*Supplementary material*

**Climate change will reduce the potential distribution ranges of Colombia’s most valuable pollinators**

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**Table S1.** Species occurrences used for modeling.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Species | Longitude | Latitude | Train/Test | Species1 | Longitude1 | Latitude1 | Train/Test1 |
| *F. paupera* | -71.157778 | 8.579056 | Train | *N. melanocera* | -75.6064 | 1.50111 | Train |
| *F. paupera* | -75.166667 | 3.216667 | Train | *N. melanocera* | -67.9299 | -1.95567 | Train |
| *F. paupera* | -85.69722 | 10.55005 | Train | *N. melanocera* | -72.65 | 2.57 | Train |
| *F. paupera* | -89.75968 | 14.98333 | Train | *N. melanocera* | -73.2096 | 4.37659 | Train |
| *F. paupera* | -85.333163 | 10.346919 | Train | *N. melanocera* | -71.5724 | -1.44293 | Train |
| *F. paupera* | -84.749598 | 10.955344 | Train | *N. melanocera* | -66.4725 | 10.22007 | Train |
| *F. paupera* | -74.80468 | 4.29866 | Train | *N. melanocera* | -73.3499 | 4.5101 | Train |
| *F. paupera* | -70.5003 | 8.813611 | Test | *N. melanocera* | -78.1262 | -2.26242 | Train |
| *F. paupera* | -86.2517 | 12.1093 | Test | *N. melanocera* | -73.4912 | 3.97106 | Train |
| *F. paupera* | -84.0082 | 10.43196 | Test | *N. melanocera* | -75.1983 | -10.7333 | Train |
| *F. paupera* | -84.9267 | 9.790525 | Test | *N. melanocera* | -73 | 4.75 | Train |
| *F. paupera* | -79.85 | 9.183333 | Test | *N. melanocera* | -64.7115 | -3.35445 | Train |
| *F. paupera* | -78.9833 | 9.35 | Test | *N. melanocera* | -73.9587 | 3.94743 | Train |
| *F. paupera* | -77.6833 | 7.75 | Test | *N. melanocera* | -70.25 | 3.68333 | Train |
| *M. eburnea* | -59.625 | -4.40411 | Train | *N. melanocera* | -65.5833 | -2.68333 | Train |
| *M. eburnea* | -67.1856 | -10.3353 | Train | *N. melanocera* | -72.3963 | -0.60139 | Train |
| *M. eburnea* | -73.3499 | 4.5084 | Train | *N. melanocera* | -76.1 | 1.33333 | Train |
| *M. eburnea* | -74.4868 | 4.1907 | Train | *N. melanocera* | -49.3333 | -0.2 | Train |
| *M. eburnea* | -67.81 | -9.97472 | Train | *N. melanocera* | -66.869 | -15.936 | Train |
| *M. eburnea* | -76.0214 | 1.816667 | Train | *N. melanocera* | -75.25 | 0.7 | Train |
| *M. eburnea* | -75.4667 | -10.4833 | Train | *N. melanocera* | -63.9 | -8.76667 | Train |
| *M. eburnea* | -74.3968 | 4.3908 | Train | *N. melanocera* | -63.5525 | -17.4992 | Train |
| *M. eburnea* | -76.3333 | -6.56667 | Train | *N. melanocera* | -69.05 | -12.55 | Train |
| *M. eburnea* | -75.3583 | -10.76 | Train | *N. melanocera* | -75.5717 | -10.1783 | Train |
| *M. eburnea* | -74.6181 | -11.2601 | Train | *N. melanocera* | -73.6957 | 3.92392 | Train |
