117  | 0.117  |
| 6    | TCAGC    | 0.028 | 0.140  | 0.112  | TCAGC      | 0.028 | 0.155  | 0.127  | GCATC | 0.084 | 0.200  | 0.116  |
| 7    | GCATC    | 0.084 | 0.195  | 0.110  | ATAAA      | 0.112 | 0.235  | 0.122  | CAGCA | 0.056 | 0.170  | 0.114  |
| 8    | CCGGC    | 0.028 | 0.136  | 0.107  | AATAA      | 0.197 | 0.314  | 0.117  | GACGA | 0.000 | 0.096  | 0.096  |
| 9    | TCATC    | 0.056 | 0.163  | 0.107  | CGGCG      | 0.028 | 0.139  | 0.111  | GTCGA | 0.000 | 0.093  | 0.093  |
| 10   | GACGA    | 0.000 | 0.106  | 0.106  | GGCGA      | 0.028 | 0.137  | 0.109  | CTTCA | 0.112 | 0.206  | 0.093  |



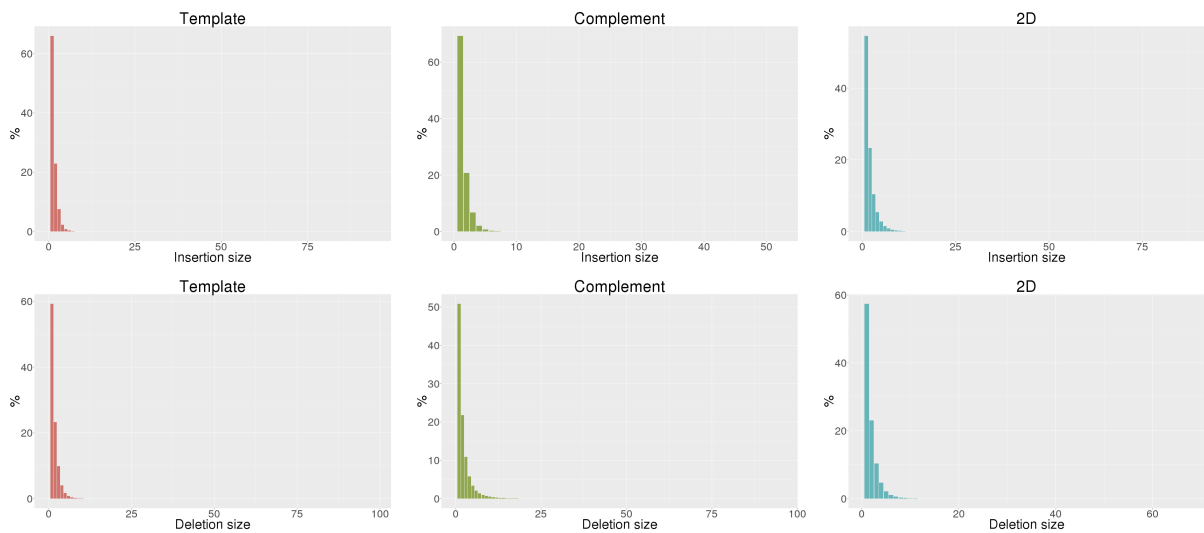


Control sequence GC content

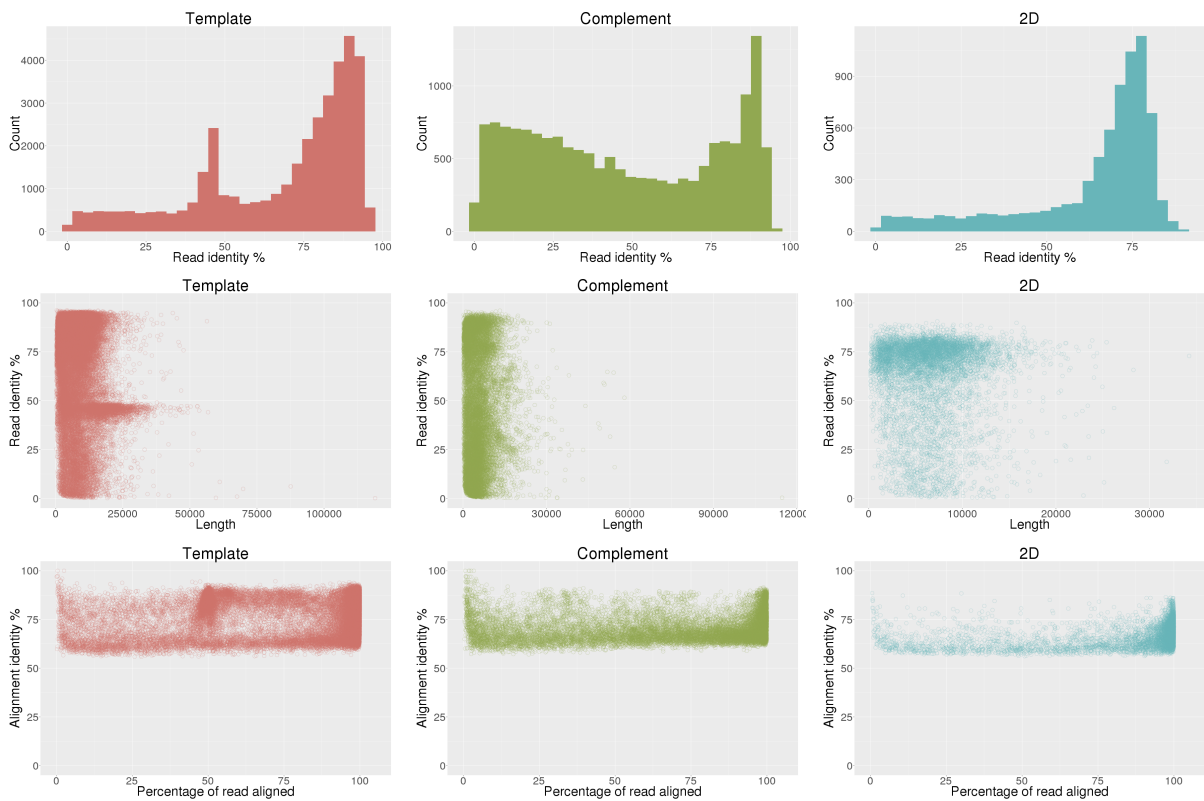


Escherichia coli error analysis

|                                                          | Template | Complement | 2D     |
|----------------------------------------------------------|----------|------------|--------|
| Overall base identity (excluding indels)                 | 64.71%   | 46.87%     | 62.74% |
| Aligned base identity (excluding indels)                 | 89.00%   | 87.67%     | 81.74% |
| Identical bases per 100 aligned bases (including indels) | 78.64%   | 71.90%     | 67.86% |
| Inserted bases per 100 aligned bases (including indels)  | 2.79%    | 2.53%      | 8.12%  |
| Deleted bases per 100 aligned bases (including indels)   | 8.86%    | 15.46%     | 8.86%  |
| Substitutions per 100 aligned bases (including indels)   | 9.72%    | 10.11%     | 15.16% |
| Mean insertion size                                      | 1.52     | 1.46       | 1.94   |
| Mean deletion size                                       | 1.75     | 2.33       | 1.82   |

