



## RESEARCH ARTICLE - ANTS

## Ant Species Distribution Models Reveal Mixed Elevational Diversity Patterns in Complete Elevation Gradients: Past and Present Climatic Effects?

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### Abstract

The juxtaposition of climatic zones in tropical mountains is considered one of the leading causes of the high diversity of tropical mountains; high peaks block oceanic winds, causing mid-elevation peaks of precipitation and diversity. Also, historically wind-protected valleys may harbor high species richness because of climate stability. Despite this knowledge, the elevational patterns of many taxa and their drivers remain unsolved. We aimed to describe the spatial patterns of ants' diversity in the Jamapa River watershed in Mexico based on species distribution models of 253 ant species. Moreover, we intend to understand the relationship between ant diversity with the current climatic conditions and historical climatic stability. The watershed includes maximum elevations of 5636, 4282, and 2500 m from south to north and is exposed to the oceanic northeastern winds. Elevational patterns of species richness were consistent with theoretical predictions but changed south (mid-elevation peaks) to north (monotonic decrease) in the watershed. Species richness was positively associated with mean annual temperature and precipitation seasonality. Climatically stable sites harbored high species richness below 2100 m of elevation but low species richness above 2400 m, while the beta diversity showed the opposite pattern. We observed that present climatic conditions and historical climatic stability were essential drivers of ant diversity in the Jamapa River watershed. Elevational patterns of species richness were concordant with theoretical expectations. They changed from a monotonic decrease of diversity to marked mid-elevation peaks of species richness, presumably associated with the maximum height of the mountains.

### Introduction

Despite 220 years of investigation, Humboldt's enigma "What causes tropical mountains to be hyper-diverse?" remains partially unsolved (Rahbek et al., 2019). The juxtaposition of climatic zones within the topography of tropical mountains is considered one of the leading causes of the high biodiversity of tropical mountains (Rahbek et al., 1997; Ohlemüller et al., 2008). Climatic diversity in tropical mountains is associated with mountain ridge exposure to the predominant winds, the height of the peaks, and protected valleys (Rahbek et al., 2019).

Windward slopes of high mountains block oceanic humid winds, causing rain to fall at mid-elevation and potentially favoring net primary productivity (an ecological response) and diversity. On the other hand, inversion layers of cold air can favor stable climates in wind-protected valleys. Such valleys may have served as refuges (museums) and favored diversification (cradles) because of climate stability (evolutionary responses) (Fjeldså, 1999; Rahbek et al., 2019). Further, if valleys remain isolated long enough, high beta diversity among valleys is likely to increase the gamma diversity of tropical mountains (Körner, 2007).



Despite multiple examples of diverse tropical mountains, the contribution of the many factors driving diversity (e.g., peak heights, juxtaposed climates, productivity, museums, cradles, extinctions) needs to be clarified in most cases, limiting our understanding of local biodiverse tropical mountains. Because different mountains have different topographical, geological, and climatic characteristics (Körner et al., 2017), diversity patterns must be compared with caution (c.f., Sanders & Rahbek, 2012). Further, distinct biological groups respond differently to environmental gradients along the mountains (Rahbek, 1995; Graham et al., 2014; Perrigo et al., 2020). Spatial patterns of diversity in tropical mountains include monotonical decreases of diversity with elevation (Grytnes & McCain, 2007) and mid-elevation peaks of diversity (Rahbek & Graves, 2001; Lomolino, 2001), while other studies found no significant changes in diversity from low to relatively high elevations (c.f., Rahbek et al., 2019).

Therefore, research within watersheds with peaks of varied heights may prove advantageous in understanding the diversity of tropical mountains. The Jamapa River watershed in central Veracruz and eastern Puebla states in Mexico combine convenient traits to investigate diversity patterns from the lowlands up to the heights of the mountains. The Jamapa River watershed faces the humid Atlantic Ocean winds, blocked on the west side by mountains that decrease in height from south to north (5636, 4282, and 2500 m asl). Such differences in the height of the mountains are likely to create different environmental gradients at mid-elevation from north to south, with consequent effects on the spatial patterns of the diversity across the mountains of the Jamapa River watershed (c.f., Rahbek & Graves, 2001; Lomolino, 2001).

In this study, we used ecological niche models (Milesi & López, 2005) and species distribution models (Peterson & Soberón, 2012) of ants (Formicidae) to investigate the spatial patterns of diversity in the elevational range of a windward watershed. Ecological niche and species distribution models are robust methods to fill gaps in the Wallacean shortfall of the biological diversity, i.e., the spatial distribution of taxa (Hortal et al., 2015). These models rely on climatic and other abiotic environmental variables to generate hypotheses on the distribution of taxa. Thus, inferring the spatial distribution of a whole taxon based on climatic variables across a complete elevational gradient can help us understand the influence of climate on maintaining the high diversity of tropical mountains.

As a group, ants are found in all land ecosystems but in arctic zones. Ant diversity concentrates in tropics climates (Vásquez, 2011; Schultheiss et al., 2022), but few ant species ascend above 4000 m in elevation (Weber, 1943; Smith, 2015). Roughly half of the studies on ants' diversity along elevational gradients (18 mountain ranges worldwide) reported monotonic decreases in taxonomic diversity. Just over 25% of the studies reported mid-elevation peaks of species richness, whereas other studies reported no significant trends (Smith, 2015).

Ants are taxonomically well-studied in the Jamapa River watershed as specialists in the local research institute (INECOL) and other institutions have conducted research within the watershed for over 30 years (e.g., Rojas-Fernandez, 2001; Valenzuela-González et al., 2013; Ríos-Casanova, 2014; Dáttilo et al., 2020; Pérez-Toledo et al., 2022). Therefore, records of species of ants inhabiting the Jamapa River watershed are considered complete. In this study, we aim to fill the Wallacean shortfall of ants in the Jamapa River watershed and investigate the distributional patterns of the alpha and beta diversity concerning current climatic conditions and the historical climatic stability in the watershed. We seek to address the following research questions: (1) Are elevational patterns of ant species richness the same north to south of the Jamapa River watershed? (2) Do elevational patterns of ant species richness correlate with mean temperature and annual precipitation in the Jamapa River watershed? (3) Is beta diversity high at mid-elevations where different climatic regimes and vegetation types juxtapose (ecotones and canyons) in the Jamapa River watershed? (4) Are diversity patterns associated with climatic stability (precipitation or temperature) in the watershed?

Because humid oceanic winds blow predominately from the northeast, we predict that mid-elevation peaks of species richness will be associated with the high peaks (Pico de Orizaba: 5636 m asl, and Cofre de Perote: 4282 m asl) in the south and central section of the Jamapa River watershed, respectively. In contrast, we expect a monotonic decrease of diversity with elevation in the north section of the watershed as mountains are considerably lower than in the central and southern sections. Since elevational changes bring about changes in climate regimes and vegetation types (Hoorn et al., 2018), we expect high beta diversity in juxtaposed climatic zones where transitions of vegetation types happen, ecotones (Carvajal-Hernandez & Krömer, 2015; Gómez-Díaz et al., 2017) and protected valleys and canyons (Peterson et al., 1997). Also, we predict that diversity (alpha and beta) will be high in climatically stable zones of the watershed.

## Material and Methods

### *Study site*

The Jamapa River watershed (CNA, 1998; CONABIO, 2001) is in central Veracruz (18.74438 N, 97.26711 W and 19.74529 N, 95.91748 W), covers an area of 10,314 km<sup>2</sup> (ca. 0.5% of continental Mexico) extending from the windward slopes of the eastern mountains in the Trans Mexican Volcanic Belt: Pico de Orizaba (highest point, 5636 m asl) in the south of the watershed, Cofre de Perote (4282 m asl) in the central part and Astillero (2 m asl) in the north of the watershed. Humid oceanic winds blow predominantly from the northeast, and the mountains form a barrier in the west, very much running north to south (Körner et al., 2011; Salinas-Rodríguez et al., 2022).

### *Species selection and occurrence records*

Based on the data paper of Dáttilo et al. (2020), there were 282 ant species in the Jamapa River watershed (Table S1), of which 13 were introduced species and were excluded from the analyses (Table S2). We used all the records in the data paper and the available records in the Global Biodiversity Information Facility for all species native to Mexico reported for the Jamapa River watershed. We discarded all records lacking coordinates, those georeferenced out of the mainland of the American continent and those georeferenced away from the distributional range of each species. Then, we did a geographic filtering to remove duplicated records in the same grid cell (30'' arc). For those records collected before or after the time range covered by the climatic variables (1970-2000), we checked if the observed values for bio1, bio12, and bio15 (mean temperature, precipitation, and precipitation seasonality) fell within the interquartile range of all other records of the species. Those records with either of the three climatic variables beyond the interquartile ranges were discarded. After data cleaning, we modeled 253 species verified to be taxonomically resolved (Fisher & Fong, 2023), including 14 species with 1-9 spatially independent records (c.f., Stockwell & Peterson, 2002).

### *Environmental variables*

For the entire American continent, we used the 19 bioclimatic variables from the WorldClim-2 project with a grain of 30'' arc resolution (Fick & Hijmans, 2017). We used the function `geodata::worldclim_title` in the R programming language (R Core Team, 2022). We downloaded ten tiles to cover the continent. To these climatic tiles, we added layers of soil physical and chemical properties (bulk density, percentage content of slit, clay, sand, and gravel, and total carbon and organic carbon) of the topsoil (0-30 cm and subsoil (30-100 cm) as soil properties are likely determinants of nesting for many ant species in the tropics (Ryder-Wilkie et al., 2010). Then, we used the `raster::extract` function to obtain each record's climatic variables (19 bioclimatic and 14 soil variables).

### *Accessibility area*

To fulfill the Wallacean shortfall, knowing the entire distributional range of the species, we used a conservative approach in defining the accessibility area of the species, i.e., the historical area at reach through dispersion events for the species and where it is likely to occur, providing the environmental conditions are met (Barve et al., 2011). To this end, we used the Eco-provinces of Canada (Marshall et al., 1999), the Ecological Regions of the United States L-III (Omernik, 1987), the Biogeographic Provinces of Mexico (Morrone et al., 2017), and the Biogeographic Provinces of the Neotropics (Morrone, 2014). Polygons in the border of those regions were merged to eliminate political boundaries. Every polygon with two or more species records was considered part of the accessibility area. Then, based on the accessibility

area, we randomly selected four times as much presence data (c.f., Barbet-Massin et al., 2012) of background points. As described above, we extracted the environmental variables for the background points.

### *Calibration and evaluation of ecological niche models*

We conducted the calibration of the ENMs in two phases. The first phase consisted of applying a machine learning algorithm, random forest, on the presence and background points with 1000 iterations. Each tree processed a random subset of 80% of the presence-background points (response variable) and the 33 environmental variables (predictor variables). Each tree is a computationally exhaustive procedure in which each possible variable and cut-off point is evaluated independently and, therefore, is not affected by the correlation between climatic variables. The process is repeated for each partition of the data set until the internal variation of the subgroups exceeds the difference between their averages. Out of the 1000 trees, we recovered the most likely topology and the environmental variables that separated observation points from background points. Because highly correlated climatic variables will compete in every partition, with only one selected, the resulting consensus tree is unlikely to emerge from highly correlated variables (De'ath & Fabricius, 2000). We coded the procedure in R, which is available in the supplementary material (Supplementary 1).

In the second stage, we used the maxent algorithm to model the species' niche with the set of climatic variables selected by the random forest (Phillips & Dudik, 2008). This algorithm relies on the maximum entropy principle to calculate the most likely distribution of environmental suitability as a function of the difference between the localities of occurrence and the environment of the accessibility area. For the training stage, 60% of the data (presence-background points) was used through the `dismo::maxent` function (Hijmans et al., 2017) of the R statistical software (R Core Team, 2022).

We used the reserved 40% data set to validate the model. We calculated the receiver operating characteristic curve (ROC) and then the partial area under the curve (pAUC), which evaluates the model's ability to discriminate between presences and background points (Peterson et al., 2008). When randomly choosing a pair of cases, this test measures the probability that the model awards a higher probability to presence than to background for all possible pairs in the sample (van Proosdij et al., 2016). Subsequently, to assess the statistical significance of the AUC values, we performed the Mann-Whitney U test using the `Wilcox-test` function of the R statistical software (R Core Team, 2022).

### *Potential distribution models*

For each of the models generated by species that resulted in a statistically significant AUC value ( $p < 0.05$ ), we transformed the continuous suitability projection to a binary projection based on the cut-off threshold of the 10th percentile of the calibration records (Bosso et al., 2013).

### *Spatial patterns of diversity*

Based on the predicted distribution of each species within the watershed, 253 occurrence maps generated in this study were considered to construct a presence/absence matrix (PAM) with 12749 rows (raster cells in the Jamapa River watershed) and 253 columns corresponding to each of the modeled species and an extra column with the ID of the cells. Then, the sum of each row in the matrix, excluding the ID of the cells, was spatially projected to obtain a species richness raster. Also, we calculated beta diversity considering the composition of each focal cell and its 16 neighboring cells. We employed Sørensen's dissimilarity coefficient for this comparison, using the `betapart::beta.pair` function (Baselga et al., 2018) of the R statistical software (R Core Team, 2022). The Sørensen index allowed us to relate the number of shared species to the arithmetic mean of the species in the focal cell and the neighboring cells.

### *Climatic stability*

The coefficient of variation of the monthly precipitation estimates and mean temperature from three periods. The last interglacial period was around 120,000 years before the present (Otto-Bliesner et al., 2006); the last glacial maximum was 21,000 years in the past, and the mid-Holocene was 6,000 years ago (Braconnot et al., 2007). Then, estimates of climatic stability on precipitation and mean temperature were multiplicatively combined in a single raster.

### *Statistical analysis*

We used generalized additive models (GAM) to test the relationship of species richness with the main climatic variables (mean temperature, annual precipitation, and precipitation seasonality). GAMs are an extension of traditional generalized linear models that incorporate smoothing. We used the `mgvc::gam` function (Wood & Wood, 2015) in R (R Core Team, 2022). We defined six transects running East to West to account for potential changes in species richness relationships with climatic variables due to large volcanos in the south and central sections of the Jamapa River watershed. We used the transects as a fixed factor in the model. We fitted the model with penalized cubic regression spline smooth that allows the fitting of humps (Wood, 2017). We estimated the parameters under the gamma probability distribution with the inverse link function. For climatic stability, we fitted non-parametric generalized linear models. Models were fitted using the rank transformation of the response variables (alpha and beta diversities) following the logic and algebraic proofs of Conover and Ima (1981) and previous experiences (Ruiz-Guerra et al. 2010; González de León et al. 2016). We used the ID of 11 elevational belts as the primary fixed factor. Elevational belts were 100 m wide and separated at least 100 m from any other belt (0-100, 200-300, 400-500, 1000-1100, 1600-1700, 1800-1900, 2000-2100, 2200-2300, 2400-2500,

2600-2700, 2800-2900). Each belt's sites (raster cells) were classified as low or high climatic stability based on the 0.25 threshold. The analysis did not include belts with less than five sites of either category. The low/high climatic stability factor was nested within the elevational transects to restrict the model to the comparisons in diversity between climatic stability levels within each transect (Sokal & Rohlf, 1987).

## **Results**

Of the 253 modeled species, the species with the smallest predicted distribution in the watershed was *Nylanderia parvula* (< 0.04%), restricted to a few sites between 410 and 460 m altitude in the southern end. In contrast, nine species (ca. 3.5% of the modeled species) were predicted to occupy at least 95% of the watershed (*Camponotus senex*, *Crematogaster corvina*, *Hypoponera opacior*, *Labidus praedator*, *Neivamyrmex swainsonii*, *Pheidole harrisonfordi*, *Pheidole oaxacana*, *Pseudomyrmex boopis* and *Stenamma felixi*). Also, 149 species (58.8%) would occupy at least 50% of the area in the watershed (Table S3).

