**Supplemental Material for manuscript**

**“Relationships between Migration and Microbiome Composition and Diversity in Urban Canada Geese”**

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*Table A*: Results of the round in which DNA extraction took place on alpha diversity for the full dataset and the dataset excluding the third group of DNA extraction.

|  |  |  |  |
| --- | --- | --- | --- |
| **Full Data DNA Extraction** | Degrees of Freedom | F | p-value |
| Shannon | 2 | 6.66 | 0.0041\*\* |
| Observed OTUS | 2 | 4.19 | 0.025\*\* |
| Faith | 2 | 3.78 | 0.034\*\* |
| **No DNA Round 3**  **DNA Extraction** |  | F | p-value |
| Shannon | 2 | 1.72 | 0.21 |
| Observed OTUS | 2 | 4.56 | 0.048\*\* |
| Faith | 2 | 4.44 | 0.050\* |
|  |  |  |  |

*Table B*: Pairwise analysis of whether the DNA extraction sample group significantly explained variation. Because round 2 was almost entirely composed of migrants, and rounds 1 and 3 were almost entirely residents, it was determined that the significance was driven by migratory status rather than the DNA extraction group.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DNA Extraction Round Pairs** | Degrees of Freedom | F | R-Squared | Adjusted p-value |
| 1 vs. 2 weighted | 1 | 2.72 | 0.14 | 0.058\* |
| 1 vs. 2 unweighted | 1 | 1.97 | 0.10 | 0.060\* |
| 2 vs. 3 weighted | 1 | 2.96 | 0.11 | 0.058\* |
| 2 vs. 3 unweighted | 1 | 2.43 | 0.096 | 0.012\*\* |
| 1 vs. 3 weighted | 1 | 0.52 | 0.026 | 0.79 |
| 1 vs. 3 unweighted | 1 | 1.03 | 0.049 | 0.34 |

*Table C:* Significance of migrant status on alpha diversity for the dataset with the third sample group of DNA extraction excluded.

|  |  |  |  |
| --- | --- | --- | --- |
| **No DNA Round 3 Migrant Status** | Degrees of Freedom | F | p-value |
| Shannon | 1 | 1.72 | 0.21 |
| Observed OTUS | 1 | 4.56 | 0.048\*\* |
| Faith | 1 | 4.45 | 0.050\* |

*Table D*: Average values of the alpha diversity metrics when excluding the third DNA extraction sample group.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No DNA Round 3** | *Shannon* | | *Observed OTUS* | | *Faith* | |
|  | Average | St. Dev. | Average | St. Dev. | Average | St. Dev. |
| Migrant | 3.25 | 0.91 | 82.78 | 43.33 | 10.44 | 4.40 |
| Resident | 3.88 | 1.13 | 134.00 | 59.01 | 14.83 | 4.65 |

*Table E*: Statistics from the PERMANOVA tests of the unweighted and weighted UniFrac distance matrices from the dataset excluding the third DNA extraction group. It measures the significance of migrant status, DNA extraction round, and location to explain variance.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No DNA Round 3** | | | | |
| **Migrant Status** | Degrees of Freedom | R-squared | F | p-value |
| Unweighted | 1 | 0.075 | 1.37 | .12 |
| Weighted | 1 | 0.12 | 2.30 | 0.048\*\* |
| **DNA Extraction** |  |  |  |  |
| Unweighted | 1 | 0.11 | 2.02 | 0.025\*\* |
| Weighted | 1 | 0.14 | 2.74 | 0.023\*\* |
| **DNA + Migrant** |  |  |  |  |
| Unweighted DNA | 1 | 0.079 | 1.50 | 0.084\* |
| Unweighted Migrant | 1 | 0.048 | .91 | 0.48 |
| Weighted DNA | 1 | 0.077 | 1.53 | 0.17 |
| Weighted Migrant | 1 | 0.057 | 1.14 | 0.32 |
| **Location** |  |  |  |  |
| Unweighted | 9 | 0.55 | 1.20 | 0.089\* |
| Weighted | 9 | 0.53 | 1.14 | 0.32 |

*Table F*: A comparison of the average alpha diversity metrics (Shannon diversity, Observed OTUs, Faith Phylogenic Diversity) and standard deviation between migrants and residents.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *Shannon* | | *Observed OTUS* | | *Faith* | |
|  | Average | St. Dev. | Average | St. Dev. | Average | St. Dev. |
| Migrant | 3.24 | 0.91 | 82.67 | 43.33 | 10.39 | 4.41 |
| Resident | 4.33 | 1.20 | 143.92167 | 66.4 | 15.13 | 5.20 |