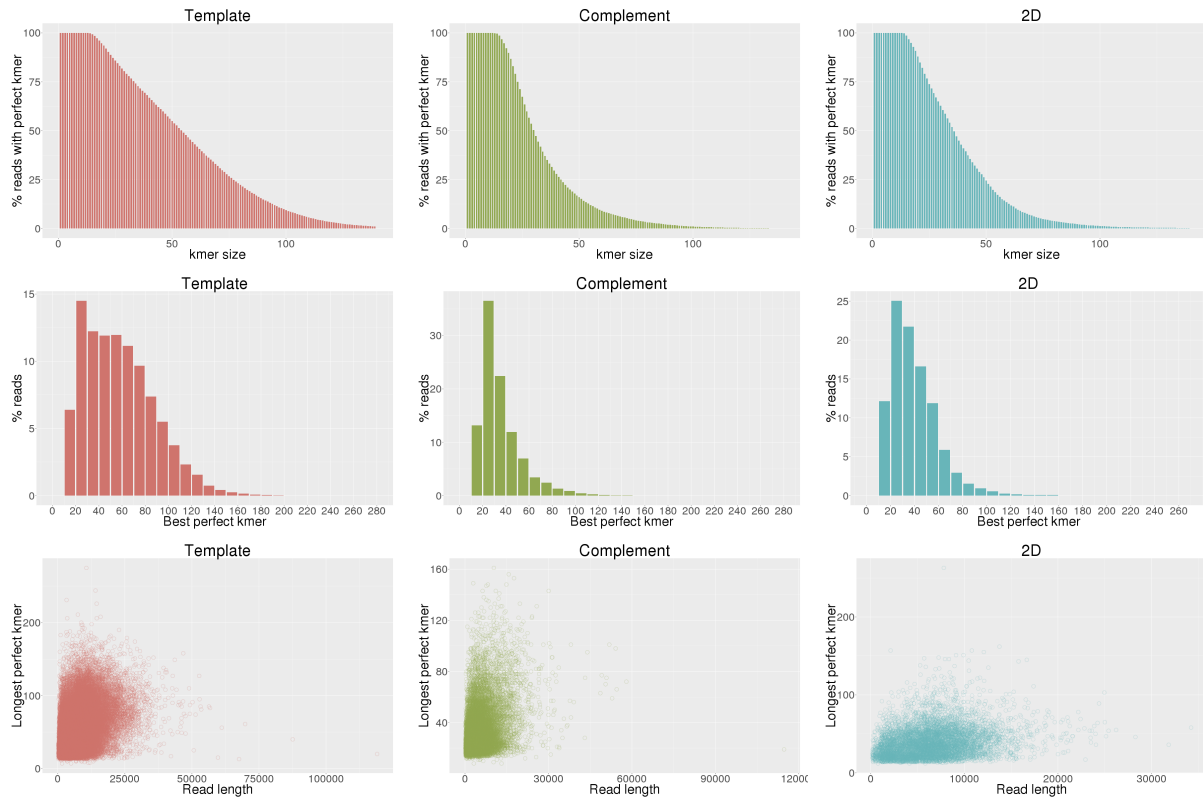


Escherichia coli read identity

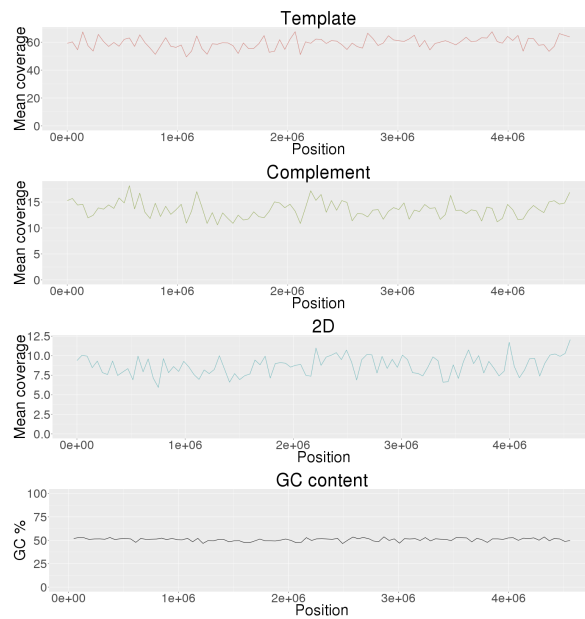




## Escherichia coli perfect kmers



## Escherichia coli coverage



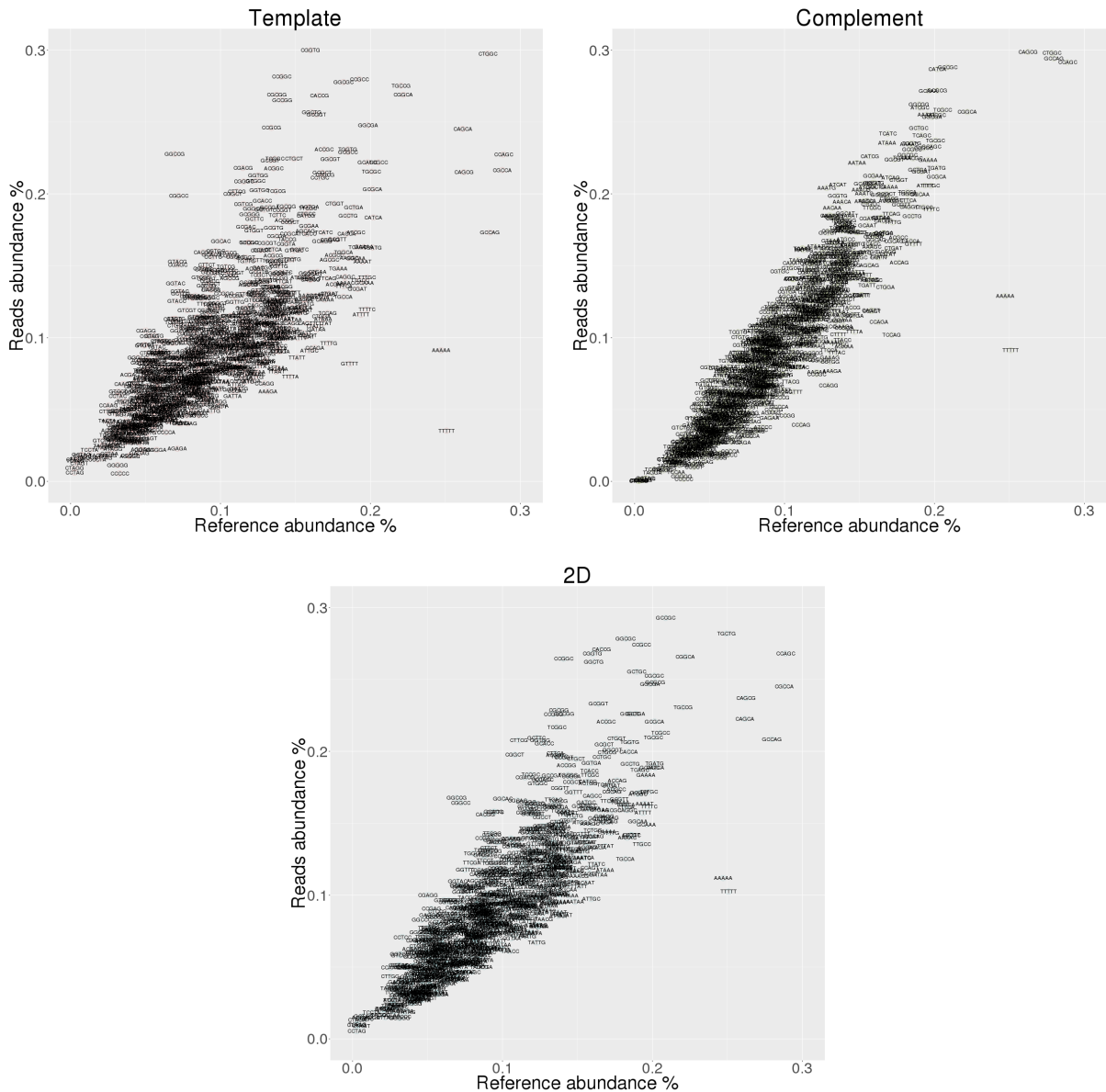
Escherichia coli 5-mer analysis

Under-represented 5-mers

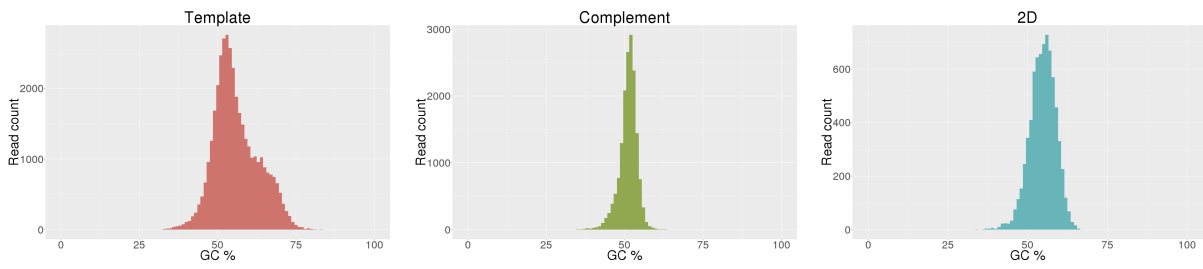
| Rank | Template |       |        |        | Complement |       |        |        | 2D    |       |        |        |
|------|----------|-------|--------|--------|------------|-------|--------|--------|-------|-------|--------|--------|
|      | kmer     | Ref % | Read % | Diff % | kmer       | Ref % | Read % | Diff % | kmer  | Ref % | Read % | Diff % |
| 1    | TTTTT    | 0.251 | 0.035  | -0.216 | TTTTT      | 0.251 | 0.091  | -0.160 | TTTTT | 0.251 | 0.102  | -0.148 |
| 2    | AAAAA    | 0.247 | 0.091  | -0.156 | AAAAA      | 0.247 | 0.129  | -0.118 | AAAAA | 0.247 | 0.112  | -0.135 |
| 3    | GCCAG    | 0.280 | 0.173  | -0.107 | CCCAG      | 0.111 | 0.039  | -0.071 | GCCAG | 0.280 | 0.208  | -0.071 |
| 4    | GTTTT    | 0.186 | 0.082  | -0.104 | TCCAG      | 0.171 | 0.102  | -0.070 | ATTGC | 0.159 | 0.097  | -0.062 |
| 5    | TTTTC    | 0.198 | 0.120  | -0.078 | CCAGG      | 0.129 | 0.067  | -0.063 | TTGCC | 0.193 | 0.136  | -0.057 |
| 6    | ATTTT    | 0.194 | 0.116  | -0.078 | AAAGA      | 0.132 | 0.077  | -0.055 | TGCCA | 0.182 | 0.125  | -0.057 |
| 7    | TTTTG    | 0.172 | 0.096  | -0.076 | CCCGG      | 0.101 | 0.046  | -0.055 | TATTG | 0.123 | 0.067  | -0.056 |