| *M. eburnea* | -75.5417 | -10.1383 | Train | *N. melanocera* | -64.4486 | -14.83 | Test |
| *M. eburnea* | -77.8167 | -0.91667 | Test | *N. melanocera* | -65.9282 | -10.1519 | Test |
| *M. eburnea* | -76.35 | -6.46667 | Test | *N. melanocera* | -66.1374 | 10.37375 | Test |
| *M. eburnea* | -69.034 | -12.5425 | Test | *N. melanocera* | -66.3007 | -14.6401 | Test |
| *M. eburnea* | -78.0026 | -1.48369 | Test | *N. melanocera* | -67.1162 | -1.75394 | Test |
| *M. eburnea* | -71.2833 | -11.9447 | Test | *N. melanocera* | -67.2663 | -5.00825 | Test |
| *M. eburnea* | -74.7444 | 4.0055 | Test | *N. melanocera* | -67.5283 | -16.4064 | Test |
| *M. eburnea* | -75.9367 | 2.208611 | Test | *N. melanocera* | -67.614 | -2.75549 | Test |
| *M. eburnea* | -76.1172 | 1.726944 | Test | *N. melanocera* | -67.6833 | 10.35 | Test |
| *M. eburnea* | -74.416 | 4.2728 | Test | *N. melanocera* | -67.7267 | -16.1897 | Test |
| *M. eburnea* | -70.0297 | -4.3744 | Test | *N. melanocera* | -68.8725 | -3.37833 | Test |
| *M. eburnea* | -66.8958 | -4.88278 | Test | *N. melanocera* | -69.92 | -1.24 | Test |
| *M. favosa* | -60.5458 | 11.32299 | Train | *N. melanocera* | -70.1064 | -12.5582 | Test |
| *M. favosa* | -74.2212 | 11.15053 | Train | *N. melanocera* | -70.9357 | 4.53504 | Test |
| *M. favosa* | -58.155 | 6.800275 | Train | *N. melanocera* | -71.7264 | -1.48565 | Test |
| *M. favosa* | -74.25 | 10.93333 | Train | *N. melanocera* | -71.9409 | 6.39944 | Test |
| *M. favosa* | -63.5367 | 10.4895 | Train | *N. melanocera* | -72.0838 | 4.31285 | Test |
| *M. favosa* | -66.8833 | 10.5 | Train | *N. melanocera* | -72.4167 | 0.21667 | Test |
| *M. favosa* | -75.53 | 10.405 | Train | *N. melanocera* | -72.9559 | 4.09134 | Test |
| *M. favosa* | -75.1667 | 3.216667 | Train | *N. melanocera* | -73.2075 | 2.94121 | Test |
| *M. favosa* | -67.4167 | 8.933333 | Train | *N. melanocera* | -73.3141 | 4.23261 | Test |
| *M. favosa* | -74.1558 | 11.25703 | Train | *N. melanocera* | -73.4623 | 4.06117 | Test |
| *M. favosa* | -70.7275 | 7.238306 | Train | *N. melanocera* | -73.474 | 4.23757 | Test |
| *M. favosa* | -70.1814 | 11.71075 | Train | *N. melanocera* | -73.52 | 3.34 | Test |
| *M. favosa* | -70.1128 | 10.12949 | Train | *N. melanocera* | -73.5625 | 4.27291 | Test |
| *M. favosa* | -66.8167 | 10.43333 | Train | *N. melanocera* | -73.6429 | 4.14623 | Test |
| *M. favosa* | -72.2169 | 7.734167 | Train | *N. melanocera* | -73.7241 | 4.0098 | Test |
| *M. favosa* | -52.7142 | 5.08609 | Train | *N. melanocera* | -73.8068 | 3.92619 | Test |
| *M. favosa* | -71.145 | 8.598333 | Test | *N. melanocera* | -73.8357 | 4.2319 | Test |
| *M. favosa* | -75.0593 | 9.167581 | Test | *N. melanocera* | -73.9333 | 3.35 | Test |