### *Alpha diversity*

The geographic pattern of predicted richness in the Jamapa River watershed showed a gradient in which richness decreased from the lowlands (east) to the highlands (west) but also revealed a marked increase in potential richness at mid-elevations, between 600 and 1400 m elevation in the southern section of the watershed, and between 800 and 1400 m elevation in the central section, while in the northern section, species richness gradually decreased from the lowlands to the highlands (Figure 1).

The GAM models showed a positive correlation between mean annual temperature (BIO1) and potential species richness with  $R^2$ -adjusted = 0.90. Above 15 °C, all six transects showed mid-range peaks in species richness, with peaks increasing in magnitude from north to south of the watershed, and the highest points of the peaks were between 17 and 21 °C (Figure 2a). While precipitation (BIO12) showed no correlation with species richness (Figure 2b), species richness increased as precipitation seasonality (BIO15) also increased and was similar in the five analyzed transects (Figure 2c).

Species richness also showed a mixed pattern regarding climatic stability (Figure 3). The lowest-elevation belt (0-100 m) showed no significant differences between low and high climatic stability sites (Figure 3a). In contrast, the remaining elevation segments below 2100 m showed significant differences between low and high-climatic stability areas. Areas of high climatic stability harbored more species richness than those of low climatic stability (Fig. 3b-g). On the other hand, elevational segments above 2300 m showed the opposite pattern with low species richness in areas of high climatic stability compared to low climatic stability areas where higher species richness was predicted (Fig 3i-k).

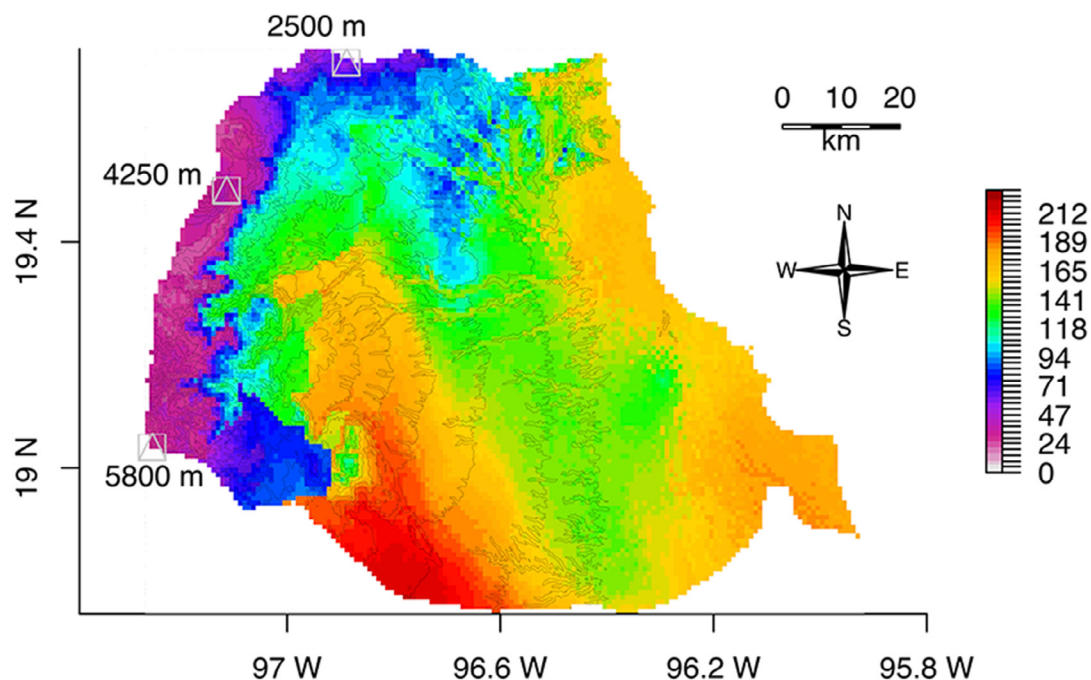


**Fig 1.** Predicted potential ant species richness in the Jamapa River watershed. Elevation intervals are separated by 200 m.

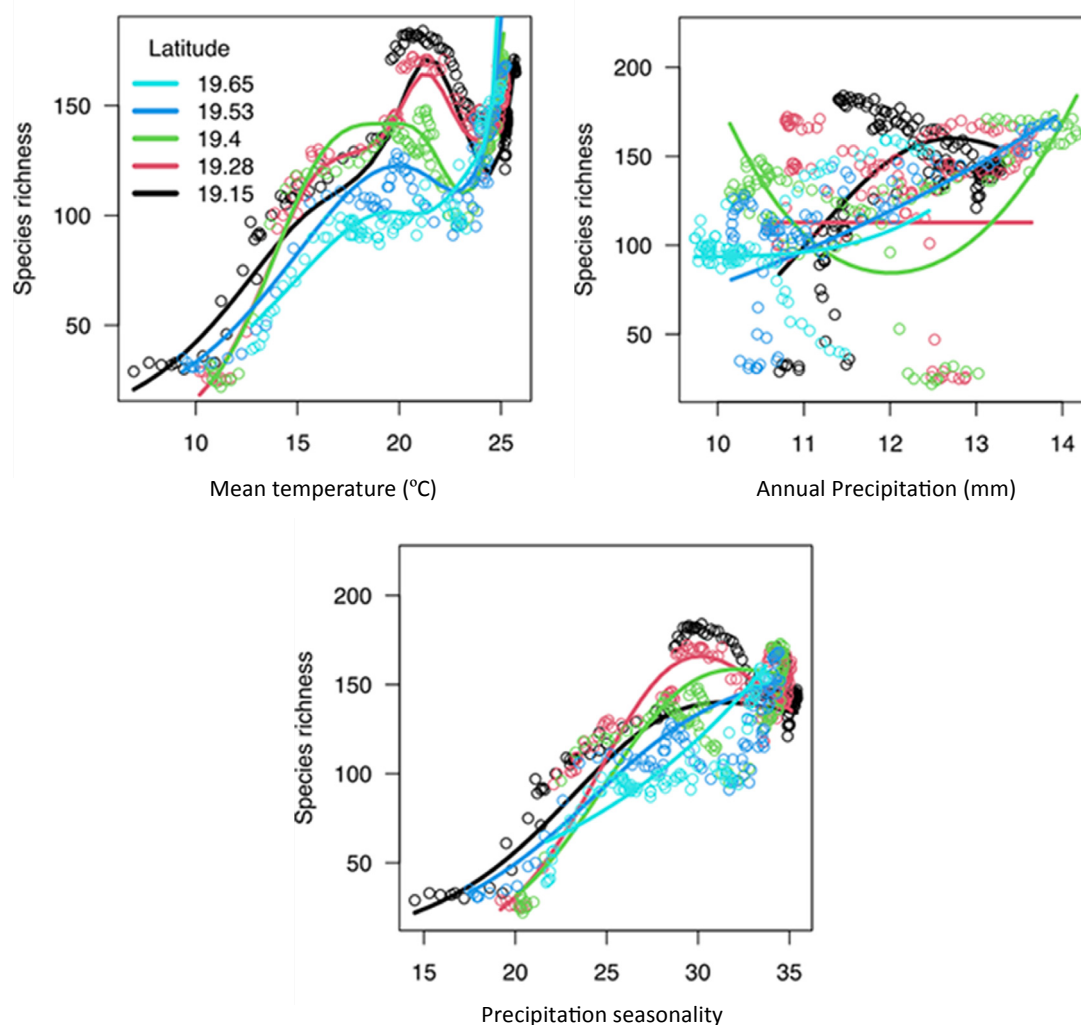


**Fig 2.** Relationship of ant species richness with (a) mean annual temperature (BIO1) with  $r^2 = 0.93$ , (b) annual precipitation (BIO12) with  $r^2 = 0.13$  and (c) precipitation seasonality (BIO15) with  $r^2 = 0.85$ , using five elevational transects at different latitudes. Lines were fitted with generalized additive models based on logarithmic values of species richness and predictions back transformed for graphical representation.

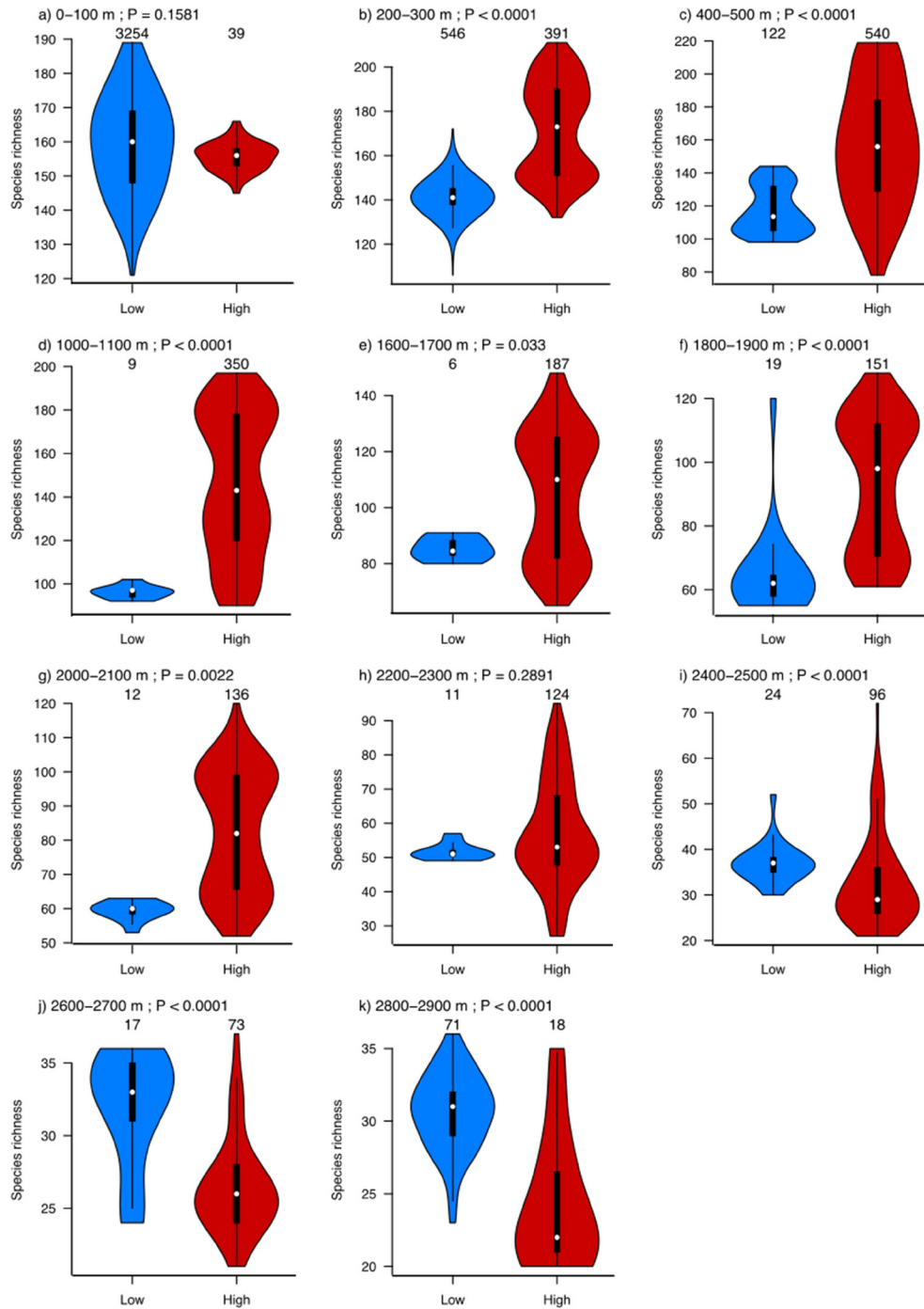


**Fig 3.** Ant species richness as a function of climatic stability across 11 elevational 100 m wide belts (a-k). Low climatic stability was defined as  $< 0.25$ , while high climatic stability was  $> 0.25$ . probability values were derived from contrast tests (a t-test in which the standard error is estimated from the linear predictor of the model) between the two climatic stability categories in each belt. The model was a generalized linear model with a gamma error structure and inverse link function.

### Beta diversity

The beta diversity of the cells about their 16 neighboring cells was low (Figure 4). Fifty-four percent of the area in the Jamapa River watershed had a Sørensen dissimilarity coefficient value less than 0.025, and only 10.2% of the cells in the watershed had a value greater than 0.1. High beta diversity was observed in the upper part of the elevation gradient, the north of the watershed (0.1 to 0.2), and some gorges in the central part (0.05 to 0.1).

Regarding climatic stability, we observed that at the lowest elevation belt (0-100 m), beta-diversity was higher in high climatically stable sites (Figure 5a). However, in the elevation belts between 200 and 1900 m, we observed higher beta-diversity in less climatically stable sites compared to climatically stable sites (Figure 5b-f). Then, from 2200 up to 2900 m, more climatically stable sites were, again, more beta diverse than less climatically stable zones (Figure 5h-k).

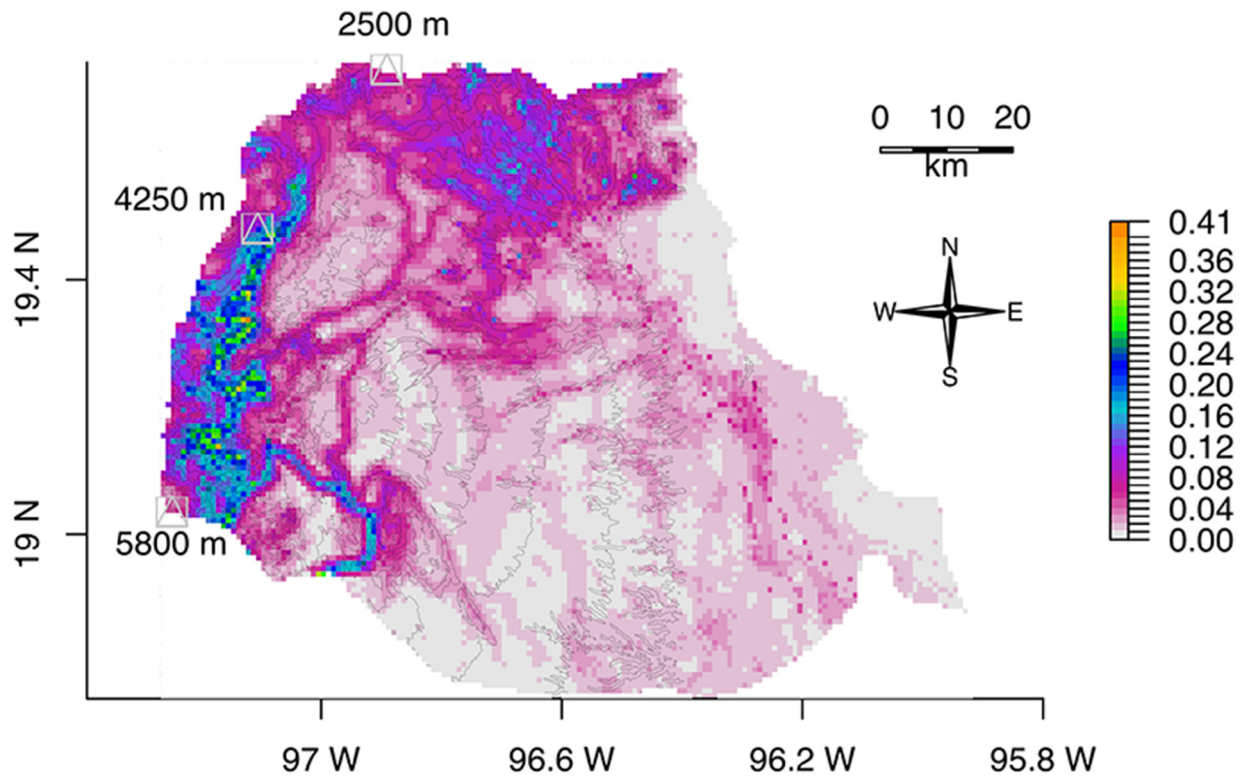


**Fig 4.** Prediction of Sørensen beta diversity of ants in the Jamapa River watershed. Elevation intervals are separated by 200 m.