| 8    | TTTTA    | 0.147 | 0.073  | -0.074 | CCAGA      | 0.163 | 0.111  | -0.052 | AATAT | 0.141 | 0.086  | -0.055 |
| 9    | CGCCA    | 0.288 | 0.217  | -0.071 | ATCCC      | 0.086 | 0.038  | -0.048 | AATAA | 0.148 | 0.095  | -0.053 |
| 10   | CCAGA    | 0.163 | 0.093  | -0.070 | CCTGG      | 0.130 | 0.083  | -0.047 | ATATT | 0.139 | 0.087  | -0.052 |

Over-represented 5-mers

| Rank | Template |       |        |        | Complement |       |        |        | 2D    |       |        |        |
|------|----------|-------|--------|--------|------------|-------|--------|--------|-------|-------|--------|--------|
|      | kmer     | Ref % | Read % | Diff % | kmer       | Ref % | Read % | Diff % | kmer  | Ref % | Read % | Diff % |
| 1    | CGGCG    | 0.221 | 0.474  | 0.253  | CGGCG      | 0.221 | 0.338  | 0.117  | CGGCG | 0.221 | 0.388  | 0.167  |
| 2    | GCGGC    | 0.210 | 0.418  | 0.208  | GCGGC      | 0.210 | 0.316  | 0.106  | GCGGC | 0.210 | 0.337  | 0.128  |
| 3    | GGCGG    | 0.190 | 0.376  | 0.186  | CGCTG      | 0.259 | 0.357  | 0.097  | GGCGG | 0.190 | 0.316  | 0.126  |
| 4    | GCCCG    | 0.219 | 0.379  | 0.160  | TGCCG      | 0.220 | 0.313  | 0.093  | CCGCG | 0.141 | 0.264  | 0.124  |
| 5    | GGCCG    | 0.069 | 0.228  | 0.158  | CGCCG      | 0.219 | 0.311  | 0.091  | CGGTG | 0.160 | 0.268  | 0.108  |
| 6    | CCGGC    | 0.141 | 0.282  | 0.141  | CATCA      | 0.202 | 0.287  | 0.085  | CGCCG | 0.219 | 0.327  | 0.108  |
| 7    | CGGTG    | 0.160 | 0.300  | 0.140  | GCCGC      | 0.209 | 0.288  | 0.079  | CACCG | 0.166 | 0.271  | 0.105  |