| *M. favosa* | -52.3782 | 4.8886 | Test | *N. melanocera* | -75.0867 | -10.5767 | Test |
| *M. favosa* | -55.0508 | 5.8458 | Test | *N. melanocera* | -75.3583 | -10.76 | Test |
| *M. favosa* | -52.6437 | 5.15839 | Test | *N. melanocera* | -75.445 | -11.1283 | Test |
| *M. favosa* | -75.3522 | 9.4955 | Test | *N. melanocera* | -75.495 | 1.41669 | Test |
| *M. favosa* | -74.9494 | 4.5847 | Test | *N. melanocera* | -75.6167 | 1.61667 | Test |
| *M. favosa* | -56.2931 | 5.655078 | Test | *N. schultzei* | -66.3007 | -14.6401 | Train |
| *M. favosa* | -61.2983 | 10.71771 | Test | *N. schultzei* | -70.25 | -3.68333 | Train |
| *M. favosa* | -67.5828 | 5.660228 | Test | *N. schultzei* | -71.2578 | -12.6528 | Train |
| *M. favosa* | -63.4642 | 9.754958 | Test | *N. schultzei* | -60.1458 | -12.7406 | Train |
| *M. favosa* | -63.8567 | 11.05548 | Test | *N. schultzei* | -73.2472 | -3.7481 | Train |
| *M. favosa* | -69.9531 | 11.85067 | Test | *N. schultzei* | -72.3963 | -0.60139 | Train |
| *M. favosa* | -62.5656 | 10.63454 | Test | *N. schultzei* | -71.2833 | -11.9447 | Train |
| *M. favosa* | -70.2367 | 8.622742 | Test | *N. schultzei* | -52.7103 | 5.11546 | Train |
| *N. gaboi* | -75.91 | 1.95 | Train | *N. schultzei* | -50.7856 | -0.57911 | Train |
| *N. gaboi* | -75.6 | 1.62 | Train | *N. schultzei* | -66.2489 | 0.4578 | Train |
| *N. gaboi* | -75.77 | 5.77 | Train | *N. schultzei* | -59.8 | -12.75 | Train |
| *N. gaboi* | -74.19 | 5.36 | Train | *N. schultzei* | -60.025 | -3.10194 | Train |
| *N. gaboi* | -75.99 | 5.73 | Train | *N. schultzei* | -71.5724 | -1.44293 | Test |
| *N. gaboi* | -73.54 | 4.74 | Train | *N. schultzei* | -71.1903 | 2.178056 | Test |
| *N. gaboi* | -75.93 | 6.41 | Train | *N. schultzei* | -55.3872 | 3.418476 | Test |
| *N. gaboi* | -73.17 | 6.33 | Train | *N. schultzei* | -71.0917 | -12.42 | Test |
| *N. gaboi* | -75.38 | 3.59 | Train | *N. schultzei* | -67.75 | 4.333333 | Test |
| *N. gaboi* | -75.57 | 5.79 | Train | *N. schultzei* | -64.7 | -3.36667 | Test |
| *N. gaboi* | -74.53 | 4.74 | Train | *N. schultzei* | -61.8574 | -9.44913 | Test |
| *N. gaboi* | -74.6 | 5.07 | Train | *N. schultzei* | -71.4193 | -12.8923 | Test |
| *N. gaboi* | -74.39 | 5.13 | Train | *N. schultzei* | -53.2167 | 3.65 | Test |
| *N. gaboi* | -74.46 | 4.63 | Train | *N. schultzei* | -52.7028 | -6.2071 | Test |
| *N. gaboi* | -75.12 | 6.77 | Train | *N. schultzei* | -58.4333 | -3.05 | Test |
| *N. gaboi* | -73.94 | 5.51 | Train | *N. schultzei* | -67.0892 | -0.13028 | Test |
| *N. gaboi* | -75.43 | 10.32 | Train | *N. schultzei* | -47.6167 | -1.1167 | Test |
| *N. gaboi* | -74.15 | 5.12 | Train | *P. eutaeniata* | -73.4078 | 4.754722 | Train |