## Discussion

The Jamapa River watershed includes full elevational gradients from sea levels up to 2500 and 4658 m and a wide range of biodiversity distributional patterns across the lowlands and the mountains. The northern portion of the watershed showed the most straightforward expected pattern for species richness. Here, species richness decreased monotonically from the lowlands to the mountains at most 2500 m in elevation. Further, species richness correlated linearly and positively with mean temperature. This elevational pattern has been reported for many taxa, including lake sediment bacteria (Zeng et al., 2016), woody vegetation (Cirimwami et al., 2019; Griffiths et al., 2021), reptiles (McCain, 2010) and ants (Kunene et al., 2022), although what are the actual drivers of changes in species richness still unclear and likely vary among taxonomic and functional groups, the specific location and orientation of the watersheds in the mountains (Kluge et al., 2006; Irl et al., 2015; Song et al., 2021). In this study, mean temperature correlated significantly with ant species richness, while precipitation did not.

In the central and southern sections of the watershed, where mountains reached well above 4000 m, there were evident mid-elevation peaks in species richness, especially in the southern end of the watershed, where species richness halfway up the mountains was higher than anywhere else. Mid-elevation humps of diversity have been observed in other tropical mountain, including various biological groups

such as vascular epiphytes (Krömer et al., 2005; Cardelús et al., 2006), vascular plants (Zhou et al., 2019), ferns (Syfert et al., 2018) and also ants (Nowrouzi et al., 2016). In our study, mid-elevation peaks in species richness also correlated closely with mean temperature, although trends were nonlinear. Mark humps in species richness were observed between 17 and 21°C, with humps occurring at warmer temperatures towards the south of the watershed. This pattern suggests that mountain height may push mid-elevation peaks of diversity down the mountain to warmer conditions. Besides, changes in temperature with elevation, high mountains exposed to humid winds from the ocean block clouds and cause high precipitation at mid-elevations, which has been taught as one of the drivers of high productivity and diversity (Currie, 1991; Kreft & Jetz, 2007; Rapp & Silman, 2012).

Further, species richness increased with precipitation seasonality, suggesting different phenologies among ant species could contribute to increased species richness. Ants' phenology may respond to the availability of different resources during the seasons in highly seasonal sites (Andersen, 1986). This pattern is concordant with the known diversity of ants not only in terms of species but also in diets and behavior that allow ants to distribute in most terrestrial environments (Decaëns et al., 2002; Lach et al., 2010; Del Toro et al., 2012;). This pattern has also been observed for other biological groups, such as lianas, which are more species-rich in seasonally dry forests than evergreen forests in Panama (Parolari et al., 2020).

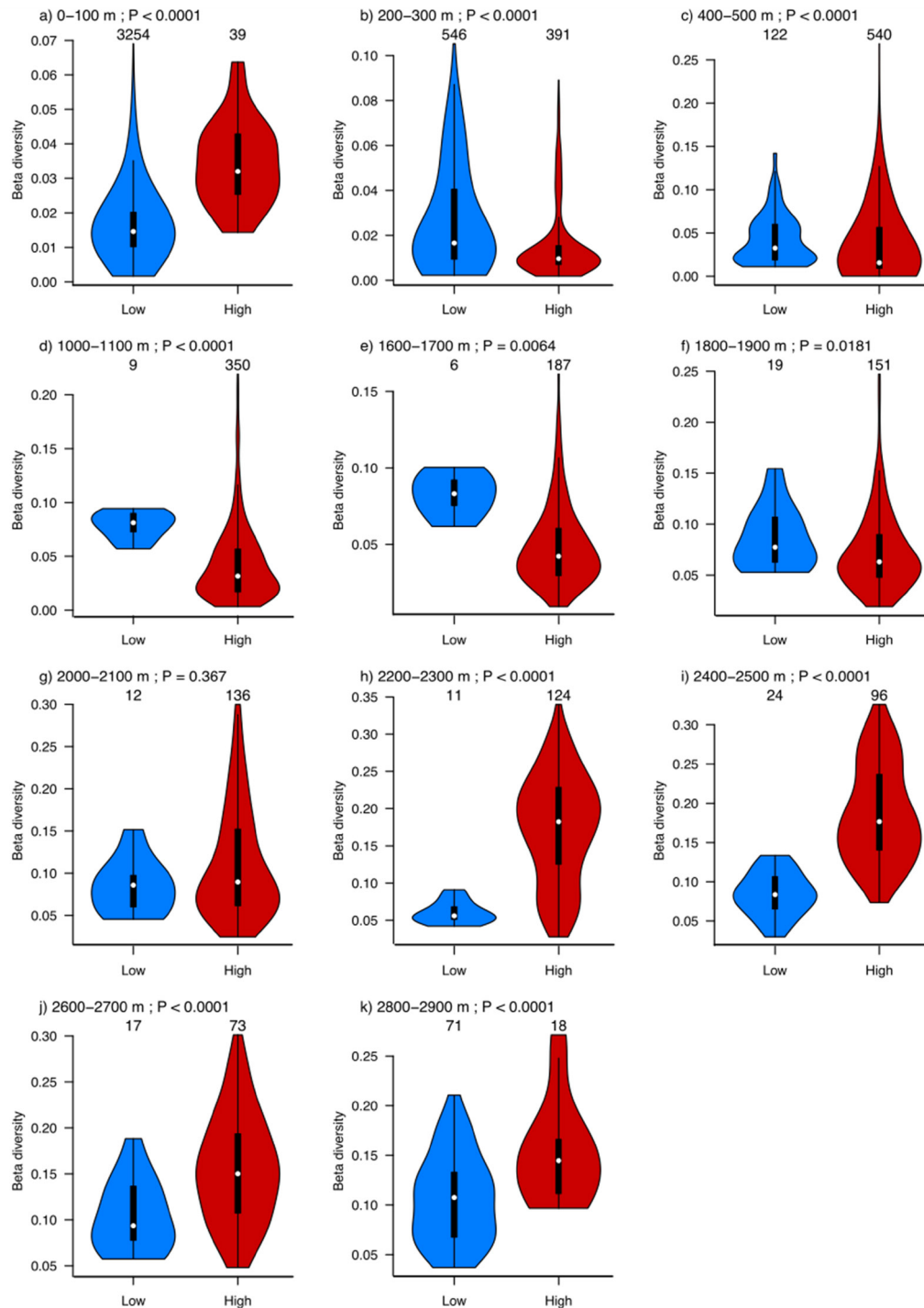


**Fig 5.** Sørensen beta diversity of ants as a function of climatic stability across 11 elevational 100 m wide belts (a-k). Low climatic stability was defined as  $< 0.25$ , while high climatic stability was  $> 0.25$ . probability values were derived from contrast tests (a t-test in which the standard error is estimated from the linear predictor of the model) between the two climatic stability categories in each belt. The model was a generalized linear model with a gamma error structure and inverse link function.

Alternatively, long-lasting climatic stability favors niche specialization along with low extinction rates, which may vary among lineages, thus favoring local alpha-diversity with a blend of derive and relic taxa (Werneck et al., 2012; Gao & Liu, 2018), although there is some evidence showing that the distribution of derived and old and relic lineages are spatially separated (Sonne et al. 2022; González-Orozco 2023; Gopal et al. 2023). Nonetheless, cloud forests, located halfway up the mountains, are species-rich zones and harbor numerous

species of restricted distribution (Cooper et al. 2022; Sonne et al. 2022; González-Orozco 2023). Here, we evaluated the climatic stability over the past 120,000 years and found it correlates with alpha and beta-diversity, but trends changed from the low land to the heights in the mountains. Species richness was high in climatically stable sites in the lowlands and up to 2100 m in the mountains. Above 2300 m of elevation, climatically stable zones harbored low species-rich communities than more climatically variable zones.

Regarding beta diversity, we observed the opposite pattern: low beta diversity in climatically stable zones in the lowlands and up to 2000 m in elevation and higher beta diversity in climatically stable zones above 2200 m in elevation. This finding suggests that at 2100 m of elevation and below, climatically stable zones accumulate a high number of species, presumably because of niche specialization and the conservation of old lineages favored by predictable climatic conditions, while above 2300 m of elevation, climatically stable zones harbored fewer species than those zones with more considerable climatic variability. This contradictory result suggests that climatic stability above 2300 m means constantly unfavorable climatic conditions that may limit resource availability (Girardin et al., 2010) and, therefore, low species richness. In contrast, climatically variable zones high in the mountains may allow species to coexist with different phenologies or a relatively large number of species to use resources during the more favorable season (Mellard et al., 2019). Both possibilities need further investigation.

The use of predictive techniques to explore geographical patterns of the distribution of diversity is a valuable opportunity to fulfill the Wallacean shortfall, i.e., on the distribution of biodiversity. Evidence supports the congruency of patterns based on actual records, and those based on species distribution models are well correlated (Sosa & Loera, 2017). However, alpha diversity richness may be overestimated (Mateo et al., 2012). Nonetheless, using predictive models of the distribution of ants in the Jamapa River watershed revealed spatial patterns of alpha beta diversity that match the predictions and further highlight the influence of high mountains in producing diversity peaks at mid-elevations. In the south of the watershed, the mid-elevation peaks of diversity occurred at warmer temperatures than those in the central section (south to north) of the watershed.

In contrast, in the north of the watershed, there were no mid-elevation peaks of alpha diversity. Thus, elevational patterns of diversity are not only susceptible to the specific geographic location of the mountains (Sanders & Rahbek, 2012; Guo et al., 2013; Körner et al., 2017) but also the specifics of the taxonomic or functional group surveyed (Rahbek, 1995) but also the specific location and orientation of elevational transects within the mountains or whole watersheds. Therefore, achieving a more comprehensive understanding of the spatial patterns of biodiversity across elevational gradients requires multiple transects in each region to adequately represent the heterogeneity that the height of mountains may cause.

Overall, we showed that niche and species distribution models of the myrmecofauna of the Jamapa River watershed produced elevational patterns of species concordant with theoretical expectations. Further, we showed that those patterns change from a monotonic decrease in diversity to marked mid-elevation peaks of species richness, presumably associated with the maximum high of the mountains that intercept the predominantly northeastern winds from the Gulf of Mexico. Further, we observed that present and historical

climatic conditions are essential drivers of ants diversity in the Jamapa River watershed.

### Authors' Contributions

SP-B: investigation; resources; visualization; writing-original draft preparation; writing-review and editing.

AL-N: conceptualization; methodology; resources; supervision; writing-review and editing.

RG: conceptualization; data curation; formal analysis; investigation; methodology; resources; software; supervision; validation; visualization; writing-review and editing.

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## Supplementary Tables

**Table S1.** List of modeled species of ants of the Jamapa River watershed in Central Veracruz, Mexico. 10P, tenth percentile of suitability predictions used as binarization threshold; TSS, true skill statistic; FOR, false omission rate; AUCp, partial area under the curve, including the minimum (Min), first (Q1), second (Q2) and third quartile (Q3) and the maximum value based on 500 random subsets of validation data; P, probability of the one sample Wilcoxon test on AUCp values. The following species also reported for the Jamapa River watershed were excluded from the analyses because of insufficient records: *Adelomyrmex doriae*, *Camponotus conspicuus sharpi*, *Colobopsis abdita*, *C. etiolata*, *C. mathildeae*, *Leptothorax striatulus*, *Dorymyrmex smithi*, *Nylanderia austroccidua*, *Paratrechina austroccidua*, *Proceratium convexiceps*, *Strumigenys crementata*, *S. oconitilloae*, *S. sevesta*, *S. turpis*, *Temnothorax striatulus* and *Trachymyrmex squamulifer*.