| 8    | GGCGG    | 0.209 | 0.344  | 0.135  | AAATG      | 0.128 | 0.204  | 0.076  | GGCTG | 0.161 | 0.262  | 0.101  |
| 9    | CGCGG    | 0.137 | 0.269  | 0.132  | GCAAA      | 0.196 | 0.272  | 0.075  | GGCCG | 0.069 | 0.168  | 0.098  |
| 10   | CGGCC    | 0.072 | 0.199  | 0.127  | TGGCG      | 0.275 | 0.349  | 0.074  | GCTGG | 0.279 | 0.377  | 0.098  |



Escherichia coli GC content



All reference 21mer analysis



All reference substitutions

|           |   | Template substituted % |       |       |       | Complement substituted % |       |       |       | 2D substituted % |       |       |      |
|-----------|---|------------------------|-------|-------|-------|--------------------------|-------|-------|-------|------------------|-------|-------|------|
|           |   | a                      | c     | g     | t     | a                        | c     | g     | t     | a                | c     | g     | t    |
| Reference | A | 0.00                   | 8.74  | 16.95 | 4.88  | 0.00                     | 5.88  | 14.40 | 5.76  | 0.00             | 8.61  | 13.51 | 6.58 |
|           | C | 3.45                   | 0.00  | 4.09  | 11.15 | 5.59                     | 0.00  | 4.10  | 12.88 | 5.50             | 0.00  | 5.49  | 9.87 |
|           | G | 10.81                  | 4.42  | 0.00  | 3.48  | 14.23                    | 4.38  | 0.00  | 5.61  | 9.79             | 5.70  | 0.00  | 5.45 |
|           | T | 4.98                   | 18.09 | 8.95  | 0.00  | 6.04                     | 15.13 | 5.98  | 0.00  | 6.78             | 14.20 | 8.52  | 0.00 |



