*Table G*: Statistics from the 40 PERMANOVA tests of the unweighted and weighted UniFrac distance matrices using a subset of 9 migrant and 9 resident samples. They measure the significance of migrant status to explain variance.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Unweighted** | | | | **Weighted** | | | |
| **Subsample #** | **r2** | **F** | **p-value** | **Subsample #** | **r2** | **F** | **p-value** |
| 1 | 0.13 | 2.45 | 0.0008 | 1 | 0.12 | 2.21 | 0.15 |
| 2 | 0.11 | 2.03 | 0.0024 | 2 | 0.08 | 1.35 | 0.26 |
| 3 | 0.11 | 2.04 | 0.0026 | 3 | 0.08 | 1.30 | 0.26 |
| 4 | 0.11 | 1.98 | 0.0030 | 4 | 0.07 | 1.26 | 0.26 |
| 5 | 0.11 | 1.98 | 0.0042 | 5 | 0.07 | 1.24 | 0.27 |
| 6 | 0.13 | 2.44 | 0.0044 | 6 | 0.06 | 1.08 | 0.30 |
| 7 | 0.10 | 1.83 | 0.0052 | 7 | 0.08 | 1.41 | 0.32 |
| 8 | 0.11 | 1.95 | 0.0052 | 8 | 0.06 | 0.95 | 0.33 |
| 9 | 0.11 | 1.88 | 0.0054 | 9 | 0.06 | 0.95 | 0.34 |
| 10 | 0.11 | 1.94 | 0.0054 | 10 | 0.05 | 0.87 | 0.35 |
| 11 | 0.13 | 2.29 | 0.0054 | 11 | 0.06 | 0.95 | 0.35 |
| 12 | 0.11 | 1.90 | 0.0058 | 12 | 0.06 | 0.96 | 0.36 |
| 13 | 0.10 | 1.83 | 0.0058 | 13 | 0.04 | 0.62 | 0.39 |
| 14 | 0.10 | 1.86 | 0.0062 | 14 | 0.05 | 0.81 | 0.41 |
| 15 | 0.10 | 1.78 | 0.0076 | 15 | 0.03 | 0.56 | 0.47 |
| 16 | 0.11 | 2.01 | 0.0096 | 16 | 0.03 | 0.58 | 0.49 |
| 17 | 0.11 | 1.95 | 0.0096 | 17 | 0.03 | 0.52 | 0.49 |
| 18 | 0.10 | 1.77 | 0.0098 | 18 | 0.02 | 0.41 | 0.50 |
| 19 | 0.10 | 1.72 | 0.0104 | 19 | 0.02 | 0.41 | 0.54 |
| 20 | 0.10 | 1.81 | 0.0106 | 20 | 0.02 | 0.38 | 0.56 |
| 21 | 0.10 | 1.76 | 0.0130 | 21 | 0.02 | 0.40 | 0.56 |
| 22 | 0.10 | 1.80 | 0.0146 | 22 | 0.03 | 0.42 | 0.56 |
| 23 | 0.09 | 1.60 | 0.0148 | 23 | 0.02 | 0.34 | 0.60 |
| 24 | 0.10 | 1.72 | 0.0176 | 24 | 0.02 | 0.31 | 0.61 |
| 25 | 0.09 | 1.60 | 0.0186 | 25 | 0.02 | 0.37 | 0.62 |
| 26 | 0.09 | 1.50 | 0.0190 | 26 | 0.01 | 0.21 | 0.63 |
| 27 | 0.10 | 1.69 | 0.0194 | 27 | 0.02 | 0.27 | 0.65 |
| 28 | 0.09 | 1.67 | 0.0206 | 28 | 0.01 | 0.20 | 0.67 |
| 29 | 0.10 | 1.72 | 0.0260 | 29 | 0.01 | 0.16 | 0.68 |
| 30 | 0.09 | 1.57 | 0.0392 | 30 | 0.01 | 0.14 | 0.71 |
| 31 | 0.08 | 1.46 | 0.0420 | 31 | 0.01 | 0.15 | 0.75 |
| 32 | 0.08 | 1.45 | 0.0430 | 32 | 0.01 | 0.17 | 0.75 |
| 33 | 0.08 | 1.42 | 0.0594 | 33 | 0.01 | 0.13 | 0.77 |
| 34 | 0.08 | 1.36 | 0.0750 | 34 | 0.01 | 0.17 | 0.78 |
| 35 | 0.08 | 1.31 | 0.0824 | 35 | 0.01 | 0.11 | 0.81 |
| 36 | 0.08 | 1.37 | 0.0854 | 36 | 0.00 | 0.07 | 0.81 |
| 37 | 0.07 | 1.27 | 0.0916 | 37 | 0.01 | 0.10 | 0.83 |
| 38 | 0.08 | 1.32 | 0.1008 | 38 | 0.00 | 0.07 | 0.87 |
| 39 | 0.07 | 1.24 | 0.1198 | 39 | 0.00 | 0.08 | 0.90 |
| 40 | 0.07 | 1.16 | 0.1584 | 40 | 0.01 | 0.08 | 0.92 |