| *N. gaboi* | -73.24 | 6.7 | Train | *P. eutaeniata* | -74.3941 | 5.360931 | Train |
| *N. gaboi* | -74.91 | 3.57 | Train | *P. eutaeniata* | -73.8128 | 6.223889 | Train |
| *N. gaboi* | -74.54 | 4.55 | Train | *P. eutaeniata* | -80.0195 | -4.01822 | Train |
| *N. gaboi* | -75.23 | 4.44 | Train | *P. eutaeniata* | -74.1167 | 4.7 | Train |
| *N. gaboi* | -73.89 | 10.46 | Train | *P. eutaeniata* | -74.0653 | 4.368056 | Train |
| *N. gaboi* | -74.65 | 4.45 | Train | *P. eutaeniata* | -74.5667 | 5.266667 | Train |
| *N. gaboi* | -73.24 | 7.13 | Train | *P. eutaeniata* | -74.4184 | 4.275781 | Train |
| *N. gaboi* | -75.73 | 6.44 | Train | *P. eutaeniata* | -74.4695 | 4.764561 | Test |
| *N. gaboi* | -74.36 | 4.34 | Train | *P. eutaeniata* | -74.4639 | 4.6335 | Test |
| *N. gaboi* | -74.43 | 4.72 | Train | *P. eutaeniata* | -74.1611 | 5.132231 | Test |
| *N. gaboi* | -74.29 | 5.25 | Train | *P. eutaeniata* | -74.6253 | 4.849167 | Test |
| *N. gaboi* | -75.13 | 6.53 | Train | *P. eutaeniata* | -74.3896 | 4.407925 | Test |
| *N. gaboi* | -72.86 | 6.7 | Train | *P. eutaeniata* | -73.2203 | 6.009167 | Test |
| *N. gaboi* | -73.51 | 5.94 | Train | *P. eutaeniata* | -74.5352 | 4.180031 | Test |
| *N. gaboi* | -75.26 | 2.78 | Train | *P. eutaeniata* | -79.1831 | -1.76694 | Test |
| *N. gaboi* | -75.36 | 9.53 | Train | *P. eutaeniata* | -76.9177 | 2.783167 | Test |
| *N. gaboi* | -74.09 | 11.11 | Test | *P. opaca* | -84.0109 | 10.43919 | Train |
| *N. gaboi* | -74.87 | 3.73 | Test | *P. opaca* | -77.5786 | -0.7208 | Train |
| *N. gaboi* | -74.42 | 4.27 | Test | *P. opaca* | -84.6081 | 9.776494 | Train |
| *N. gaboi* | -74.39 | 5.36 | Test | *P. opaca* | -84.0804 | 10.32804 | Train |
| *N. gaboi* | -74.65 | 5.47 | Test | *P. opaca* | -83.7056 | 9.3194 | Train |
| *N. gaboi* | -74.8 | 4.3 | Test | *P. opaca* | -83.7833 | 10.2166 | Train |
| *N. gaboi* | -74.34 | 5 | Test | *P. opaca* | -84.7962 | 10.3043 | Train |
| *N. gaboi* | -73.81 | 6.22 | Test | *P. opaca* | -74.3428 | 5.002222 | Train |
| *N. gaboi* | -73.12 | 7.12 | Test | *P. opaca* | -83.5667 | 8.679096 | Test |
| *N. gaboi* | -74.48 | 5.19 | Test | *P. opaca* | -83.2273 | 8.680656 | Test |
| *N. gaboi* | -75.48 | 3.72 | Test | *P. opaca* | -83.4255 | 8.536614 | Test |
| *N. gaboi* | -75.94 | 2.21 | Test | *P. opaca* | -82.9563 | 9.519349 | Test |
| *N. gaboi* | -76.12 | 1.73 | Test | *P. opaca* | -84.0 | 9.66667 | Test |
| *N. gaboi* | -74.8 | 3.6 | Test | *P. opaca* | -83.3912 | 9.1591 | Test |
| *N. gaboi* | -74.15 | 3.9 | Test | *P. opaca* | -73.65 | 4.166667 | Test |
| *N. gaboi* | -75.9 | 6.05 | Test | *P. opaca* | -73.3499 | 4.5084 | Test |
| *N. gaboi* | -74.25 | 11.01 | Test | *P. opaca* | -91.2603 | 16.81707 | Test |