| Subfamily/Species                                  | 10P   | TSS   | FOR   | AUCp  |       |        |        |         | P       |
|----------------------------------------------------|-------|-------|-------|-------|-------|--------|--------|---------|---------|
|                                                    |       |       |       | Min   | Q1    | Q2     | Q3     | Max     |         |
| Amblyoponinae                                      |       |       |       |       |       |        |        |         |         |
| <i>Fulakora orizabana</i> (Brown, 1960)            | 0.325 | 0.822 | 0.022 | 4.8   | 5.3   | 5.7    | 81.2   | 437.1   | < 0.001 |
| Dolichoderinae                                     |       |       |       |       |       |        |        |         |         |
| <i>Azteca alfari</i> Emery, 1893                   | 0.456 | 0.858 | 0.012 | 27.6  | 39.6  | 43.5   | 56.3   | 228.0   | < 0.001 |
| <i>Azteca gnava</i> Forel, 1906                    | 0.373 | 0.842 | 0.008 | 53.0  | 180.7 | 352.6  | 580.8  | 8321.1  | < 0.001 |
| <i>Azteca nigricans</i> Forel, 1899                | 0.580 | 0.908 | 0.008 | 191.4 | 673.3 | 1078.9 | 2398.7 | 5038.3  | < 0.001 |
| <i>Azteca velox</i> Forel, 1899                    | 0.468 | 0.811 | 0.014 | 34.0  | 42.8  | 50.2   | 61.1   | 141.3   | < 0.001 |
| <i>Dolichoderus diversus</i> Emery, 1894           | 0.431 | 0.823 | 0.024 | 3.1   | 3.2   | 3.4    | 67.0   | 226.1   | < 0.001 |
| <i>Dolichoderus lutosus</i> (Smith, 1858)          | 0.394 | 0.804 | 0.021 | 23.9  | 31.6  | 37.3   | 59.9   | 159.1   | < 0.001 |
| <i>Dorymyrmex bicolor</i> Wheeler, 1906            | 0.242 | 0.854 | 0.020 | 6.8   | 7.1   | 7.3    | 7.5    | 29.6    | < 0.001 |
| <i>Dorymyrmex insanus</i> (Buckley, 1866)          | 0.448 | 0.809 | 0.027 | 5.3   | 5.7   | 5.8    | 6.6    | 7.4     | < 0.001 |
| <i>Forelius damiani</i> Guerrero & Fernández, 2008 | 0.204 | 0.851 | 0.011 | 22.9  | 35.0  | 46.2   | 56.5   | 1088.3  | < 0.001 |
| <i>Forelius pruinosus</i> (Roger, 1863)            | 0.415 | 0.797 | 0.025 | 6.1   | 6.5   | 6.6    | 6.8    | 8.3     | < 0.001 |
| <i>Linepithema dispertitum</i> (Forel, 1885)       | 0.350 | 0.84  | 0.022 | 21.5  | 35.8  | 44.2   | 69.8   | 2858.8  | < 0.001 |
| <i>Tapinoma litorale</i> Wheeler, 1905             | 0.525 | 0.849 | 0.016 | 42.8  | 61.1  | 70.6   | 99.9   | 479.6   | < 0.001 |
| <i>Tapinoma ramulorum</i> Emery, 1896              | 0.494 | 0.839 | 0.012 | 16.6  | 18.7  | 20.3   | 22.5   | 40.1    | < 0.001 |
| Dorylinae                                          |       |       |       |       |       |        |        |         |         |
| <i>Cheliomyrmex morosus</i> (Smith, 1859)          | 0.365 | 0.778 | 0.031 | 12.1  | 14.4  | 16.0   | 17.6   | 94.8    | < 0.001 |
| <i>Eciton burchellii</i> (Westwood, 1842)          | 0.445 | 0.799 | 0.009 | 21.7  | 24.1  | 25.1   | 26.2   | 34.0    | < 0.001 |
| <i>Eciton mexicanum</i> Roger, 1863                | 0.335 | 0.829 | 0.009 | 24.0  | 30.0  | 34.1   | 37.5   | 109.7   | < 0.001 |
| <i>Eciton vagans</i> (Olivier, 1792)               | 0.377 | 0.816 | 0.012 | 50.8  | 67.1  | 75.4   | 91.6   | 170.1   | < 0.001 |
| <i>Labidus coecus</i> (Latreille, 1802)            | 0.334 | 0.778 | 0.022 | 5.6   | 5.9   | 6.1    | 6.6    | 16.2    | < 0.001 |
| <i>Labidus praedator</i> (Smith, 1858)             | 0.243 | 0.816 | 0.017 | 15.0  | 18.0  | 19.2   | 21.5   | 25.3    | < 0.001 |
| <i>Neivamyrmex adnepos</i> (Wheeler, 1922)         | 0.627 | 0.975 | 0.000 | 52.8  | 142.8 | 247.0  | 377.0  | 510.9   | < 0.001 |
| <i>Neivamyrmex cornutus</i> Watkins, 1975          | 0.499 | 0.842 | 0.033 | 41.7  | 91.2  | 144.9  | 375.4  | 713.3   | < 0.001 |
| <i>Neivamyrmex halidaii</i> (Shuckard, 1840)       | 0.632 | 0.785 | 0.016 | 41.3  | 78.3  | 97.3   | 133.6  | 14796.3 | < 0.001 |
| <i>Neivamyrmex harrisii</i> (Haldeman, 1852)       | 0.301 | 0.871 | 0.012 | 53.4  | 54.2  | 65.5   | 73.6   | 111.0   | 0.008   |
| <i>Neivamyrmex impudens</i> (Mann, 1922)           | 0.479 | 0.691 | 0.031 | 1.6   | 60.8  | 133.8  | 285.8  | 583.7   | < 0.001 |
| <i>Neivamyrmex nigrescens</i> (Cresson, 1872)      |       | 0.845 | 0.016 | 24.9  | 29.2  | 31.4   | 33.6   | 65.9    | < 0.001 |
| <i>Neivamyrmex opacithorax</i> (Emery, 1894)       | 0.647 | 0.856 | 0.012 | 18.2  | 20.6  | 22.8   | 40.8   | 82.5    | < 0.001 |
| <i>Neivamyrmex pauxillus</i> (Wheeler, 1903)       | 0.487 | 0.769 | 0.000 | 1.0   | 20.1  | 29.7   | 91.0   | 171.5   | < 0.001 |
| <i>Neivamyrmex pilosus</i> (Smith, 1858)           | 0.503 | 0.65  | 0.028 | 4.4   | 4.9   | 5.2    | 7.9    | 25.7    | < 0.001 |
| <i>Neivamyrmex sumichrasti</i> (Norton, 1868)      | 0.318 | 0.82  | 0.016 | 31.5  | 194.2 | 296.1  | 531.4  | 970.4   | < 0.001 |
| <i>Neivamyrmex swainsonii</i> (Shuckard, 1840)     | 0.370 | 0.841 | 0.013 | 14.1  | 16.0  | 17.1   | 41.0   | 70.6    | < 0.001 |
| <i>Neivamyrmex tristis</i> (Forel, 1901)           | 0.597 | 0.818 | 0.000 | 0.0   | 0.0   | 0.0    | 0.0    | 0.0     | < 0.001 |
| <i>Nomamyrmex esenbeckii</i> (Westwood, 1842)      | 0.492 | 0.777 | 0.017 | 15.1  | 18.6  | 20.1   | 24.4   | 47.6    | < 0.001 |
| <i>Syscia augustae</i> (Wheeler, 1902)             | 0.384 | 0.102 | 0.063 | 0.6   | 5.1   | 8.4    | 16.2   | 8277.7  | < 0.001 |

| Subfamily/Species                                         | 10P   | TSS   | FOR   | AUCp  |       |       |          |          | P       |
|-----------------------------------------------------------|-------|-------|-------|-------|-------|-------|----------|----------|---------|
|                                                           |       |       |       | Min   | Q1    | Q2    | Q3       | Max      |         |
| Ectatomminae                                              |       |       |       |       |       |       |          |          |         |
| <i>Ectatomma parasiticum</i> Feitosa & Fresneau, 2008     | 0.334 | 1     | 0.000 | 0.0   | 0.0   | 0.0   | 0.0      | 0.0      | < 0.001 |
| <i>Ectatomma ruidum</i> (Roger, 1860)                     | 0.362 | 0.787 | 0.004 | 0.0   | 0.0   | 0.0   | 0.0      | 0.0      | < 0.001 |
| <i>Ectatomma tuberculatum</i> (Olivier, 1792)             | 0.275 | 0.803 | 0.024 | 12.8  | 14.6  | 16.0  | 17.9     | 26.2     | < 0.001 |
| <i>Gnamptogenys hartmani</i> (Wheeler, 1915)              | 0.293 | 0.664 | 0.038 | 15.4  | 32.1  | 42.7  | 59.7     | 172.3    | < 0.001 |
| <i>Gnamptogenys striatula</i> Mayr, 1884                  | 0.632 | 0.818 | 0.022 | 3.1   | 3.2   | 3.3   | 4.7      | 69.3     | < 0.001 |
| <i>Gnamptogenys sulcata</i> (Smith, 1858)                 |       | 0.854 | 0.012 | 34.7  | 53.5  | 63.8  | 96.4     | 333.1    | < 0.001 |
| <i>Holcaponera bisulca</i> (Kempf & Brown, 1968)          | 0.425 | 0.881 | 0.010 | 27.6  | 40.2  | 46.0  | 53.7     | 87.1     | < 0.001 |
| <i>Holcaponera strigata</i> (Norton, 1868)                | 0.418 | 0.842 | 0.010 | 14.9  | 16.3  | 16.9  | 18.7     | 46.7     | < 0.001 |
| <i>Typhlomymex prolatus</i> Brown, 1965                   | 0.482 | 1     | 0.000 | 0.0   | 0.0   | 0.0   | 0.0      | 0.0      | < 0.001 |
| Formicinae                                                |       |       |       |       |       |       |          |          |         |
| <i>Acropyga exsanguis</i> (Wheeler, 1909)                 | 0.312 | 0.818 | 0.013 | 10.8  | 13.7  | 15.1  | 32.6     | 86.9     | < 0.001 |
| <i>Brachymyrmex depilis</i> Emery, 1893                   | 0.437 | 0.823 | 0.029 | 3.1   | 3.2   | 3.2   | 3.2      | 13.5     | < 0.001 |
| <i>Brachymyrmex minutus</i> Forel, 1893                   | 0.293 | 0.822 | 0.007 | 19.7  | 23.0  | 24.8  | 27.7     | 44.0     | < 0.001 |
| <i>Brachymyrmex musculus</i> Forel, 1899                  | 0.511 | 0.812 | 0.028 | 63.7  | 87.9  | 113.7 | 211.3    | 362.0    | < 0.001 |
| <i>Brachymyrmex obscurior</i> Forel, 1893                 | 0.347 | 0.779 | 0.024 | 17.4  | 23.1  | 24.7  | 27.0     | 36.4     | < 0.001 |
| <i>Camponotus abscisus</i> Roger, 1863                    | 0.477 | 0.87  | 0.015 | 54.1  | 72.0  | 88.5  | 114.1    | 7515.9   | < 0.001 |
| <i>Camponotus albicoxis</i> Forel, 1899                   | 0.439 | 0.766 | 0.020 | 13.5  | 102.0 | 162.7 | 261.4    | 8942.8   | < 0.001 |
| <i>Camponotus atriceps</i> (Smith, 1858)                  | 0.432 | 0.768 | 0.016 | 11.8  | 12.9  | 13.3  | 13.9     | 20.5     | < 0.001 |
| <i>Camponotus brettsei</i> Forel, 1899                    | 0.292 | 0.691 | 0.012 | 19.4  | 29.6  | 39.8  | 58.8     | 1361.9   | < 0.001 |
| <i>Camponotus claviscapus</i> Forel, 1899                 | 0.418 | 0.874 | 0.010 | 30.2  | 41.9  | 50.2  | 76.5     | 375.4    | < 0.001 |
| <i>Camponotus coloratus</i> Forel, 1904                   | 0.429 | 0.851 | 0.000 | 24.8  | 40.2  | 60.7  | 100.2    | 2489.6   | < 0.001 |
| <i>Camponotus coruscus</i> (Smith, 1862)                  | 0.375 | 0.918 | 0.007 | 20.9  | 34.5  | 45.5  | 271.6    | 519.7    | < 0.001 |
| <i>Camponotus curviscapus</i> Emery, 1896                 | 0.432 | 0.755 | 0.022 | 0.7   | 42.1  | 65.9  | 103.7    | 2520.8   | < 0.001 |
| <i>Camponotus excisus</i> Mayr, 1870                      | 0.279 | 0.738 | 0.009 | 3.2   | 3.4   | 3.5   | 55.1     | 272.8    | < 0.001 |
| <i>Camponotus fasciatellus</i> Dalla Torre, 1892          | 0.536 | 0.857 | 0.000 | 8.6   | 23.0  | 35.0  | 411877.5 | 823743.9 | < 0.001 |
| <i>Camponotus formiciformis</i> Forel, 1885               | 0.541 | 0.9   | 0.000 | 8.0   | 12.5  | 17.0  | 26.0     | 53.0     | < 0.001 |
| <i>Camponotus linnaei</i> Forel, 1886                     | 0.345 | 0.798 | 0.014 | 43.9  | 62.1  | 70.8  | 82.9     | 110.0    | < 0.001 |
| <i>Camponotus montivagus</i> Forel, 1885                  | 0.447 | 0.75  | 0.083 | 0.0   | 0.0   | 0.0   | 0.0      | 0.0      | < 0.001 |
| <i>Camponotus mucronatus</i> Emery, 1890                  | 0.421 | 0.927 | 0.005 | 86.6  | 199.6 | 284.8 | 456.0    | 797.6    | < 0.001 |
| <i>Camponotus nitidior</i> (Santschi, 1921)               | 0.381 | 0.754 | 0.016 | 34.7  | 54.8  | 72.3  | 121.9    | 3810.9   | < 0.001 |
| <i>Camponotus novogranadensis</i> Mayr, 1870              | 0.404 | 0.829 | 0.016 | 3.1   | 3.2   | 3.2   | 3.2      | 43.3     | < 0.001 |
| <i>Camponotus piceatus</i> Norton, 1868                   | 0.601 | 0.8   | 0.050 | 0.0   | 0.0   | 0.0   | 0.0      | 0.0      | < 0.001 |
| <i>Camponotus planatus</i> Roger, 1863                    | 0.421 | 0.779 | 0.029 | 3.3   | 3.3   | 3.4   | 7.2      | 20.4     | < 0.001 |
| <i>Camponotus pudorosus</i> Emery, 1925                   | 0.450 | 0.883 | 0.019 | 188.2 | 481.3 | 967.0 | 1222.9   | 2450.4   | < 0.001 |
| <i>Camponotus pullatus</i> Mayr, 1866                     | 0.472 | 0.793 | 0.040 | 33.2  | 76.0  | 153.0 | 175.0    | 351.0    | < 0.001 |
| <i>Camponotus rectangularis</i> Emery, 1890               | 0.423 | 0.828 | 0.018 | 28.6  | 36.1  | 43.7  | 55.0     | 125.7    | < 0.001 |
| <i>Camponotus rubrithorax</i> Forel, 1899                 | 0.263 | 0.728 | 0.054 | 50.7  | 117.9 | 163.6 | 283.2    | 5863.2   | < 0.001 |
| <i>Camponotus senex</i> (Smith, 1858)                     | 0.352 | 0.783 | 0.012 | 25.7  | 41.8  | 48.0  | 65.5     | 193.2    | < 0.001 |
| <i>Camponotus sericeiventris</i> (Guérin-Ménéville, 1838) | 0.432 | 0.802 | 0.032 | 9.2   | 9.8   | 10.1  | 24.4     | 33.2     | < 0.001 |
| <i>Camponotus striatus</i> (Smith, 1862)                  | 0.399 | 0.819 | 0.014 | 24.0  | 30.5  | 35.3  | 42.7     | 74.8     | < 0.001 |
| <i>Camponotus textor</i> Forel, 1899                      | 0.324 | 0.651 | 0.059 | 9.0   | 43.2  | 62.7  | 104.1    | 184.6    | < 0.001 |
| <i>Camponotus vicinus</i> Mayr, 1870                      | 0.447 | 0.897 | 0.020 | 3.0   | 3.1   | 3.1   | 3.1      | 44.9     | < 0.001 |
| <i>Camponotus zoc</i> Forel, 1879                         | 0.402 | 0.629 | 0.065 | 3.4   | 12.5  | 16.8  | 23.2     | 95.5     | < 0.001 |
| <i>Colobopsis mathildeae</i> (Smith, M.R., 1949)          |       | 0.667 | 0.167 | 0.0   | 0.0   | 0.0   | 0.0      | 0.0      | < 0.001 |