Table H: Statistics from the 40 beta dispersion tests using a subset of 9 migrant and 9 resident samples with both weighted and unweighted UniFrac distances. They measure the significance of migrant status to explain inter-individual variance.

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| --- | --- | --- | --- | --- | --- |
| **Unweighted** | | | **Weighted** | | |
| **Subsample #** | **F** | **p** | **Subsample #** | **F** | **p** |
| 1 | 11.7987225 | 0.00340006 | 1 | 12.6025613 | 0.00266646 |
| 2 | 9.56308057 | 0.00698993 | 2 | 9.80906345 | 0.00643437 |
| 3 | 9.17840623 | 0.00797162 | 3 | 9.50913661 | 0.00711893 |
| 4 | 9.14221614 | 0.00807178 | 4 | 9.08204459 | 0.0082415 |
| 5 | 9.0778985 | 0.00825335 | 5 | 8.55120634 | 0.0099283 |
| 6 | 8.87914455 | 0.00884446 | 6 | 8.08651923 | 0.01173339 |
| 7 | 8.82701296 | 0.00900738 | 7 | 7.87665279 | 0.01266932 |
| 8 | 8.25996887 | 0.01101909 | 8 | 7.54126137 | 0.01434758 |
| 9 | 8.20929005 | 0.01122254 | 9 | 7.50061841 | 0.01456769 |
| 10 | 8.05410799 | 0.01187264 | 10 | 7.46799374 | 0.01474717 |
| 11 | 7.37926625 | 0.0152482 | 11 | 7.35752365 | 0.01537393 |
| 12 | 7.3738823 | 0.01527922 | 12 | 7.33808628 | 0.01548733 |
| 13 | 7.18585326 | 0.01640931 | 13 | 7.13116108 | 0.01675576 |
| 14 | 7.15667721 | 0.0165931 | 14 | 6.97958289 | 0.0177605 |
| 15 | 7.0765614 | 0.01710999 | 15 | 6.94172393 | 0.0180221 |
| 16 | 7.0725251 | 0.01713651 | 16 | 6.85891079 | 0.01860984 |
| 17 | 6.99324128 | 0.01766719 | 17 | 6.64783594 | 0.02020984 |
| 18 | 6.77665173 | 0.01921548 | 18 | 6.63379458 | 0.02032174 |
| 19 | 6.5058628 | 0.02137475 | 19 | 6.62654965 | 0.02037976 |
| 20 | 6.49221681 | 0.02149071 | 20 | 6.60995188 | 0.0205134 |
| 21 | 6.48207936 | 0.02157733 | 21 | 6.47501689 | 0.02163791 |
| 22 | 6.0583386 | 0.0255836 | 22 | 6.45145448 | 0.02184144 |
| 23 | 5.91127187 | 0.0271692 | 23 | 6.3715823 | 0.0225479 |
| 24 | 5.73137774 | 0.02926484 | 24 | 6.33301827 | 0.02289835 |
| 25 | 5.5695612 | 0.03131026 | 25 | 6.17006116 | 0.02444997 |
| 26 | 5.49501472 | 0.03230769 | 26 | 5.77269881 | 0.02876748 |
| 27 | 5.46078113 | 0.03277799 | 27 | 5.73331773 | 0.02924127 |
| 28 | 5.41977163 | 0.0333518 | 28 | 5.66355231 | 0.03010284 |
| 29 | 5.240087 | 0.03600672 | 29 | 5.61145454 | 0.03076533 |
| 30 | 4.93683651 | 0.04106214 | 30 | 5.56259741 | 0.03140192 |
| 31 | 4.69301283 | 0.04572949 | 31 | 5.49606431 | 0.0322934 |
| 32 | 4.41948445 | 0.05171712 | 32 | 5.38163858 | 0.0338958 |
| 33 | 4.27068812 | 0.055356 | 33 | 5.22932346 | 0.03617336 |
| 34 | 4.0953679 | 0.0600338 | 34 | 4.99562708 | 0.04002094 |
| 35 | 3.96741286 | 0.06374094 | 35 | 4.97590319 | 0.04036681 |
| 36 | 3.83809274 | 0.06776326 | 36 | 4.81592556 | 0.04330383 |
| 37 | 3.54797636 | 0.07792459 | 37 | 4.70138969 | 0.04555925 |
| 38 | 3.39833886 | 0.0838645 | 38 | 4.17091018 | 0.05796372 |
| 39 | 3.36969034 | 0.08506198 | 39 | 4.03091775 | 0.06186855 |
| 40 | 3.31049745 | 0.08760101 | 40 | 3.17880039 | 0.09358015 |