Kmer motifs before errors

3-mer error motif analysis

| Rank | Template    |             |              | Complement  |             |              | 2D          |             |              |              |
|------|-------------|-------------|--------------|-------------|-------------|--------------|-------------|-------------|--------------|--------------|
|      | Insertion   | Deletion    | Substitution | Insertion   | Deletion    | Substitution | Insertion   | Deletion    | Substitution |              |
| 1    | TTC (3.36%) | CGC (3.22%) | CGC (3.69%)  | TTT (3.49%) | TTT (3.23%) | TTT (3.52%)  | TTT (3.19%) | TTT (3.31%) | TTT (3.72%)  | Most common  |
| 2    | TTT (2.81%) | TTC (3.06%) | GCC (3.19%)  | ATC (3.10%) | ATC (3.04%) | ATC (3.34%)  | TTC (3.14%) | ATT (3.08%) | CGC (3.22%)  |              |
| 3    | ATC (2.79%) | ATC (2.75%) | ATC (3.02%)  | TTC (2.91%) | CGC (2.78%) | CGC (3.09%)  | ATC (2.85%) | ATC (3.08%) | ATC (3.05%)  |              |
| 4    | CGC (2.75%) | TTT (2.75%) | TGC (2.97%)  | CGC (2.82%) | ATT (2.78%) | AAA (2.83%)  | CGC (2.63%) | TTC (2.98%) | TTC (2.85%)  |              |
| 5    | GCC (2.44%) | GCC (2.64%) | TTC (2.86%)  | ATT (2.57%) | TTC (2.77%) | TGC (2.79%)  | TGC (2.42%) | CGC (2.77%) | GCC (2.67%)  |              |
| 6    | TGC (2.35%) | GCG (2.59%) | ACC (2.81%)  | GCG (2.48%) | AAA (2.53%) | AAC (2.74%)  | ATT (2.30%) | TGC (2.53%) | TGC (2.66%)  |              |
| 7    | ACC (2.20%) | GGC (2.55%) | GGC (2.77%)  | TGC (2.44%) | TGC (2.53%) | GCC (2.63%)  | GCG (2.22%) | ACC (2.44%) | AAA (2.58%)  |              |
| 8    | GCG (2.18%) | ACC (2.50%) | TTT (2.70%)  | AAC (2.27%) | GAT (2.28%) | TTC (2.53%)  | GCC (2.18%) | GCG (2.15%) | ACC (2.42%)  |              |
| 9    | AAC (2.14%) | TGC (2.34%) | AAC (2.68%)  | AAT (2.26%) | ATG (2.26%) | GCG (2.32%)  | CTG (2.16%) | GCC (2.08%) | GCG (2.41%)  |              |
| 10   | GGC (2.08%) | ATT (2.30%) | AGC (2.43%)  | GAT (2.25%) | AAT (2.23%) | ATG (2.20%)  | TCA (2.13%) | GAT (2.05%) | GGC (2.37%)  |              |
|      |             |             |              |             |             |              |             |             |              | Least common |
| -10  | CCC (1.07%) | TAT (0.98%) | GTA (0.97%)  | GAG (1.01%) | ACT (0.92%) | AGA (0.90%)  | TAC (0.99%) | GAG (0.98%) | ACA (0.91%)  |              |
| -9   | GAG (0.97%) | AGA (0.97%) | CAT (0.95%)  | AGA (0.88%) | CCC (0.89%) | TCT (0.90%)  | AGT (0.98%) | ACA (0.95%) | TAT (0.90%)  |              |
| -8   | AGT (0.94%) | GTA (0.88%) | CCT (0.88%)  | CCC (0.83%) | CCT (0.84%) | GTA (0.89%)  | GTA (0.92%) | TAT (0.92%) | GTA (0.88%)  |              |
| -7   | TAA (0.91%) | CCT (0.87%) | ACT (0.87%)  | AGT (0.80%) | GAG (0.76%) | CCT (0.72%)  | GAG (0.91%) | AGA (0.83%) | ACT (0.84%)  |              |
| -6   | AGA (0.83%) | AGT (0.85%) | AGT (0.68%)  | AGG (0.80%) | AGG (0.75%) | ACT (0.66%)  | GGA (0.87%) | GTA (0.79%) | AGA (0.73%)  |              |
| -5   | GGA (0.81%) | TAA (0.81%) | AGA (0.68%)  | GTA (0.75%) | AGT (0.75%) | GGA (0.61%)  | AGA (0.86%) | AGT (0.78%) | AGT (0.70%)  |              |
| -4   | AGG (0.79%) | AGG (0.78%) | GGG (0.65%)  | GGA (0.74%) | GTA (0.70%) | AGT (0.61%)  | AGG (0.85%) | AGG (0.77%) | GGG (0.68%)  |              |
| -3   | GGG (0.52%) | GGG (0.59%) | GGA (0.62%)  | GGG (0.47%) | GGG (0.47%) | GGG (0.53%)  | GGG (0.57%) | GGG (0.53%) | GGA (0.65%)  |              |
| -2   | TAG (0.49%) | TAG (0.43%) | TAG (0.46%)  | TAG (0.42%) | TAG (0.35%) | TAG (0.43%)  | TAG (0.43%) | TAG (0.40%) | TAG (0.45%)  |              |
| -1   | CTA (0.49%) | CTA (0.36%) | CTA (0.32%)  | CTA (0.28%) | CTA (0.26%) | CTA (0.26%)  | CTA (0.36%) | CTA (0.36%) | CTA (0.30%)  |              |
|      |             |             |              |             |             |              |             |             |              |              |



