| Subfamily/Species                                  | 10P   | TSS   | FOR   | AUCp  |       |        |        |         | P       |
|----------------------------------------------------|-------|-------|-------|-------|-------|--------|--------|---------|---------|
|                                                    |       |       |       | Min   | Q1    | Q2     | Q3     | Max     |         |
| Formicinae                                         |       |       |       |       |       |        |        |         |         |
| <i>Formica pulla</i> Francoeur, 1973               | 0.514 | 1     |       |       |       |        |        |         |         |
| <i>Lasius sitiens</i> Wilson, 1955                 | 0.275 | 0.867 | 0.015 | 9.7   | 11.1  | 12.0   | 53.9   | 690.6   | < 0.001 |
| <i>Myrmelachista amicta</i> Wheeler, 1934          | 0.384 | 1     |       |       |       |        |        |         |         |
| <i>Myrmelachista mexicana</i> Wheeler, 1934        | 0.372 | 0.771 | 0.013 | 12.4  | 16.9  | 20.9   | 24.6   | 59.2    | < 0.001 |
| <i>Myrmelachista skwarrae</i> Wheeler, 1934        | 0.295 | 0.892 | 0.013 | 17.1  | 143.0 | 345.8  | 1150.9 | 2361.5  | < 0.001 |
| <i>Myrmelachista zeledoni</i> Emery, 1896          | 0.304 | 0.846 | 0.015 | 44.2  | 71.2  | 94.0   | 230.4  | 23131.6 | < 0.001 |
| <i>Nylanderia guatemalensis</i> (Forel, 1885)      | 0.376 | 0.823 | 0.016 | 32.9  | 49.3  | 59.3   | 76.5   | 135.7   | < 0.001 |
| <i>Nylanderia parvula</i> (Mayr, 1870)             | 0.446 | 0.858 | 0.016 | 3.1   | 3.1   | 3.2    | 72.9   | 321.6   | < 0.001 |
| <i>Nylanderia steinheili</i> (Forel, 1893)         | 0.496 | 0.797 | 0.012 | 16.3  | 18.9  | 26.0   | 37.2   | 52.3    | < 0.001 |
| Myrmicinae                                         |       |       |       |       |       |        |        |         |         |
| <i>Acromyrmex octospinosus</i> (Reich, 1793)       | 0.457 | 0.863 | 0.016 | 13.3  | 14.4  | 15.5   | 50.4   | 74.9    | < 0.001 |
| <i>Adelomyrmex micans</i> Fernández, 2003          | 0.434 | 0.909 | 0.008 | 0.0   | 0.0   | 0.0    | 0.0    | 0.0     | < 0.001 |
| <i>Adelomyrmex myops</i> (Wheeler, 1910)           | 0.426 | 0.881 | 0.021 | 33.2  | 85.2  | 130.5  | 229.6  | 419.4   | < 0.001 |
| <i>Adelomyrmex paratristani</i> Longino, 2012      | 0.523 | 0.826 | 0.006 | 134.1 | 341.7 | 470.5  | 829.7  | 7648.6  | < 0.001 |
| <i>Adelomyrmex robustus</i> Fernández, 2003        | 0.391 | 0.686 | 0.007 | 350.2 | 859.2 | 1338.1 | 3224.8 | 6069.3  | < 0.001 |
| <i>Adelomyrmex silvestrii</i> (Menozzi, 1931)      | 0.395 | 0.841 | 0.011 | 35.5  | 42.8  | 48.1   | 94.0   | 145.3   | < 0.001 |
| <i>Adelomyrmex tristani</i> (Menozzi, 1931)        | 0.307 | 0.795 | 0.022 | 56.6  | 84.2  | 95.0   | 109.7  | 353.1   | < 0.001 |
| <i>Apterostigma pilosum</i> Mayr, 1865             | 0.479 | 0.811 | 0.026 | 32.2  | 50.2  | 86.5   | 226.7  | 439.5   | < 0.001 |
| <i>Atta cephalotes</i> (Linnaeus, 1758)            | 0.403 | 0.836 | 0.019 | 14.4  | 15.9  | 16.9   | 18.7   | 38.0    | < 0.001 |
| <i>Atta mexicana</i> (Smith, 1858)                 | 0.338 | 0.798 | 0.012 | 32.8  | 41.9  | 45.2   | 51.7   | 72.1    | < 0.001 |
| <i>Carebara urichi</i> (Wheeler, 1922)             | 0.311 | 0.844 | 0.013 | 3.1   | 3.1   | 3.2    | 44.4   | 73.1    | < 0.001 |
| <i>Cephalotes minutus</i> (Fabricius, 1804)        | 0.399 | 0.821 | 0.012 | 19.9  | 22.9  | 24.5   | 27.0   | 52.6    | < 0.001 |
| <i>Cephalotes multispinosus</i> (Norton, 1868)     | 0.401 | 0.851 | 0.015 | 11.5  | 15.6  | 20.0   | 47.5   | 139.4   | < 0.001 |
| <i>Cephalotes pallens</i> (Klug, 1824)             | 0.493 | 0.815 | 0.024 | 3.2   | 3.3   | 3.5    | 86.8   | 481.3   | < 0.001 |
| <i>Cephalotes scutulatus</i> (Smith, 1867)         | 0.368 | 0.89  | 0.019 | 17.4  | 22.4  | 26.6   | 108.0  | 563.0   | < 0.001 |
| <i>Cephalotes setulifer</i> (Emery, 1894)          | 0.426 | 0.826 | 0.022 | 4.8   | 96.3  | 155.1  | 270.1  | 28751.3 | < 0.001 |
| <i>Cephalotes umbraculatus</i> (Fabricius, 1804)   | 0.491 | 0.833 | 0.023 | 20.9  | 28.0  | 43.8   | 81.7   | 292.5   | < 0.001 |
| <i>Crematogaster corvina</i> Mayr, 1870            | 0.477 | 0.85  | 0.000 | 17.0  | 35.0  | 35.0   | 35.0   | 71.0    | 0.001   |
| <i>Crematogaster crinosa</i> Mayr, 1862            | 0.333 | 0.767 | 0.020 | 11.2  | 11.9  | 12.7   | 15.3   | 34.0    | < 0.001 |
| <i>Crematogaster curvispinosa</i> Mayr, 1862       | 0.456 | 0.836 | 0.021 | 26.8  | 31.7  | 36.4   | 51.5   | 77.2    | < 0.001 |
| <i>Crematogaster erecta</i> Mayr, 1866             | 0.298 | 0.818 | 0.013 | 31.1  | 41.1  | 46.4   | 53.5   | 311.7   | < 0.001 |
| <i>Crematogaster formosa</i> Mayr, 1870            | 0.570 | 0.706 | 0.032 | 2.2   | 89.2  | 212.8  | 443.8  | 922.1   | < 0.001 |
| <i>Crematogaster limata</i> Smith, 1858            | 0.361 | 0.823 | 0.016 | 3.1   | 3.2   | 3.2    | 3.3    | 33.4    | < 0.001 |
| <i>Crematogaster montezumia</i> Smith, 1858        | 0.386 | 0.684 | 0.027 | 9.9   | 14.2  | 18.4   | 22.7   | 603.4   | < 0.001 |
| <i>Crematogaster nigropilosa</i> Mayr, 1870        | 0.350 | 0.872 | 0.009 | 8.6   | 9.4   | 10.6   | 19.1   | 59.6    | < 0.001 |
| <i>Crematogaster obscurata</i> Emery, 1895         | 0.635 | 0.826 | 0.010 | 35.4  | 63.0  | 78.5   | 99.1   | 5848.2  | < 0.001 |
| <i>Crematogaster opaca</i> Mayr, 1870              | 0.334 | 0.834 | 0.023 | 43.6  | 73.3  | 124.1  | 251.6  | 6466.1  | < 0.001 |
| <i>Crematogaster sumichrasti</i> Mayr, 1870        | 0.353 | 0.806 | 0.007 | 3.1   | 3.2   | 3.2    | 3.3    | 79.3    | < 0.001 |
| <i>Crematogaster torosa</i> Mayr, 1870             | 0.379 | 0.797 | 0.016 | 26.6  | 33.2  | 35.4   | 38.3   | 48.6    | < 0.001 |
| <i>Cyphomyrmex costatus</i> Mann, 1922             | 0.339 | 0.835 | 0.013 | 31.5  | 44.7  | 51.8   | 60.8   | 165.8   | < 0.001 |
| <i>Cyphomyrmex minutus</i> Mayr, 1862              | 0.232 | 0.829 | 0.028 | 14.8  | 16.6  | 17.8   | 19.2   | 25.4    | < 0.001 |
| <i>Cyphomyrmex rimosus</i> (Spinola, 1851)         | 0.384 | 0.838 | 0.017 | 14.6  | 16.2  | 16.9   | 17.6   | 25.5    | < 0.001 |
| <i>Cyphomyrmex wheeleri</i> Forel, 1900            | 0.399 | 0.796 | 0.025 | 3.2   | 3.4   | 3.7    | 5.1    | 398.1   | < 0.001 |
| <i>Eurhopalothrix clypeata</i> Brown & Kempf, 1960 | 0.421 | 0.683 | 0.056 | 1.0   | 17.0  | 36.7   | 107.0  | 216.7   | < 0.001 |
| <i>Eurhopalothrix hunhau</i> Longino, 2013         | 0.848 | 0.818 | 0.010 | 0.0   | 0.0   | 0.0    | 0.0    | 0.0     | < 0.001 |

| Subfamily/Species                                      | 10P   | TSS   | FOR   | AUCp  |       |       |        |         | P       |
|--------------------------------------------------------|-------|-------|-------|-------|-------|-------|--------|---------|---------|
|                                                        |       |       |       | Min   | Q1    | Q2    | Q3     | Max     |         |
| Myrmicinae                                             |       |       |       |       |       |       |        |         |         |
| <i>Megalomyrmex drifti</i> Kempf, 1961                 | 0.411 | 0.778 | 0.024 | 3.6   | 4.1   | 4.3   | 37.3   | 136.0   | < 0.001 |
| <i>Megalomyrmex incisus</i> Smith, 1947                | 0.345 | 0.805 | 0.018 | 44.9  | 84.1  | 109.1 | 143.7  | 476.5   | < 0.001 |
| <i>Monomorium cyaneum</i> Wheeler, 1914                | 0.475 | 0.773 | 0.024 | 5.3   | 6.2   | 6.6   | 7.1    | 8.7     | < 0.001 |
| <i>Monomorium ebeninum</i> Forel, 1891                 | 0.633 | 0.8   | 0.038 | 33.5  | 39.4  | 43.3  | 47.7   | 61.8    | < 0.001 |
| <i>Monomorium minimum</i> (Buckley, 1867)              | 0.471 | 0.862 | 0.017 | 3.1   | 3.1   | 3.1   | 7.7    | 9.2     | < 0.001 |
| <i>Mycetomoellerius turrifex</i> (Wheeler, W.M., 1903) | 0.254 | 0.725 | 0.042 | 3.2   | 3.4   | 3.5   | 35.3   | 90.0    | < 0.001 |
| <i>Mycetosoritis hartmanni</i> (Wheeler, 1907)         | 0.318 | 0.778 | 0.017 | 34.8  | 66.4  | 84.4  | 128.6  | 820.0   | < 0.001 |
| <i>Mycocepurus curvispinosus</i> Mackay, 1998          | 0.336 | 0.333 | 0.038 | 0.0   | 0.0   | 0.0   | 0.0    | 0.0     | < 0.001 |
| <i>Mycocepurus smithii</i> (Forel, 1893)               | 0.248 | 0.879 | 0.013 | 20.8  | 27.2  | 31.1  | 49.7   | 115.6   | < 0.001 |
| <i>Myrmicocrypta dilacerata</i> (Forel, 1885)          | 0.363 | 1     | 0.000 | 0.0   | 0.0   | 0.0   | 0.0    | 0.0     | < 0.001 |
| <i>Nesomyrmex echinatinodis</i> (Forel, 1886)          | 0.371 | 0.834 | 0.017 | 9.6   | 12.6  | 14.2  | 46.1   | 232.0   | < 0.001 |
| <i>Nesomyrmex wilda</i> (Smith, 1943)                  | 0.541 | 0.777 | 0.033 | 16.8  | 22.7  | 28.0  | 35.5   | 568.4   | < 0.001 |
| <i>Octostruma balzani</i> (Emery, 1894)                | 0.482 | 0.856 | 0.011 | 11.1  | 12.3  | 13.0  | 31.4   | 45.1    | < 0.001 |
| <i>Octostruma trithrix</i> Longino, 2013               | 0.460 | 0.885 | 0.011 | 72.9  | 131.1 | 221.4 | 1203.5 | 7472.2  | < 0.001 |
| <i>Paratrachymyrmex intermedius</i> (Forel, 1909)      | 0.462 | 0.88  | 0.012 | 12.6  | 24.3  | 36.0  | 282.8  | 553.1   | < 0.001 |
| <i>Pheidole absurda</i> Forel, 1886                    | 0.550 | 0.694 | 0.033 | 8.6   | 11.6  | 15.0  | 67.3   | 708.4   | < 0.001 |
| <i>Pheidole agricola</i> Wilson, 2003                  | 0.372 | 1     | 0.000 | 0.0   | 0.0   | 0.0   | 0.0    | 0.0     | < 0.001 |
| <i>Pheidole bilimeki</i> Mayr, 1870                    | 0.360 | 0.719 | 0.020 | 11.0  | 12.2  | 13.0  | 22.5   | 35.3    | < 0.001 |
| <i>Pheidole fimbriata</i> Roger, 1863                  | 0.423 | 0.775 | 0.017 | 26.1  | 33.3  | 36.9  | 45.8   | 102.7   | < 0.001 |
| <i>Pheidole flavens</i> Roger, 1863                    | 0.469 | 0.816 | 0.007 | 21.2  | 24.8  | 27.5  | 30.7   | 38.4    | < 0.001 |
| <i>Pheidole gouldi</i> Forel, 1886                     | 0.360 | 0.853 | 0.005 | 24.0  | 144.2 | 181.2 | 237.8  | 368.4   | < 0.001 |
| <i>Pheidole harrisonfordi</i> Wilson, 2003             | 0.408 | 0.868 | 0.006 | 59.1  | 68.4  | 72.9  | 79.5   | 98.3    | < 0.001 |
| <i>Pheidole insipida</i> Forel, 1899                   | 0.645 | 0.803 | 0.030 | 132.7 | 471.0 | 824.9 | 1886.7 | 3656.5  | < 0.001 |
| <i>Pheidole lamia</i> Wheeler, W.M., 1901              | 0.416 | 0.857 | 0.029 | 0.0   | 0.0   | 0.0   | 0.0    | 0.0     | < 0.001 |
| <i>Pheidole mackayi</i> Wilson, 2003                   | 0.430 | 1     | 0.000 | 0.0   | 0.0   | 0.0   | 0.0    | 0.0     | < 0.001 |
| <i>Pheidole nubicola</i> Wilson, 2003                  | 0.317 | 0.745 | 0.005 | 57.7  | 233.7 | 351.0 | 702.9  | 1406.9  | < 0.001 |
| <i>Pheidole oaxacana</i> Wilson, 2003                  | 0.334 | 0.789 | 0.011 | 234.2 | 502.9 | 587.1 | 1006.9 | 1595.1  | < 0.001 |
| <i>Pheidole prattorum</i> Wilson, 2003                 | 0.354 | 0.849 | 0.011 | 33.0  | 43.2  | 51.5  | 64.5   | 9285.7  | < 0.001 |
| <i>Pheidole psilogaster</i> Wilson, 2003               | 0.398 | 0.954 | 0.002 | 24.8  | 30.7  | 36.1  | 1785.4 | 3545.5  | < 0.001 |
| <i>Pheidole punctatissima</i> Mayr, 1870               | 0.287 | 0.823 | 0.009 | 3.2   | 3.3   | 3.5   | 18.9   | 3424.5  | < 0.001 |
| <i>Pheidole roushiae</i> Wilson, 2003                  | 0.777 | 0.778 | 0.013 | 55.6  | 88.2  | 108.0 | 137.6  | 413.6   | < 0.001 |
| <i>Pheidole simonsi</i> Wilson, 2003                   | 0.553 | 0.755 | 0.011 | 17.0  | 19.9  | 22.8  | 37.9   | 116.5   | < 0.001 |
| <i>Pheidole subarmata</i> Mayr, 1884                   | 0.694 | 0.808 | 0.010 | 22.4  | 25.6  | 27.3  | 29.0   | 37.4    | < 0.001 |
| <i>Pheidole susannae</i> Forel, 1886                   | 0.651 | 0.783 | 0.014 | 3.2   | 3.3   | 3.4   | 20.2   | 75.7    | < 0.001 |
| <i>Pheidole tepicana</i> Pergande, 1896                | 0.539 | 0.792 | 0.021 | 11.8  | 14.8  | 16.2  | 33.4   | 58.4    | < 0.001 |
| <i>Pheidole titanis</i> Wheeler, 1903                  | 0.419 | 0.823 | 0.018 | 4.9   | 5.6   | 6.0   | 6.6    | 295.4   | < 0.001 |
| <i>Pheidole ursus</i> Mayr, 1870                       | 0.456 | 0.847 | 0.009 | 193.7 | 337.6 | 512.0 | 943.5  | 28789.2 | < 0.001 |
| <i>Pheidole xyston</i> Wilson, 2003                    | 0.420 | 0.897 | 0.007 | 155.4 | 372.6 | 629.0 | 1178.5 | 17540.5 | < 0.001 |
| <i>Pogonomyrmex barbatus</i> (Smith, 1858)             | 0.269 | 0.883 | 0.035 | 8.0   | 8.3   | 8.6   | 9.6    | 16.0    | < 0.001 |
| <i>Procryptocerus scabriusculus</i> Forel, 1899        | 0.479 | 0.845 | 0.002 | 0.0   | 0.0   | 0.0   | 0.0    | 0.0     | < 0.001 |
| <i>Rhopalothrix weberi</i> Brown & Kempf, 1960         | 0.203 | 1     | 0.000 | 0.0   | 0.0   | 0.0   | 0.0    | 0.0     | < 0.001 |
| <i>Rogeria belti</i> Mann, 1922                        | 0.429 | 0.843 | 0.022 | 23.8  | 33.3  | 44.6  | 232.0  | 4400.4  | < 0.001 |
| <i>Rogeria innotabilis</i> Kugler, 1994                | 0.417 | 0.84  | 0.008 | 25.1  | 32.3  | 38.9  | 64.5   | 664.4   | < 0.001 |
| <i>Sericomyrmex opacus</i> Mayr, 1865                  | 0.338 | 0.73  | 0.021 | 8.3   | 39.5  | 43.9  | 57.0   | 754.9   | < 0.001 |
| <i>Solenopsis azteca</i> Forel, 1893                   | 0.448 | 0.865 | 0.006 | 20.9  | 25.6  | 28.5  | 33.7   | 540.7   | < 0.001 |