| *N. gaboi* | -72.57 | 6.41 | Test | *S. longula* | -56.1 | -1.53333 | Train |
| *N. gaboi* | -73.89 | 11.12 | Test | *S. longula* | -63.9033 | -8.76222 | Train |
| *N. gaboi* | -72.72 | 6.71 | Test | *S. longula* | -51.8167 | -7.35 | Train |
| *N. gaboi* | -73.26 | 6.47 | Test | *S. longula* | -47.9503 | -16.2525 | Train |
| *N. gaboi* | -74.35 | 4.62 | Test | *S. longula* | -67.81 | -9.97472 | Train |
| *N. gaboi* | -74.54 | 4.13 | Test | *S. longula* | -73.9006 | 2.969111 | Train |
| *N. gaboi* | -73.81 | 4.22 | Test | *S. longula* | -69 | -3 | Train |
| *N. gaboi* | -76.8 | 2.12 | Test | *S. longula* | -60.1458 | -12.7406 | Train |
| *N. gaboi* | -73.6 | 5.91 | Test | *S. longula* | -69.05 | -12.55 | Train |
| *N. gaboi* | -74.47 | 5 | Test | *S. longula* | -64.0083 | 3.299722 | Train |
| *N. gaboi* | -74.89 | 4.15 | Test | *S. longula* | -52.6911 | 5.108825 | Train |
| *N. gaboi* | -75.66 | 2.46 | Test | *S. longula* | -48.2772 | -18.9186 | Train |
| *N. gaboi* | -73.13 | 5.23 | Test | *S. longula* | -62.2044 | -1.30583 | Test |
| *N. gaboi* | -74.62 | 4.2 | Test | *S. longula* | -57.0333 | -1.06667 | Test |
| *N. gaboi* | -75.4 | 7.58 | Test | *S. longula* | -65.0 | -3.0 | Test |
| *N. gaboi* | -74.83 | 6.67 | Test | *S. longula* | -52.25 | -15.8833 | Test |
| *N. melanocera* | -71.0356 | -0.51279 | Train | *S. longula* | -64.7 | -3.36667 | Test |
| *N. melanocera* | -70.0452 | -3.52998 | Train | *S. longula* | -76.6 | -0.4 | Test |
| *N. melanocera* | -76.4597 | -0.47056 | Train | *S. longula* | -51.9956 | 4.389578 | Test |
| *N. melanocera* | -67.81 | -9.97472 | Train | *S. longula* | -58.8333 | -3.03333 | Test |
| *N. melanocera* | -72.7033 | 2.41012 | Train | *S. longula* | -58.4442 | -3.14306 | Test |
| *N. melanocera* | -67.6119 | -1.74194 | Train | *S. longula* | -55.8661 | -1.76556 | Test |
| *N. melanocera* | -66.0 | -3.0 | Train | *S. longula* | -47.81 | -21.17 | Test |
| *N. melanocera* | -73.7053 | 3.54483 | Train | *S. longula* | -48.5044 | -1.45583 | Test |
| *N. melanocera* | -70.25 | -3.68333 | Train | *S. longula* | -62.724 | -11.0747 | Test |
| *N. melanocera* | -67.0386 | 10.3455 | Train |  |  |  |  |

**Table S2.** Sets of variables used during model calibration and for producing final ecological niche models for the studied species.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Predictor sets | PC1 | PC2 | PC3 | PC4 | PC5 | PC6 | Species using set in final models |
| Set 1 | x | x | x | x | x | x |  |
| Set 2 | x | x | x | x | x |  | *M. eburnea* |
| Set 3 | x | x | x | x |  |  | *N. melanocera, P. opaca* |
| Set 4 | x | x | x |  |  |  | *F. paupera, M. favosa, N. gaboi, N. schultzei, P. eutaeniata, S. longula* |