Kmer space for 3-mers: 64      Random chance for any given 3-mer: 1.56%

## 4-mer error motif analysis

| Rank | Template                                                                          |                                                                                   |                                                                                   | Complement                                                                        |                                                                                   |                                                                                   | 2D                                                                                |                                                                                     |                                                                                     |
|------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|      | Insertion                                                                         | Deletion                                                                          | Substitution                                                                      | Insertion                                                                         | Deletion                                                                          | Substitution                                                                      | Insertion                                                                         | Deletion                                                                            | Substitution                                                                        |
| 1    | TTTC (1.10%)                                                                      | CGCC (1.12%)                                                                      | CGCC (1.36%)                                                                      | TTTT (1.31%)                                                                      | TTTC (1.10%)                                                                      | CGCC (1.13%)                                                                      | TTTT (1.13%)                                                                      | TTTT (1.31%)                                                                        | TTTT (1.27%)                                                                        |
| 2    | CGCC (1.02%)                                                                      | GCGC (1.07%)                                                                      | GCGC (1.17%)                                                                      | ATTT (0.99%)                                                                      | TTTT (1.07%)                                                                      | TTTT (1.11%)                                                                      | TTTC (1.02%)                                                                      | TATT (1.24%)                                                                        | CGCC (1.11%)                                                                        |
| 3    | GCGC (0.89%)                                                                      | TTTC (1.07%)                                                                      | CAGC (1.04%)                                                                      | TTTC (0.95%)                                                                      | ATGC (0.96%)                                                                      | GATG (0.99%)                                                                      | ATTT (0.91%)                                                                      | ATGC (1.13%)                                                                        | GCGC (1.04%)                                                                        |
| 4    | CTTC (0.89%)                                                                      | CGGC (0.98%)                                                                      | CGGC (1.00%)                                                                      | GATG (0.89%)                                                                      | CAGC (0.95%)                                                                      | CATC (0.96%)                                                                      | CGCC (0.88%)                                                                      | TTTC (1.10%)                                                                        | ATTT (1.00%)                                                                        |
| 5    | TTTT (0.88%)                                                                      | CAGC (0.91%)                                                                      | CATC (0.94%)                                                                      | GCGC (0.89%)                                                                      | GATG (0.94%)                                                                      | AAAC (0.96%)                                                                      | CTTC (0.86%)                                                                      | GATG (0.93%)                                                                        | AAAA (0.99%)                                                                        |
| 6    | ATTT (0.82%)                                                                      | GCGC (0.85%)                                                                      | ACGC (0.90%)                                                                      | CGCC (0.87%)                                                                      | TGAT (0.91%)                                                                      | GCGC (0.94%)                                                                      | GATG (0.84%)                                                                      | TGAT (0.93%)                                                                        | GATG (0.95%)                                                                        |
| 7    | CAGC (0.82%)                                                                      | CATC (0.85%)                                                                      | CTGC (0.90%)                                                                      | AATC (0.86%)                                                                      | GCGC (0.91%)                                                                      | AAAA (0.94%)                                                                      | GCGC (0.84%)                                                                      | TGCT (0.88%)                                                                        | TTTC (0.92%)                                                                        |
| 8    | GTTC (0.81%)                                                                      | TTTT (0.84%)                                                                      | CACC (0.88%)                                                                      | TGAT (0.84%)                                                                      | TATT (0.89%)                                                                      | ATCA (0.93%)                                                                      | AATC (0.83%)                                                                      | AATT (0.87%)                                                                        | GTTT (0.91%)                                                                        |
| 9    | GCTG (0.78%)                                                                      | ATGC (0.78%)                                                                      | CCGC (0.87%)                                                                      | CAGC (0.84%)                                                                      | CGCC (0.89%)                                                                      | ATTT (0.89%)                                                                      | CAGC (0.82%)                                                                      | AACC (0.86%)                                                                        | CATC (0.88%)                                                                        |
| 10   | GATG (0.78%)                                                                      | TATT (0.77%)                                                                      | TGGC (0.86%)                                                                      | CATC (0.81%)                                                                      | ATTT (0.87%)                                                                      | TGCC (0.86%)                                                                      | GCTG (0.79%)                                                                      | GCGC (0.85%)                                                                        | TTCC (0.85%)                                                                        |
|      |  |  |  |  |  |  |  |  |  |
| -10  | TCTA (0.12%)                                                                      | ACTA (0.10%)                                                                      | GCTA (0.11%)                                                                      | CTTA (0.09%)                                                                      | CTTG (0.09%)                                                                      | CAAG (0.08%)                                                                      | TTAG (0.11%)                                                                      | TTAG (0.09%)                                                                        | TAGT (0.10%)                                                                        |
| -9   | GGGA (0.11%)                                                                      | TAGA (0.10%)                                                                      | GGGA (0.09%)                                                                      | CTAA (0.09%)                                                                      | CAAG (0.09%)                                                                      | TAGT (0.07%)                                                                      | CTTA (0.10%)                                                                      | CAAG (0.09%)                                                                        | CTAA (0.10%)                                                                        |
| -8   | CTTA (0.11%)                                                                      | TTAG (0.10%)                                                                      | GGGG (0.09%)                                                                      | TCTA (0.08%)                                                                      | CTTA (0.08%)                                                                      | CCCT (0.07%)                                                                      | GGGG (0.10%)                                                                      | TCTA (0.08%)                                                                        | GCTA (0.10%)                                                                        |
| -7   | AGGG (0.10%)                                                                      | TCTA (0.09%)                                                                      | ACTA (0.08%)                                                                      | GGGA (0.07%)                                                                      | ACTA (0.07%)                                                                      | GGGA (0.07%)                                                                      | CTAA (0.09%)                                                                      | CTAA (0.08%)                                                                        | GGGA (0.09%)                                                                        |
| -6   | CCTA (0.09%)                                                                      | CTTA (0.08%)                                                                      | GAGT (0.08%)                                                                      | TAGA (0.07%)                                                                      | TAGA (0.07%)                                                                      | TAGA (0.07%)                                                                      | ACTA (0.09%)                                                                      | GGGG (0.07%)                                                                        | CCTA (0.08%)                                                                        |
| -5   | CTAA (0.09%)                                                                      | GGGG (0.08%)                                                                      | CCTA (0.08%)                                                                      | ACTA (0.06%)                                                                      | TCTA (0.05%)                                                                      | ACTA (0.05%)                                                                      | TCTA (0.08%)                                                                      | TAGA (0.07%)                                                                        | ACTA (0.08%)                                                                        |
| -4   | TAGA (0.09%)                                                                      | CTAA (0.08%)                                                                      | TCTA (0.07%)                                                                      | GGGG (0.06%)                                                                      | GGGG (0.05%)                                                                      | CCTA (0.05%)                                                                      | TAGG (0.08%)                                                                      | CTTA (0.06%)                                                                        | TCTA (0.07%)                                                                        |
| -3   | GGGG (0.08%)                                                                      | TAGG (0.06%)                                                                      | TAGG (0.07%)                                                                      | TAGG (0.05%)                                                                      | TAGG (0.05%)                                                                      | TCTA (0.05%)                                                                      | CCTA (0.08%)                                                                      | CCTA (0.06%)                                                                        | TAGA (0.05%)                                                                        |
| -2   | TAGG (0.07%)                                                                      | CCTA (0.05%)                                                                      | TAGA (0.06%)                                                                      | CCTA (0.04%)                                                                      | CCTA (0.04%)                                                                      | TAGG (0.05%)                                                                      | TAGA (0.07%)                                                                      | TAGG (0.04%)                                                                        | TAGG (0.05%)                                                                        |
| -1   | CTAG (0.02%)                                                                      | CTAG (0.01%)                                                                      | CTAG (0.01%)                                                                      | CTAG (0.00%)                                                                      | CTAG (0.00%)                                                                      | CTAG (0.00%)                                                                      | CTAG (0.02%)                                                                      | CTAG (0.01%)                                                                        | CTAG (0.01%)                                                                        |
|      |  |  |  |  |  |  |  |  |  |