| Subfamily/Species                                  | 10P   | TSS   | FOR   | AUCp   |         |         |         |          | P       |
|----------------------------------------------------|-------|-------|-------|--------|---------|---------|---------|----------|---------|
|                                                    |       |       |       | Min    | Q1      | Q2      | Q3      | Max      |         |
| Myrmicinae                                         |       |       |       |        |         |         |         |          |         |
| <i>Solenopsis geminata</i> (Fabricius, 1804)       | 0.384 | 0.772 | 0.017 | 3.3    | 3.3     | 3.4     | 7.0     | 10.0     | < 0.001 |
| <i>Solenopsis globularia</i> (Smith, 1858)         | 0.386 | 0.771 | 0.020 | 22.0   | 27.1    | 30.0    | 33.0    | 91.5     | < 0.001 |
| <i>Solenopsis molesta</i> (Say, 1836)              | 0.436 | 0.883 | 0.016 | 3.1    | 3.1     | 3.2     | 7.3     | 44.6     | < 0.001 |
| <i>Solenopsis picea</i> Emery, 1896                | 0.613 | 0.793 | 0.008 | 20.4   | 22.5    | 24.3    | 26.9    | 40.6     | < 0.001 |
| <i>Solenopsis succinea</i> Emery, 1890             | 0.492 | 0.841 | 0.011 | 13.8   | 27.4    | 43.2    | 111.8   | 3261.7   | < 0.001 |
| <i>Solenopsis tenuis</i> Mayr, 1878                | 0.397 | 0.837 | 0.014 | 15.6   | 90.9    | 155.3   | 333.9   | 641.3    | < 0.001 |
| <i>Solenopsis xyloni</i> McCook, 1880              | 0.257 | 0.874 | 0.021 | 5.8    | 6.2     | 6.5     | 7.6     | 19.6     | < 0.001 |
| <i>Solenopsis zeteki</i> Wheeler, 1942             | 0.276 | 0.795 | 0.020 | 37.7   | 51.6    | 58.3    | 71.1    | 122.8    | < 0.001 |
| <i>Stenamma connectum</i> Branstetter, 2013        | 0.402 | 0.913 | 0.004 | 3496.8 | 10492.3 | 17127.6 | 35182.0 | 35182.0  | < 0.001 |
| <i>Stenamma excisum</i> Branstetter, 2013          | 0.379 | 0.794 | 0.008 | 27.7   | 46.2    | 57.6    | 75.8    | 417.3    | < 0.001 |
| <i>Stenamma felixi</i> Mann, 1922                  | 0.424 | 0.891 | 0.007 | 101.6  | 142.3   | 189.4   | 267.3   | 823.7    | < 0.001 |
| <i>Stenamma huachucanum</i> Smith, 1957            | 0.206 | 0.798 | 0.025 | 4.2    | 4.6     | 4.9     | 33.7    | 120.9    | < 0.001 |
| <i>Stenamma leptospinum</i> Branstetter, 2013      | 0.518 | 0.857 | 0.000 | 0.0    | 0.0     | 0.0     | 0.0     | 0.0      | < 0.001 |
| <i>Stenamma lobinodus</i> Branstetter, 2013        | 0.665 | 0.919 | 0.000 | 0.0    | 0.0     | 0.0     | 0.0     | 0.0      | < 0.001 |
| <i>Stenamma maximon</i> Branstetter, 2013          | 0.384 | 0.808 | 0.006 | 240.9  | 499.7   | 674.8   | 1083.6  | 64493.8  | < 0.001 |
| <i>Stenamma pelophilum</i> Branstetter, 2013       | 0.339 | 0.952 | 0.000 | 130.0  | 522.9   | 1046.9  | 2029.2  | 4190.4   | < 0.001 |
| <i>Stenamma stictosomum</i> Branstetter, 2013      | 0.442 | 0.933 | 0.000 | 21.9   | 31.0    | 52.3    | 99.0    | 159.0    | < 0.001 |
| <i>Stenamma vexator</i> Branstetter, 2013          | 0.393 | 0.914 | 0.003 | 0.0    | 0.0     | 0.0     | 0.0     | 0.0      | < 0.001 |
| <i>Strumigenys boneti</i> Brown, 1959              | 0.492 | 0.772 | 0.020 | 21.4   | 56.4    | 69.9    | 106.3   | 110688.3 | < 0.001 |
| <i>Strumigenys brevicornis</i> Mann, 1922          | 0.243 | 0.849 | 0.008 | 64.4   | 78.1    | 84.4    | 91.4    | 118.5    | < 0.001 |
| <i>Strumigenys eggersi</i> Emery, 1890             | 0.483 | 0.808 | 0.029 | 19.9   | 22.9    | 24.3    | 26.4    | 37.9     | < 0.001 |
| <i>Strumigenys elongata</i> Roger, 1863            | 0.648 | 0.81  | 0.014 | 18.8   | 22.2    | 23.7    | 27.0    | 52.3     | < 0.001 |
| <i>Strumigenys louisianae</i> Roger, 1863          | 0.453 | 0.809 | 0.020 | 7.5    | 8.0     | 8.4     | 10.7    | 19.4     | < 0.001 |
| <i>Strumigenys ludia</i> Mann, 1922                | 0.432 | 0.885 | 0.014 | 23.6   | 37.9    | 47.6    | 93.2    | 521.3    | < 0.001 |
| <i>Strumigenys margaritae</i> Forel, 1893          | 0.467 | 0.871 | 0.015 | 3.1    | 3.1     | 3.2     | 3.3     | 121.0    | < 0.001 |
| <i>Strumigenys micretes</i> Brown, 1959            | 0.634 | 0.818 | 0.012 | 32.0   | 51.8    | 64.0    | 152.0   | 6958.0   | < 0.001 |
| <i>Strumigenys pariensis</i> Lattke & Goitia, 1997 | 0.255 | 0.733 | 0.009 | 0.6    | 40.7    | 46.9    | 67.1    | 1825.0   | < 0.001 |
| <i>Strumigenys rogata</i> (Bolton, 2000)           | 0.347 | 0.892 | 0.005 | 60.2   | 89.6    | 110.8   | 157.7   | 743.2    | < 0.001 |
| <i>Strumigenys schulzi</i> Emery, 1894             | 0.461 | 0.882 | 0.013 | 51.0   | 95.7    | 138.5   | 218.9   | 5546.2   | < 0.001 |
| <i>Strumigenys subdentata</i> Mayr, 1887           | 0.310 | 0.845 | 0.013 | 26.1   | 32.5    | 36.3    | 43.7    | 126.2    | < 0.001 |
| <i>Temnothorax aztecus</i> (Wheeler, 1931)         | 0.485 | 0.904 | 0.011 | 626.0  | 1891.4  | 3561.2  | 5843.2  | 12021.3  | < 0.001 |
| <i>Temnothorax subditivus</i> (Wheeler, 1903)      | 0.289 | 0.79  | 0.013 | 3.2    | 3.3     | 3.4     | 19.9    | 34.2     | < 0.001 |
| <i>Tetramorium spinosum</i> (Pergande, 1896)       | 0.426 | 0.827 | 0.023 | 9.4    | 11.0    | 12.3    | 25.5    | 118.3    | < 0.001 |
| <i>Trachymyrmex saussurei</i> (Forel, 1885)        | 0.406 | 0.711 | 0.030 | 2.7    | 46.4    | 63.0    | 138.7   | 247.7    | < 0.001 |
| <i>Wasmannia auropunctata</i> (Roger, 1863)        | 0.419 | 0.766 | 0.017 | 3.2    | 3.2     | 3.3     | 12.1    | 20.5     | < 0.001 |
| <i>Xenomyrmex panamanus</i> (Wheeler, W.M., 1922)  | 0.435 | 1     | 0.000 | 0.0    | 0.0     | 0.0     | 0.0     | 0.0      | < 0.001 |
| Ponerinae                                          |       |       |       |        |         |         |         |          |         |
| <i>Anochetus mayri</i> Emery, 1884                 | 0.408 | 0.842 | 0.020 | 29.8   | 35.7    | 37.8    | 42.9    | 53.1     | < 0.001 |
| <i>Cryptopone gilva</i> (Roger, 1863)              | 0.311 | 0.804 | 0.019 | 3.1    | 3.2     | 3.3     | 30.5    | 133.2    | < 0.001 |
| <i>Hypoponera nitidula</i> (Emery, 1890)           | 0.345 | 0.872 | 0.008 | 3.0    | 3.1     | 3.1     | 24.3    | 76.1     | < 0.001 |
| <i>Hypoponera opaciceps</i> (Mayr, 1887)           | 0.442 | 0.73  | 0.029 | 3.2    | 3.3     | 3.4     | 4.8     | 6.6      | < 0.001 |
| <i>Hypoponera opacior</i> (Forel, 1893)            | 0.270 | 0.792 | 0.022 | 5.0    | 5.2     | 5.3     | 5.9     | 9.3      | < 0.001 |
| <i>Hypoponera parva</i> (Forel, 1909)              | 0.368 | 0.854 | 0.012 | 3.1    | 3.1     | 3.2     | 16.3    | 111.3    | < 0.001 |
| <i>Leptogenys elongata</i> (Buckley, 1866)         | 0.363 | 0.888 | 0.013 | 5.6    | 6.3     | 6.5     | 14.6    | 66.3     | < 0.001 |
| <i>Leptogenys pusilla</i> (Emery, 1890)            | 0.211 | 0.88  | 0.019 | 34.9   | 51.5    | 62.7    | 92.6    | 13341.1  | < 0.001 |

| Subfamily/Species                                  | 10P   | TSS   | FOR   | AUCp |       |       |       |          | P       |
|----------------------------------------------------|-------|-------|-------|------|-------|-------|-------|----------|---------|
|                                                    |       |       |       | Min  | Q1    | Q2    | Q3    | Max      |         |
| Ponerinae                                          |       |       |       |      |       |       |       |          |         |
| <i>Leptogenys quiriguana</i> Wheeler, 1923         | 0.346 | 0.952 | 0.000 | 0.0  | 0.0   | 0.0   | 0.0   | 0.0      | < 0.001 |
| <i>Neoponera apicalis</i> (Latreille, 1802)        | 0.380 | 0.854 | 0.019 | 12.2 | 14.1  | 16.4  | 24.7  | 65.8     | < 0.001 |
| <i>Neoponera carinulata</i> (Roger, 1861)          |       | 0.778 | 0.026 | 46.8 | 71.7  | 90.0  | 135.5 | 1305.2   | < 0.001 |
| <i>Neoponera crenata</i> (Roger, 1861)             | 0.495 | 0.833 | 0.019 | 27.7 | 36.1  | 48.8  | 93.3  | 297.9    | < 0.001 |
| <i>Neoponera verenae</i> Forel, 1922               | 0.218 | 0.865 | 0.015 | 12.2 | 14.1  | 15.8  | 121.0 | 290.5    | < 0.001 |
| <i>Neoponera villosa</i> (Fabricius, 1804)         | 0.391 | 0.82  | 0.019 | 15.4 | 16.7  | 17.5  | 18.5  | 30.6     | < 0.001 |
| <i>Odontomachus bauri</i> Emery, 1892              | 0.383 | 0.82  | 0.017 | 12.6 | 13.8  | 14.7  | 18.1  | 44.9     | < 0.001 |
| <i>Odontomachus biolleyi</i> Forel, 1908           | 0.321 | 0.889 | 0.000 | 0.0  | 0.0   | 0.0   | 0.0   | 0.0      | < 0.001 |
| <i>Odontomachus chelifer</i> (Latreille, 1802)     | 0.423 | 0.801 | 0.021 | 26.8 | 31.4  | 34.4  | 38.5  | 85.5     | < 0.001 |
| <i>Odontomachus laticeps</i> Roger, 1861           | 0.532 | 0.835 | 0.016 | 16.1 | 18.9  | 20.6  | 27.8  | 91.1     | < 0.001 |
| <i>Odontomachus ruginodis</i> Wheeler, 1908        | 0.383 | 0.812 | 0.022 | 15.9 | 19.0  | 20.8  | 23.9  | 44.5     | < 0.001 |
| <i>Odontomachus yucatecus</i> Brown, 1976          | 0.328 | 0.903 | 0.007 | 35.4 | 48.7  | 56.9  | 197.6 | 354.7    | < 0.001 |
| <i>Pachycondyla harpax</i> (Fabricius, 1804)       | 0.476 | 0.825 | 0.017 | 8.0  | 8.3   | 8.7   | 14.8  | 20.4     | < 0.001 |
| <i>Pachycondyla impressa</i> (Roger, 1861)         | 0.410 | 0.831 | 0.024 | 30.0 | 37.1  | 39.7  | 45.5  | 65.7     | < 0.001 |
| <i>Platythyrea punctata</i> (Smith, 1858)          | 0.322 | 0.844 | 0.016 | 18.0 | 21.0  | 23.5  | 33.2  | 47.6     | < 0.001 |
| <i>Ponera exotica</i> Smith, 1962                  | 0.301 | 0.847 | 0.009 | 3.1  | 3.1   | 3.2   | 28.3  | 55.8     | < 0.001 |
| <i>Ponera pennsylvanica</i> Buckley, 1866          | 0.357 | 0.872 | 0.017 | 3.0  | 3.1   | 3.1   | 14.1  | 84.5     | < 0.001 |
| <i>Pseudoponera stigma</i> (Fabricius, 1804)       | 0.396 | 0.779 | 0.026 | 18.3 | 24.0  | 29.1  | 46.4  | 79.0     | < 0.001 |
| <i>Rasopone ferruginea</i> (Smith, 1858)           | 0.475 | 0.809 | 0.024 | 17.9 | 24.4  | 28.7  | 178.1 | 30625.7  | < 0.001 |
| Proceratiinae                                      |       |       |       |      |       |       |       |          |         |
| <i>Discothyrea horni</i> Menozzi, 1927             | 0.437 | 0.87  | 0.009 | 16.9 | 25.9  | 30.5  | 125.6 | 1758.3   | < 0.001 |
| <i>Proceratium mancum</i> Mann, 1922               | 0.338 | 0.809 | 0.022 | 40.1 | 88.9  | 111.5 | 164.8 | 1637.2   | < 0.001 |
| <i>Proceratium micrommatum</i> (Roger, 1863)       | 0.267 | 0.838 | 0.016 | 25.9 | 45.6  | 75.1  | 124.8 | 233.4    | < 0.001 |
| Pseudomyrmecinae                                   |       |       |       |      |       |       |       |          |         |
| <i>Pseudomyrmex boopis</i> (Roger, 1863)           | 0.718 | 0.819 | 0.019 | 16.2 | 18.6  | 20.3  | 23.3  | 57.5     | < 0.001 |
| <i>Pseudomyrmex brunneus</i> (Smith, 1877)         | 0.495 | 0.704 | 0.038 | 4.4  | 6.0   | 21.3  | 58.8  | 57161.2  | < 0.001 |
| <i>Pseudomyrmex caeciliae</i> (Forel, 1913)        | 0.404 | 0.72  | 0.026 | 0.5  | 53.1  | 78.7  | 112.1 | 36604.7  | < 0.001 |
| <i>Pseudomyrmex championi</i> (Forel, 1899)        | 0.440 | 0.861 | 0.021 | 60.7 | 118.6 | 161.8 | 274.2 | 9200.4   | < 0.001 |
| <i>Pseudomyrmex cubaensis</i> (Forel, 1901)        | 0.461 | 0.763 | 0.021 | 35.4 | 44.8  | 52.5  | 58.9  | 86.5     | < 0.001 |
| <i>Pseudomyrmex ejectus</i> (Smith, 1858)          | 0.464 | 0.801 | 0.032 | 13.5 | 15.6  | 17.5  | 20.6  | 28.0     | < 0.001 |
| <i>Pseudomyrmex elongatus</i> (Mayr, 1870)         | 0.464 | 0.768 | 0.021 | 3.2  | 3.3   | 3.3   | 3.4   | 44.1     | < 0.001 |
| <i>Pseudomyrmex ferrugineus</i> (Smith, 1877)      | 0.176 | 0.878 | 0.015 | 34.9 | 43.2  | 55.2  | 86.1  | 153.5    | < 0.001 |
| <i>Pseudomyrmex filiformis</i> (Fabricius, 1804)   | 0.393 | 0.799 | 0.026 | 25.8 | 60.4  | 96.1  | 144.5 | 406740.5 | < 0.001 |
| <i>Pseudomyrmex gracilis</i> (Fabricius, 1804)     | 0.326 | 0.76  | 0.039 | 3.2  | 3.3   | 3.3   | 3.3   | 13.1     | < 0.001 |
| <i>Pseudomyrmex ita</i> (Forel, 1906)              | 0.243 | 0.862 | 0.013 | 22.9 | 35.0  | 45.9  | 69.9  | 314.9    | < 0.001 |
| <i>Pseudomyrmex major</i> (Forel, 1899)            | 0.361 | 0.825 | 0.023 | 2.1  | 139.9 | 215.0 | 330.3 | 596.0    | < 0.001 |
| <i>Pseudomyrmex oculatus</i> (Smith, 1855)         | 0.380 | 0.738 | 0.004 | 0.0  | 0.0   | 0.0   | 0.0   | 0.0      | < 0.001 |
| <i>Pseudomyrmex pallidus</i> (Smith, 1855)         | 0.346 | 0.747 | 0.030 | 6.5  | 6.8   | 7.1   | 14.2  | 19.4     | < 0.001 |
| <i>Pseudomyrmex peperi</i> (Forel, 1913)           | 0.425 | 0.824 | 0.018 | 11.2 | 15.0  | 17.6  | 50.9  | 115.7    | < 0.001 |
| <i>Pseudomyrmex seminole</i> Ward, 1985            | 0.396 | 0.66  | 0.041 | 3.4  | 3.7   | 4.1   | 6.9   | 40617.8  | < 0.001 |
| <i>Pseudomyrmex simplex</i> (Smith, 1877)          | 0.361 | 0.783 | 0.024 | 20.9 | 24.0  | 26.5  | 29.5  | 42.8     | < 0.001 |
| <i>Pseudomyrmex spiculus</i> Ward, 1989            | 0.426 | 0.818 | 0.030 | 0.0  | 0.0   | 0.0   | 0.0   | 0.0      | < 0.001 |
| <i>Pseudomyrmex subater</i> (Wheeler & Mann, 1914) | 0.440 | 0.715 | 0.022 | 8.1  | 46.7  | 64.9  | 93.0  | 34309.3  | < 0.001 |
| <i>Pseudomyrmex tenuissimus</i> (Emery, 1906)      | 0.424 | 0.852 | 0.014 | 9.3  | 97.1  | 130.1 | 181.6 | 113976.9 | < 0.001 |