Table I: Statistics from 40 linear mixed effects models using a subset of 9 migrant and 9 resident samples for both Shanno diversity and Faith’s Phylogenetic Diversity. They measure the significance of the variation in average alpha diversity between migrants and residents.

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Shannon** | | | **Faith's PD** | | |
| **Subsample #** | **X2** | **P value** | **Subsample #** | **X2** | **P value** |
| 1 | 15.24 | 9.4541E-05 | 1 | 14.67 | 0.0001 |
| 2 | 13.73 | 0.0002 | 2 | 12.76 | 0.0004 |
| 3 | 13.03 | 0.0003 | 3 | 10.75 | 0.0010 |
| 4 | 11.98 | 0.0005 | 4 | 10.20 | 0.0014 |
| 5 | 11.51 | 0.0007 | 5 | 9.34 | 0.0022 |
| 6 | 10.28 | 0.0013 | 6 | 7.63 | 0.0057 |
| 7 | 7.67 | 0.0056 | 7 | 7.21 | 0.0073 |
| 8 | 7.51 | 0.0062 | 8 | 6.94 | 0.0084 |
| 9 | 7.50 | 0.0062 | 9 | 6.89 | 0.0087 |
| 10 | 7.45 | 0.0064 | 10 | 6.80 | 0.0091 |
| 11 | 7.27 | 0.0070 | 11 | 6.72 | 0.0095 |
| 12 | 6.56 | 0.0104 | 12 | 6.42 | 0.0113 |
| 13 | 6.09 | 0.0136 | 13 | 6.40 | 0.0114 |
| 14 | 5.83 | 0.0158 | 14 | 6.29 | 0.0121 |
| 15 | 5.79 | 0.0161 | 15 | 6.03 | 0.0141 |
| 16 | 5.60 | 0.0180 | 16 | 5.98 | 0.0144 |
| 17 | 5.35 | 0.0208 | 17 | 5.91 | 0.0151 |
| 18 | 5.28 | 0.0216 | 18 | 5.82 | 0.0159 |
| 19 | 4.82 | 0.0282 | 19 | 5.76 | 0.0164 |
| 20 | 4.66 | 0.0308 | 20 | 5.57 | 0.0183 |
| 21 | 4.34 | 0.0373 | 21 | 5.10 | 0.0239 |
| 22 | 4.22 | 0.0401 | 22 | 5.02 | 0.0251 |
| 23 | 4.06 | 0.0439 | 23 | 4.98 | 0.0256 |
| 24 | 3.99 | 0.0458 | 24 | 4.42 | 0.0354 |
| 25 | 3.84 | 0.0500 | 25 | 4.31 | 0.0379 |
| 26 | 3.65 | 0.0562 | 26 | 4.16 | 0.0414 |
| 27 | 3.42 | 0.0643 | 27 | 3.91 | 0.0479 |
| 28 | 3.31 | 0.0691 | 28 | 3.35 | 0.0673 |
| 29 | 3.07 | 0.0797 | 29 | 2.93 | 0.0870 |
| 30 | 2.96 | 0.0853 | 30 | 2.86 | 0.0909 |
| 31 | 2.91 | 0.0883 | 31 | 2.78 | 0.0956 |
| 32 | 2.72 | 0.0989 | 32 | 2.68 | 0.1015 |
| 33 | 2.65 | 0.1037 | 33 | 2.49 | 0.1147 |
| 34 | 2.40 | 0.1213 | 34 | 2.44 | 0.1182 |
| 35 | 2.27 | 0.1323 | 35 | 2.34 | 0.1258 |
| 36 | 2.22 | 0.1362 | 36 | 2.18 | 0.1401 |
| 37 | 2.05 | 0.1524 | 37 | 2.09 | 0.1479 |
| 38 | 1.41 | 0.2349 | 38 | 1.73 | 0.1880 |
| 39 | 1.36 | 0.2434 | 39 | 1.55 | 0.2135 |
| 40 | 0.91 | 0.3411 | 40 | 1.36 | 0.2443 |