Kmer space for 4-mers: 256 Random chance for any given 4-mer: 0.39%

## 5-mer error motif analysis

| Rank | Template                                                                            |                                                                                     |                                                                                     | Complement                                                                          |                                                                                     |                                                                                     | 2D                                                                                  |                                                                                       |                                                                                       |
|------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|      | Insertion                                                                           | Deletion                                                                            | Substitution                                                                        | Insertion                                                                           | Deletion                                                                            | Substitution                                                                        | Insertion                                                                           | Deletion                                                                              | Substitution                                                                          |
| 1    | ATTTTC (0.35%)                                                                      | TTATT (0.41%)                                                                       | CCAGC (0.42%)                                                                       | TTTTTT (0.44%)                                                                      | TTATT (0.50%)                                                                       | TGATG (0.47%)                                                                       | TTTTTT (0.41%)                                                                      | TTATT (0.93%)                                                                         | TGATG (0.41%)                                                                         |
| 2    | CGCCA (0.34%)                                                                       | GCGGC (0.41%)                                                                       | CCGCC (0.38%)                                                                       | TGATG (0.41%)                                                                       | GATGC (0.43%)                                                                       | TTATC (0.44%)                                                                       | TGATG (0.35%)                                                                       | GATGC (0.63%)                                                                         | TTATC (0.38%)                                                                         |
| 3    | GTTTC (0.33%)                                                                       | TTTTTC (0.37%)                                                                      | TTGGC (0.37%)                                                                       | GTTTT (0.37%)                                                                       | ATGAT (0.42%)                                                                       | TCGCC (0.37%)                                                                       | CGCCA (0.35%)                                                                       | TCGGA (0.60%)                                                                         | TATTT (0.37%)                                                                         |
| 4    | TGATG (0.31%)                                                                       | GGCGC (0.35%)                                                                       | GCGGC (0.37%)                                                                       | TTATC (0.36%)                                                                       | TGATG (0.41%)                                                                       | TTGCG (0.34%)                                                                       | AAATC (0.34%)                                                                       | CTGCT (0.60%)                                                                         | GATGC (0.35%)                                                                         |
| 5    | CCAGC (0.31%)                                                                       | GATGC (0.35%)                                                                       | TCGCC (0.36%)                                                                       | ATTTT (0.36%)                                                                       | TTTTTC (0.39%)                                                                      | CTGGC (0.34%)                                                                       | CCAGC (0.33%)                                                                       | ATGAT (0.56%)                                                                         | CCAGC (0.34%)                                                                         |
| 6    | TGTTTC (0.30%)                                                                      | CCAGC (0.33%)                                                                       | GCGCC (0.34%)                                                                       | CCAGC (0.33%)                                                                       | ATTTT (0.38%)                                                                       | GATGC (0.34%)                                                                       | GATGC (0.33%)                                                                       | AGCCT (0.55%)                                                                         | GATTT (0.33%)                                                                         |
| 7    | TTTTTC (0.28%)                                                                      | GCGAC (0.31%)                                                                       | GATGC (0.33%)                                                                       | CTGGC (0.33%)                                                                       | TTATC (0.37%)                                                                       | AATCA (0.34%)                                                                       | ATTTTC (0.33%)                                                                      | TAGCA (0.55%)                                                                         | TTTTTT (0.33%)                                                                        |
| 8    | GCGGC (0.27%)                                                                       | ATTTT (0.30%)                                                                       | GCCGC (0.33%)                                                                       | TGGCG (0.31%)                                                                       | CCAGC (0.36%)                                                                       | CCAGC (0.33%)                                                                       | TTATC (0.31%)                                                                       | TTTTT (0.50%)                                                                         | TCGCC (0.33%)                                                                         |
| 9    | CCGCC (0.27%)                                                                       | TGATG (0.30%)                                                                       | TGATG (0.32%)                                                                       | ACGTT (0.31%)                                                                       | GCGGC (0.35%)                                                                       | TCATC (0.33%)                                                                       | GCTTC (0.31%)                                                                       | TGGAA (0.48%)                                                                         | TTTTTC (0.32%)                                                                        |