**Table S3.** Details about the General Circulation Models (GCMs) used to project ecological niche models.

|  |  |
| --- | --- |
| GCM | Model center or group (Institute ID) |
| BCC-CSM 1-1 | Beijing Climate Center, China Meteorological Administration (BCC); <http://bcc.ncc-cma.net/> |
| CCSM4 | National Center for Atmospheric Research, USA (NCAR); <https://but.lt.ly/2NpvYaQ> |
| MIROC 5 | Atmosphere and Ocean Research Institute (University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC); <https://bit.ly/2ZXQcK9> |

**Table S4.** Parameter settings selected during model calibration, used for creating ecological niche models of the species. R. M. = regularization multiplier; F. C. = feature classes; Var. Set. = set of variables selected; p. ROC = *p* value derived from partial ROC; O. rate = omission rate.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| R. M. | F. C. | Var. Set | p. ROC | O. rate | Delta AICc | Parameters |
| *Frieseomelitta paupera* | | | | | | |
| 0.4 | q | Set 4 | 0 | 0 | 0 | 2 |
| 0.7 | q | Set 4 | 0 | 0 | 0.26 | 2 |
| *Melipona eburnea* | | | | | | |
| 3 | q | Set 2 | 0 | 0.18 | 0 | 2 |
| 2 | qp | Set 2 | 0 | 0.18 | 1.19 | 2 |
| 2 | lqp | Set 2 | 0 | 0.18 | 1.19 | 2 |
| *Melipona favosa* | | | | | | |
| 3 | lqp | Set 4 | 0 | 0.06 | 0 | 4 |
| 3 | qp | Set 4 | 0 | 0.06 | 1.83 | 2 |
| *Nannotrigona gaboi* | | | | | | |
| 0.1 | lqp | Set 4 | 0 | 0.06 | 0 | 9 |
| *Nannotrigona melanocera* | | | | | | |
| 0.7 | qp | Set 3 | 0 | 0 | 0 | 8 |
| 1 | qp | Set 3 | 0 | 0 | 1.98 | 8 |
| *Nannotrigona schultzei* | | | | | | |
| 0.7 | lq | Set 4 | 0 | 0.07 | 0 | 5 |
| *Paratrigona eutaeniata* | | | | | | |
| 0.1 | q | Set 4 | 0 | 0 | 0 | 3 |
| 0.4 | q | Set 4 | 0 | 0 | 0.13 | 3 |
| 0.7 | q | Set 4 | 0 | 0 | 0.41 | 3 |
| 1 | q | Set 4 | 0 | 0 | 0.80 | 3 |
| *Paratrigona opaca* | | | | | | |
| 0.1 | lp | Set 3 | 0 | 0 | 0 | 9 |
| *Scaura longula* | | | | | | |
| 0.1 | q | Set 4 | 0 | 0.07 | 0 | 3 |

**Table S5.** Summary of changes in suitable areas. Percentages are in reference to current suitable areas. Genus names: *F* = *Frieseomelitta*, *M* = *Melipona*, *N* = *Nannotrigona*, *P* = *Paratrigona*, *S* = *Scaura*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species | Scenario | Stable suitable | Gain | Loss |
| *F. paupera* | RCP 4.5 | 86.88 | 4.72 | 13.12 |
|  | RCP 8.5 | 81.64 | 5.37 | 18.36 |
| *M. eburnea* | RCP 4.5 | 44.07 | 10.77 | 55.93 |
|  | RCP 8.5 | 38.20 | 7.62 | 61.80 |
| *M. favosa* | RCP 4.5 | 63.75 | 61.11 | 36.25 |
|  | RCP 8.5 | 58.06 | 71.72 | 41.94 |
| *N. gaboi* | RCP 4.5 | 52.20 | 16.34 | 47.80 |
|  | RCP 8.5 | 43.20 | 14.62 | 56.80 |
| *N. melanocera* | RCP 4.5 | 84.32 | 7.89 | 15.68 |
|  | RCP 8.5 | 80.71 | 8.81 | 19.29 |
| *N. schultzei* | RCP 4.5 | 63.29 | 10.76 | 36.71 |
|  | RCP 8.5 | 48.41 | 16.68 | 51.59 |
| *P. eutaeniata* | RCP 4.5 | 52.36 | 8.00 | 47.64 |
|  | RCP 8.5 | 30.87 | 7.22 | 69.13 |
| *P. opaca* | RCP 4.5 | 88.39 | 18.51 | 11.61 |
|  | RCP 8.5 | 84.31 | 22.22 | 15.69 |
| *S. longula* | RCP 4.5 | 76.61 | 9.23 | 23.39 |
|  | RCP 8.5 | 67.71 | 11.16 | 32.29 |