**Table S2.** List of nonnative ant species reported for the Jamapa River watershed in central Veracruz, Mexico.

| Subfamily/Species                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Dolichoderinae</b>                                                                                                                                                                                                                                                                                                                                                                                             |
| <i>Tapinoma melanocephalum</i> (Fabricius, 1793) ; <i>Tapinoma sessile</i> (Say, 1836)                                                                                                                                                                                                                                                                                                                            |
| <b>Formicinae</b>                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>Paratrechina longicornis</i> (Latreille, 1802)                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Myrmicinae</b>                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>Cardiocondyla emeryi</i> Forel, 1881; <i>Cardiocondyla minutior</i> Forel, 1899; <i>Cardiocondyla obscurior</i> Wheeler, 1929; <i>Cardiocondyla venustula</i> Wheeler, 1908; <i>Monomorium floricola</i> (Jerdon, 1851); <i>Monomorium pharaonis</i> (Linnaeus, 1758); <i>Tetramorium bicarinatum</i> (Nylander, 1846); <i>Tetramorium caldarium</i> (Roger, 1857); <i>Tetramorium lanuginosum</i> Mayr, 1870. |
| <b>Ponerinae</b>                                                                                                                                                                                                                                                                                                                                                                                                  |
| <i>Hypoponera punctatissima</i> (Roger, 1859)                                                                                                                                                                                                                                                                                                                                                                     |

**Table S3.** Occupancy of ant species in the Jamapa River watershed based on ecological niche modeling and species distribution models. N = number of pixels in a resolution of 30 arc seconds; Percentage (%) represents the percentage of the watershed where the presence of the species was predicted.

| Subfamily/Species                                  | N     | %      | Subfamily/Species                                     | N     | %      |
|----------------------------------------------------|-------|--------|-------------------------------------------------------|-------|--------|
| <b>Amblyoponinae</b>                               |       |        | <i>Neivamyrmex swainsonii</i> (Shuckard, 1840)        | 12158 | 95.364 |
| <i>Fulakora orizabana</i> (Brown, 1960)            | 3272  | 25.665 | <i>Neivamyrmex tristis</i> (Forel, 1901)              | 11045 | 86.634 |
| <b>Dolichoderinae</b>                              |       |        | <i>Nomamyrmex esenbeckii</i> (Westwood, 1842)         | 7925  | 62.162 |
| <i>Azteca alfari</i> Emery, 1893                   | 9214  | 72.272 | <i>Syscia augustae</i> (Wheeler, 1902)                | 2703  | 21.202 |
| <i>Azteca gnava</i> Forel, 1906                    | 5506  | 43.188 | <b>Ectatomminae</b>                                   |       |        |
| <i>Azteca nigricans</i> Forel, 1899                | 23    | 0.18   | <i>Ectatomma parasiticum</i> Feitosa & Fresneau, 2008 | 8456  | 66.327 |
| <i>Azteca velox</i> Forel, 1899                    | 10959 | 85.96  | <i>Ectatomma ruidum</i> (Roger, 1860)                 | 5260  | 41.258 |
| <i>Dolichoderus diversus</i> Emery, 1894           | 6002  | 47.078 | <i>Ectatomma tuberculatum</i> (Olivier, 1792)         | 3855  | 30.238 |
| <i>Dolichoderus lutosus</i> (Smith, 1858)          | 6433  | 50.459 | <i>Gnamptogenys hartmani</i> (Wheeler, 1915)          | 471   | 3.694  |
| <i>Dorymyrmex bicolor</i> Wheeler, 1906            | 8676  | 68.052 | <i>Gnamptogenys striatula</i> Mayr, 1884              | 8088  | 63.44  |
| <i>Dorymyrmex insanus</i> (Buckley, 1866)          | 10358 | 81.246 | <i>Gnamptogenys sulcata</i> (Smith, 1858)             | 7968  | 62.499 |
| <i>Forelius damiani</i> Guerrero & Fernández, 2008 | 11065 | 86.791 | <i>Holcoponera bisulca</i> (Kempf & Brown, 1968)      | 5517  | 43.274 |
| <i>Forelius pruinosus</i> (Roger, 1863)            | 11170 | 87.615 | <i>Holcoponera strigata</i> (Norton, 1868)            | 8024  | 62.938 |
| <i>Linepithema dispertitum</i> (Forel, 1885)       | 1637  | 12.84  | <i>Typhlomyrmex prolatus</i> Brown, 1965              | 9381  | 73.582 |
| <i>Tapinoma litorale</i> Wheeler, 1905             | 11419 | 89.568 | <b>Formicinae</b>                                     |       |        |
| <i>Tapinoma ramulorum</i> Emery, 1896              | 3026  | 23.735 | <i>Acropyga exsanguis</i> (Wheeler, 1909)             | 11268 | 88.383 |
| <b>Dorylinae</b>                                   |       |        | <i>Brachymyrmex depilis</i> Emery, 1893               | 7230  | 56.71  |
| <i>Cheliomyrmex morosus</i> (Smith, 1859)          | 6178  | 48.459 | <i>Brachymyrmex minutus</i> Forel, 1893               | 3148  | 24.692 |
| <i>Eciton burchellii</i> (Westwood, 1842)          | 10381 | 81.426 | <i>Brachymyrmex musculus</i> Forel, 1899              | 9161  | 71.857 |
| <i>Eciton mexicanum</i> Roger, 1863                | 10748 | 84.305 | <i>Brachymyrmex obscurior</i> Forel, 1893             | 9354  | 73.37  |
| <i>Eciton vagans</i> (Olivier, 1792)               | 11232 | 88.101 | <i>Camponotus abscisus</i> Roger, 1863                | 5018  | 39.36  |
| <i>Labidus coecus</i> (Latreille, 1802)            | 6909  | 54.192 | <i>Camponotus albicoxis</i> Forel, 1899               | 10552 | 82.767 |
| <i>Labidus praedator</i> (Smith, 1858)             | 12580 | 98.674 | <i>Camponotus atriceps</i> (Smith, 1858)              | 11730 | 92.007 |
| <i>Neivamyrmex adnepos</i> (Wheeler, 1922)         | 944   | 7.405  | <i>Camponotus brettei</i> Forel, 1899                 | 8946  | 70.17  |
| <i>Neivamyrmex cornutus</i> Watkins, 1975          | 436   | 3.42   | <i>Camponotus claviger</i> Forel, 1899                | 8044  | 63.095 |
| <i>Neivamyrmex halidaii</i> (Shuckard, 1840)       | 7066  | 55.424 | <i>Camponotus coloratus</i> Forel, 1904               | 9376  | 73.543 |
| <i>Neivamyrmex harrisii</i> (Haldeman, 1852)       | 7310  | 57.338 | <i>Camponotus coruscus</i> (Smith, 1862)              | 8187  | 64.217 |
| <i>Neivamyrmex impudens</i> (Mann, 1922)           | 11546 | 90.564 | <i>Camponotus curviscapus</i> Emery, 1896             | 11226 | 88.054 |
| <i>Neivamyrmex nigrescens</i> (Cresson, 1872)      | 2635  | 20.668 | <i>Camponotus excisus</i> Mayr, 1870                  | 3461  | 27.147 |
| <i>Neivamyrmex opacithorax</i> (Emery, 1894)       | 4445  | 34.865 | <i>Camponotus fasciellus</i> Dalla Torre, 1892        | 2019  | 15.837 |
| <i>Neivamyrmex pauxillus</i> (Wheeler, 1903)       | 8183  | 64.185 | <i>Camponotus formiciformis</i> Forel, 1885           | 7794  | 61.134 |
| <i>Neivamyrmex pilosus</i> (Smith, 1858)           | 7823  | 61.362 | <i>Camponotus linnaei</i> Forel, 1886                 | 7883  | 61.832 |
| <i>Neivamyrmex sumichrasti</i> (Norton, 1868)      | 11897 | 93.317 | <i>Camponotus montivagus</i> Forel, 1885              | 7     | 0.055  |