| 10   | TCTTC (0.27%)                                                                       | CCGCC (0.30%)                                                                       | GGCGC (0.32%)                                                                       | GATTT (0.30%)                                                                       | TATCG (0.34%)                                                                       | AAAAC (0.32%)                                                                       | GTTTT (0.30%)                                                                       | CGTGT (0.46%)                                                                         | CTGGC (0.32%)                                                                         |
|      |  |  |  |  |  |  |  |  |  |
| -10  | TAGGG (0.01%)                                                                       | GGGGG (0.01%)                                                                       | CTCTA (0.01%)                                                                       | CCCTA (0.00%)                                                                       | CTTAG (0.00%)                                                                       | CTAGA (0.00%)                                                                       | CTAGA (0.01%)                                                                       | ATAGG (0.01%)                                                                         | TAGGT (0.01%)                                                                         |
| -9   | CCTGG (0.01%)                                                                       | TAGGA (0.01%)                                                                       | CCCTA (0.01%)                                                                       | TCCTA (0.00%)                                                                       | GCTAG (0.00%)                                                                       | TAGGA (0.00%)                                                                       | CCCTA (0.01%)                                                                       | TCCTA (0.00%)                                                                         | CTCTA (0.01%)                                                                         |
| -8   | CCTAG (0.01%)                                                                       | GCTAG (0.00%)                                                                       | GGGGG (0.01%)                                                                       | GCTAG (0.00%)                                                                       | GGGGG (0.00%)                                                                       | GCTAG (0.00%)                                                                       | CCTAG (0.01%)                                                                       | GCTAG (0.00%)                                                                         | CTTAG (0.01%)                                                                         |
| -7   | CTAGA (0.01%)                                                                       | CTAGA (0.00%)                                                                       | CTAGC (0.01%)                                                                       | CCCCC (0.00%)                                                                       | CTAGA (0.00%)                                                                       | CCAAG (0.00%)                                                                       | TAGGG (0.01%)                                                                       | CTTAG (0.00%)                                                                         | GTCTA (0.01%)                                                                         |
| -6   | CTAGT (0.01%)                                                                       | CTAGT (0.00%)                                                                       | CTAGA (0.00%)                                                                       | CTAGA (0.00%)                                                                       | CTAGC (0.00%)                                                                       | CCCTA (0.00%)                                                                       | CTTAG (0.00%)                                                                       | TAGGG (0.00%)                                                                         | GCTAG (0.00%)                                                                         |
| -5   | GGGGG (0.00%)                                                                       | CTAGC (0.00%)                                                                       | GCTAG (0.00%)                                                                       | GGGGG (0.00%)                                                                       | CCTAG (0.00%)                                                                       | CTAGC (0.00%)                                                                       | CTAGT (0.00%)                                                                       | ACTAG (0.00%)                                                                         | CCTAG (0.00%)                                                                         |
| -4   | CTAGC (0.00%)                                                                       | ACTAG (0.00%)                                                                       | ACTAG (0.00%)                                                                       | CCTAG (0.00%)                                                                       | CTAGT (0.00%)                                                                       | CCTAG (0.00%)                                                                       | CTAGC (0.00%)                                                                       | CTAGC (0.00%)                                                                         | CTAGC (0.00%)                                                                         |
| -3   | ACTAG (0.00%)                                                                       | CCTAG (0.00%)                                                                       | CCTAG (0.00%)                                                                       | ACTAG (0.00%)                                                                       | ACTAG (0.00%)                                                                       | ACTAG (0.00%)                                                                       | ACTAG (0.00%)                                                                       | TCTAG (0.00%)                                                                         | TCTAG (0.00%)                                                                         |
| -2   | TCTAG (0.00%)                                                                       | TCTAG (0.00%)                                                                       | TCTAG (0.00%)                                                                       | CTAGT (0.00%)                                                                       | TCTAG (0.00%)                                                                       | TCTAG (0.00%)                                                                       | CTAGG (0.00%)                                                                       | CTAGT (0.00%)                                                                         | ACTAG (0.00%)                                                                         |
| -1   | CTAGG (0.00%)                                                                       | CTAGG (0.00%)                                                                       | CTAGG (0.00%)                                                                       | CTAGC (0.00%)                                                                       | CTAGG (0.00%)                                                                       | CTAGG (0.00%)                                                                       | TCTAG (0.00%)                                                                       | CTAGG (0.00%)                                                                         | CTAGG (0.00%)                                                                         |
|      |  |  |  |  |  |  |  |  |  |

Kmer space for 5-mers: 1024 Random chance for any given 5-mer: 0.10%