| Subfamily/Species                                         | N     | %      | Subfamily/Species                                      | N     | %      |
|-----------------------------------------------------------|-------|--------|--------------------------------------------------------|-------|--------|
| <i>Camponotus mucronatus</i> Emery, 1890                  | 1427  | 11.193 | <i>Crematogaster montezumia</i> Smith, 1858            | 1779  | 13.954 |
| <i>Camponotus nitidior</i> (Santschi, 1921)               | 6681  | 52.404 | <i>Crematogaster nigropilosa</i> Mayr, 1870            | 9503  | 74.539 |
| <i>Camponotus novogranadensis</i> Mayr, 1870              | 364   | 2.855  | <i>Crematogaster obscurata</i> Emery, 1895             | 4007  | 31.43  |
| <i>Camponotus piceatus</i> Norton, 1868                   | 10512 | 82.454 | <i>Crematogaster opaca</i> Mayr, 1870                  | 6390  | 50.122 |
| <i>Camponotus planatus</i> Roger, 1863                    | 8771  | 68.798 | <i>Crematogaster sumichrasti</i> Mayr, 1870            | 8973  | 70.382 |
| <i>Camponotus pudorosus</i> Emery, 1925                   | 11657 | 91.435 | <i>Crematogaster torosa</i> Mayr, 1870                 | 9598  | 75.284 |
| <i>Camponotus pullatus</i> Mayr, 1866                     | 786   | 6.165  | <i>Cyphomyrmex costatus</i> Mann, 1922                 | 4401  | 34.52  |
| <i>Camponotus rectangularis</i> Emery, 1890               | 11818 | 92.697 | <i>Cyphomyrmex minutus</i> Mayr, 1862                  | 4312  | 33.822 |
| <i>Camponotus rubrithorax</i> Forel, 1899                 | 5588  | 43.831 | <i>Cyphomyrmex rimosus</i> (Spinola, 1851)             | 1490  | 11.687 |
| <i>Camponotus senex</i> (Smith, 1858)                     | 12434 | 97.529 | <i>Cyphomyrmex wheeleri</i> Forel, 1900                | 8549  | 67.056 |
| <i>Camponotus sericeiventris</i> (Guérin-Ménéville, 1838) | 9005  | 70.633 | <i>Eurhopalothrix clypeata</i> Brown & Kempf, 1960     | 9225  | 72.359 |
| <i>Camponotus striatus</i> (Smith, 1862)                  | 11729 | 91.999 | <i>Eurhopalothrix hunhau</i> Longino, 2013             | 3219  | 25.249 |
| <i>Camponotus textor</i> Forel, 1899                      | 10882 | 85.356 | <i>Megalomyrmex drifti</i> Kempf, 1961                 | 10019 | 78.587 |
| <i>Camponotus vicinus</i> Mayr, 1870                      | 9301  | 72.955 | <i>Megalomyrmex incisus</i> Smith, 1947                | 4971  | 38.991 |
| <i>Camponotus zoc</i> Forel, 1879                         | 74    | 0.58   | <i>Monomorium cyaneum</i> Wheeler, 1914                | 344   | 2.698  |
| <i>Colobopsis mathildeae</i> (Smith, M.R., 1949)          | 9921  | 77.818 | <i>Monomorium ebeninum</i> Forel, 1891                 | 9799  | 76.861 |
| <i>Formica pulla</i> Francoeur, 1973                      | 7660  | 60.083 | <i>Monomorium minimum</i> (Buckley, 1867)              | 9982  | 78.296 |
| <i>Lasius sitiens</i> Wilson, 1955                        | 221   | 1.733  | <i>Mycetomoellerius turrifex</i> (Wheeler, W.M., 1903) | 67    | 0.526  |
| <i>Myrmelachista amicta</i> Wheeler, 1934                 | 8024  | 62.938 | <i>Mycetosoritis hartmanni</i> (Wheeler, 1907)         | 7319  | 57.408 |
| <i>Myrmelachista mexicana</i> Wheeler, 1934               | 9503  | 74.539 | <i>Myoceporus curvispinosus</i> Mackay, 1998           | 6487  | 50.882 |
| <i>Myrmelachista skwarrae</i> Wheeler, 1934               | 9067  | 71.119 | <i>Myoceporus smithii</i> (Forel, 1893)                | 3817  | 29.94  |
| <i>Myrmelachista zeledoni</i> Emery, 1896                 | 11825 | 92.752 | <i>Myrmicocrypta dilacerata</i> (Forel, 1885)          | 1339  | 10.503 |
| <i>Nylanderia guatemalensis</i> (Forel, 1885)             | 10857 | 85.16  | <i>Nesomyrmex echinatinodis</i> (Forel, 1886)          | 10401 | 81.583 |
| <i>Nylanderia parvula</i> (Mayr, 1870)                    | 5     | 0.039  | <i>Nesomyrmex wilda</i> (Smith, 1943)                  | 6167  | 48.372 |
| <i>Nylanderia steinheili</i> (Forel, 1893)                | 9231  | 72.406 | <i>Octostruma balzani</i> (Emery, 1894)                | 7333  | 57.518 |
| <b>Myrmicinae</b>                                         |       |        | <i>Octostruma trithrix</i> Longino, 2013               | 6877  | 53.941 |
| <i>Acromyrmex octospinosus</i> (Reich, 1793)              | 2434  | 19.092 | <i>Paratrachymyrmex intermedius</i> (Forel, 1909)      | 11521 | 90.368 |
| <i>Adelomyrmex micans</i> Fernández, 2003                 | 4586  | 35.971 | <i>Pheidole absurda</i> Forel, 1886                    | 1615  | 12.668 |
| <i>Adelomyrmex myops</i> (Wheeler, 1910)                  | 6272  | 49.196 | <i>Pheidole agricola</i> Wilson, 2003                  | 9466  | 74.249 |
| <i>Adelomyrmex paratristani</i> Longino, 2012             | 2853  | 22.378 | <i>Pheidole bilimeki</i> Mayr, 1870                    | 4559  | 35.76  |
| <i>Adelomyrmex robustus</i> Fernández, 2003               | 2455  | 19.256 | <i>Pheidole fimbriata</i> Roger, 1863                  | 10553 | 82.775 |
| <i>Adelomyrmex silvestrii</i> (Menozi, 1931)              | 10648 | 83.52  | <i>Pheidole flavens</i> Roger, 1863                    | 9247  | 72.531 |
| <i>Adelomyrmex tristani</i> (Menozi, 1931)                | 6289  | 49.329 | <i>Pheidole gouldi</i> Forel, 1886                     | 8542  | 67.001 |
| <i>Apterostigma pilosum</i> Mayr, 1865                    | 10125 | 79.418 | <i>Pheidole harrisonfordi</i> Wilson, 2003             | 12181 | 95.545 |
| <i>Atta cephalotes</i> (Linnaeus, 1758)                   | 3720  | 29.179 | <i>Pheidole insipida</i> Forel, 1899                   | 3563  | 27.947 |
| <i>Atta mexicana</i> (Smith, 1858)                        | 7418  | 58.185 | <i>Pheidole lamia</i> Wheeler, W.M., 1901              | 22    | 0.173  |
| <i>Carebara urichi</i> (Wheeler, 1922)                    | 9789  | 76.782 | <i>Pheidole mackayi</i> Wilson, 2003                   | 6260  | 49.102 |
| <i>Cephalotes minutus</i> (Fabricius, 1804)               | 11062 | 86.768 | <i>Pheidole nubicola</i> Wilson, 2003                  | 10156 | 79.661 |
| <i>Cephalotes multispinosus</i> (Norton, 1868)            | 8321  | 65.268 | <i>Pheidole oaxacana</i> Wilson, 2003                  | 12533 | 98.306 |
| <i>Cephalotes pallens</i> (Klug, 1824)                    | 9762  | 76.571 | <i>Pheidole prattorum</i> Wilson, 2003                 | 4101  | 32.167 |
| <i>Cephalotes scutulatus</i> (Smith, 1867)                | 7633  | 59.871 | <i>Pheidole psilogaster</i> Wilson, 2003               | 5388  | 42.262 |
| <i>Cephalotes setulifer</i> (Emery, 1894)                 | 8296  | 65.072 | <i>Pheidole punctatissima</i> Mayr, 1870               | 836   | 6.557  |
| <i>Cephalotes umbraculatus</i> (Fabricius, 1804)          | 1195  | 9.373  | <i>Pheidole roushae</i> Wilson, 2003                   | 11616 | 91.113 |
| <i>Crematogaster corvina</i> Mayr, 1870                   | 12319 | 96.627 | <i>Pheidole simonsi</i> Wilson, 2003                   | 6166  | 48.365 |
| <i>Crematogaster crinosa</i> Mayr, 1862                   | 10055 | 78.869 | <i>Pheidole subarmata</i> Mayr, 1884                   | 2187  | 17.154 |
| <i>Crematogaster curvispinosa</i> Mayr, 1862              | 9115  | 71.496 | <i>Pheidole susannae</i> Forel, 1886                   | 8742  | 68.57  |
| <i>Crematogaster erecta</i> Mayr, 1866                    | 11165 | 87.575 | <i>Pheidole tepicana</i> Pergande, 1896                | 8159  | 63.997 |
| <i>Crematogaster formosa</i> Mayr, 1870                   | 5482  | 42.999 | <i>Pheidole titanis</i> Wheeler, 1903                  | 10445 | 81.928 |
| <i>Crematogaster limata</i> Smith, 1858                   | 11353 | 89.05  | <i>Pheidole ursus</i> Mayr, 1870                       | 298   | 2.337  |

| Subfamily/Species                                  | N     | %      | Subfamily/Species                                  | N     | %      |
|----------------------------------------------------|-------|--------|----------------------------------------------------|-------|--------|
| <i>Pheidole xyston</i> Wilson, 2003                | 2669  | 20.935 | <i>Hypoponera opacior</i> (Forel, 1893)            | 12307 | 96.533 |
| <i>Pogonomyrmex barbatus</i> (Smith, 1858)         | 6797  | 53.314 | <i>Hypoponera parva</i> (Forel, 1909)              | 6874  | 53.918 |
| <i>Procryptocerus scabriusculus</i> Forel, 1899    | 3298  | 25.869 | <i>Leptogenys elongata</i> (Buckley, 1866)         | 10084 | 79.096 |
| <i>Rhopalothrix weberi</i> Brown & Kempf, 1960     | 11328 | 88.854 | <i>Leptogenys pusilla</i> (Emery, 1890)            | 300   | 2.353  |
| <i>Rogeria belti</i> Mann, 1922                    | 8722  | 68.413 | <i>Leptogenys quiriguana</i> Wheeler, 1923         | 6     | 0.047  |
| <i>Rogeria innotabilis</i> Kugler, 1994            | 3579  | 28.073 | <i>Neoponera apicalis</i> (Latreille, 1802)        | 9375  | 73.535 |
| <i>Sericomyrmex opacus</i> Mayr, 1865              | 5411  | 42.443 | <i>Neoponera carinulata</i> (Roger, 1861)          | 10035 | 78.712 |
| <i>Solenopsis azteca</i> Forel, 1893               | 94    | 0.737  | <i>Neoponera crenata</i> (Roger, 1861)             | 1619  | 12.699 |
| <i>Solenopsis geminata</i> (Fabricius, 1804)       | 7558  | 59.283 | <i>Neoponera verenae</i> Forel, 1922               | 8344  | 65.448 |
| <i>Solenopsis globularia</i> (Smith, 1858)         | 11591 | 90.917 | <i>Neoponera villosa</i> (Fabricius, 1804)         | 2982  | 23.39  |
| <i>Solenopsis molesta</i> (Say, 1836)              | 6750  | 52.945 | <i>Odontomachus bauri</i> Emery, 1892              | 554   | 4.345  |
| <i>Solenopsis picea</i> Emery, 1896                | 236   | 1.851  | <i>Odontomachus biolleyi</i> Forel, 1908           | 10176 | 79.818 |
| <i>Solenopsis succinea</i> Emery, 1890             | 4006  | 31.422 | <i>Odontomachus chelifer</i> (Latreille, 1802)     | 3151  | 24.716 |
| <i>Solenopsis tenuis</i> Mayr, 1878                | 5994  | 47.015 | <i>Odontomachus laticeps</i> Roger, 1861           | 4815  | 37.768 |
| <i>Solenopsis xyloni</i> McCook, 1880              | 6210  | 48.71  | <i>Odontomachus ruginodis</i> Wheeler, 1908        | 11929 | 93.568 |
| <i>Solenopsis zeteki</i> Wheeler, 1942             | 283   | 2.22   | <i>Odontomachus yucatecus</i> Brown, 1976          | 5165  | 40.513 |
| <i>Stenamma connectum</i> Branstetter, 2013        | 1237  | 9.703  | <i>Pachycondyla harpax</i> (Fabricius, 1804)       | 5995  | 47.023 |
| <i>Stenamma excisum</i> Branstetter, 2013          | 6291  | 49.345 | <i>Pachycondyla impressa</i> (Roger, 1861)         | 10900 | 85.497 |
| <i>Stenamma felixi</i> Mann, 1922                  | 12747 | 99.984 | <i>Platythyrea punctata</i> (Smith, 1858)          | 2221  | 17.421 |
| <i>Stenamma huachucanum</i> Smith, 1957            | 4214  | 33.054 | <i>Ponera exotica</i> Smith, 1962                  | 5539  | 43.447 |
| <i>Stenamma leptospinum</i> Branstetter, 2013      | 7250  | 56.867 | <i>Ponera pennsylvanica</i> Buckley, 1866          | 1000  | 7.844  |
| <i>Stenamma lobinodus</i> Branstetter, 2013        | 10111 | 79.308 | <i>Pseudoponera stigma</i> (Fabricius, 1804)       | 9875  | 77.457 |
| <i>Stenamma maximon</i> Branstetter, 2013          | 11778 | 92.384 | <i>Rasopone ferruginea</i> (Smith, 1858)           | 8639  | 67.762 |
| <i>Stenamma pelophilum</i> Branstetter, 2013       | 3434  | 26.935 | <b>Proceratiinae</b>                               |       |        |
| <i>Stenamma stictosomum</i> Branstetter, 2013      | 8933  | 70.068 | <i>Discothyrea horni</i> Menozzi, 1927             | 6494  | 50.937 |
| <i>Stenamma vexator</i> Branstetter, 2013          | 4752  | 37.274 | <i>Proceratium mancum</i> Mann, 1922               | 5111  | 40.089 |
| <i>Strumigenys boneti</i> Brown, 1959              | 2518  | 19.751 | <i>Proceratium micrommatum</i> (Roger, 1863)       | 6416  | 50.326 |
| <i>Strumigenys brevicornis</i> Mann, 1922          | 8667  | 67.982 | <b>Pseudomyrmecinae</b>                            |       |        |
| <i>Strumigenys eggersi</i> Emery, 1890             | 7970  | 62.515 | <i>Pseudomyrmex boopis</i> (Roger, 1863)           | 12711 | 99.702 |
| <i>Strumigenys elongata</i> Roger, 1863            | 3526  | 27.657 | <i>Pseudomyrmex brunneus</i> (Smith, 1877)         | 2988  | 23.437 |
| <i>Strumigenys louisianae</i> Roger, 1863          | 4748  | 37.242 | <i>Pseudomyrmex caeciliae</i> (Forel, 1913)        | 10899 | 85.489 |
| <i>Strumigenys ludia</i> Mann, 1922                | 4794  | 37.603 | <i>Pseudomyrmex championi</i> (Forel, 1899)        | 8715  | 68.358 |
| <i>Strumigenys margaritae</i> Forel, 1893          | 7423  | 58.224 | <i>Pseudomyrmex cubaensis</i> (Forel, 1901)        | 9349  | 73.331 |
| <i>Strumigenys micretes</i> Brown, 1959            | 673   | 5.279  | <i>Pseudomyrmex ejectus</i> (Smith, 1858)          | 9391  | 73.661 |
| <i>Strumigenys pariensis</i> Lattke & Goitía, 1997 | 1875  | 14.707 | <i>Pseudomyrmex elongatus</i> (Mayr, 1870)         | 10915 | 85.615 |
| <i>Strumigenys rogata</i> (Bolton, 2000)           | 4326  | 33.932 | <i>Pseudomyrmex ferrugineus</i> (Smith, 1877)      | 10119 | 79.371 |
| <i>Strumigenys schulzi</i> Emery, 1894             | 7937  | 62.256 | <i>Pseudomyrmex filiformis</i> (Fabricius, 1804)   | 10403 | 81.599 |
| <i>Strumigenys subdentata</i> Mayr, 1887           | 715   | 5.608  | <i>Pseudomyrmex gracilis</i> (Fabricius, 1804)     | 8667  | 67.982 |
| <i>Temnothorax aztecus</i> (Wheeler, 1931)         | 11079 | 86.901 | <i>Pseudomyrmex ita</i> (Forel, 1906)              | 11026 | 86.485 |
| <i>Temnothorax subditivus</i> (Wheeler, 1903)      | 4087  | 32.057 | <i>Pseudomyrmex major</i> (Forel, 1899)            | 5573  | 43.713 |
| <i>Tetramorium spinosum</i> (Pergande, 1896)       | 9459  | 74.194 | <i>Pseudomyrmex oculatus</i> (Smith, 1855)         | 10994 | 86.234 |
| <i>Trachymyrmex saussurei</i> (Forel, 1885)        | 7372  | 57.824 | <i>Pseudomyrmex pallidus</i> (Smith, 1855)         | 6410  | 50.278 |
| <i>Wasmannia auropunctata</i> (Roger, 1863)        | 52    | 0.408  | <i>Pseudomyrmex peperii</i> (Forel, 1913)          | 11707 | 91.827 |
| <i>Xenomyrmex panamanus</i> (Wheeler, W.M., 1922)  | 6382  | 50.059 | <i>Pseudomyrmex seminole</i> Ward, 1985            | 7827  | 61.393 |
| <b>Ponerinae</b>                                   |       |        | <i>Pseudomyrmex simplex</i> (Smith, 1877)          | 8589  | 67.37  |
| <i>Anochetus mayri</i> Emery, 1884                 | 1735  | 13.609 | <i>Pseudomyrmex spiculus</i> Ward, 1989            | 11202 | 87.866 |
| <i>Cryptopone gilva</i> (Roger, 1863)              | 9064  | 71.096 | <i>Pseudomyrmex subater</i> (Wheeler & Mann, 1914) | 3835  | 30.081 |
| <i>Hypoponera nitidula</i> (Emery, 1890)           | 9497  | 74.492 | <i>Pseudomyrmex tenuissimus</i> (Emery, 1906)      | 9165  | 71.888 |
| <i>Hypoponera opaciceps</i> (Mayr, 1887)           | 3494  | 27.406 | <i>Pseudomyrmex viduus</i> (Smith, 1858)           | 7735  | 60.671 |