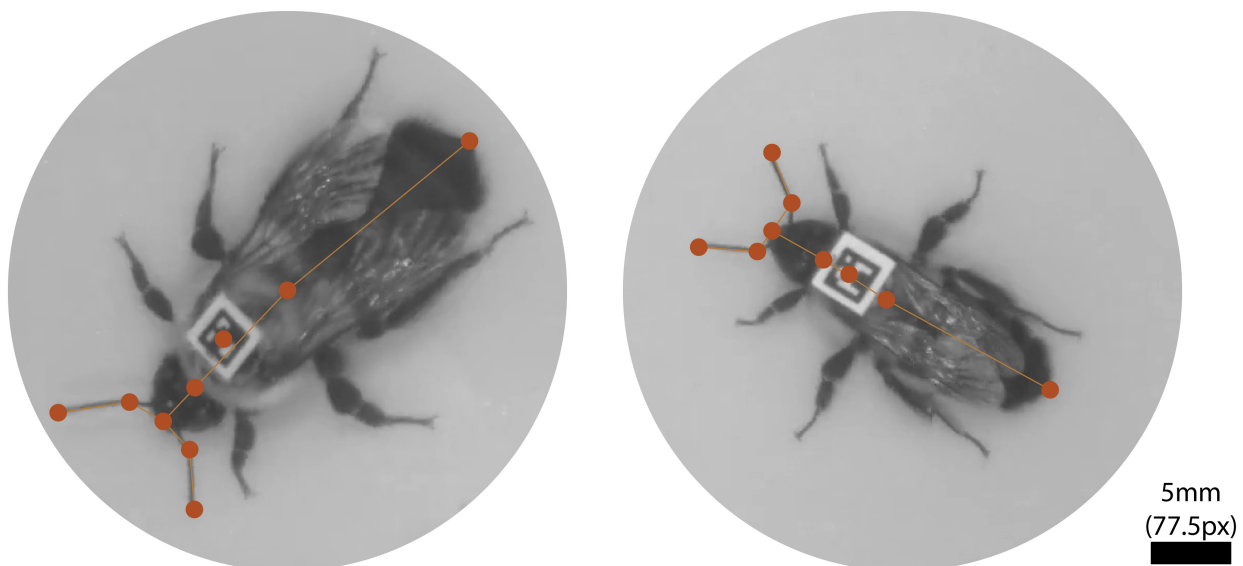


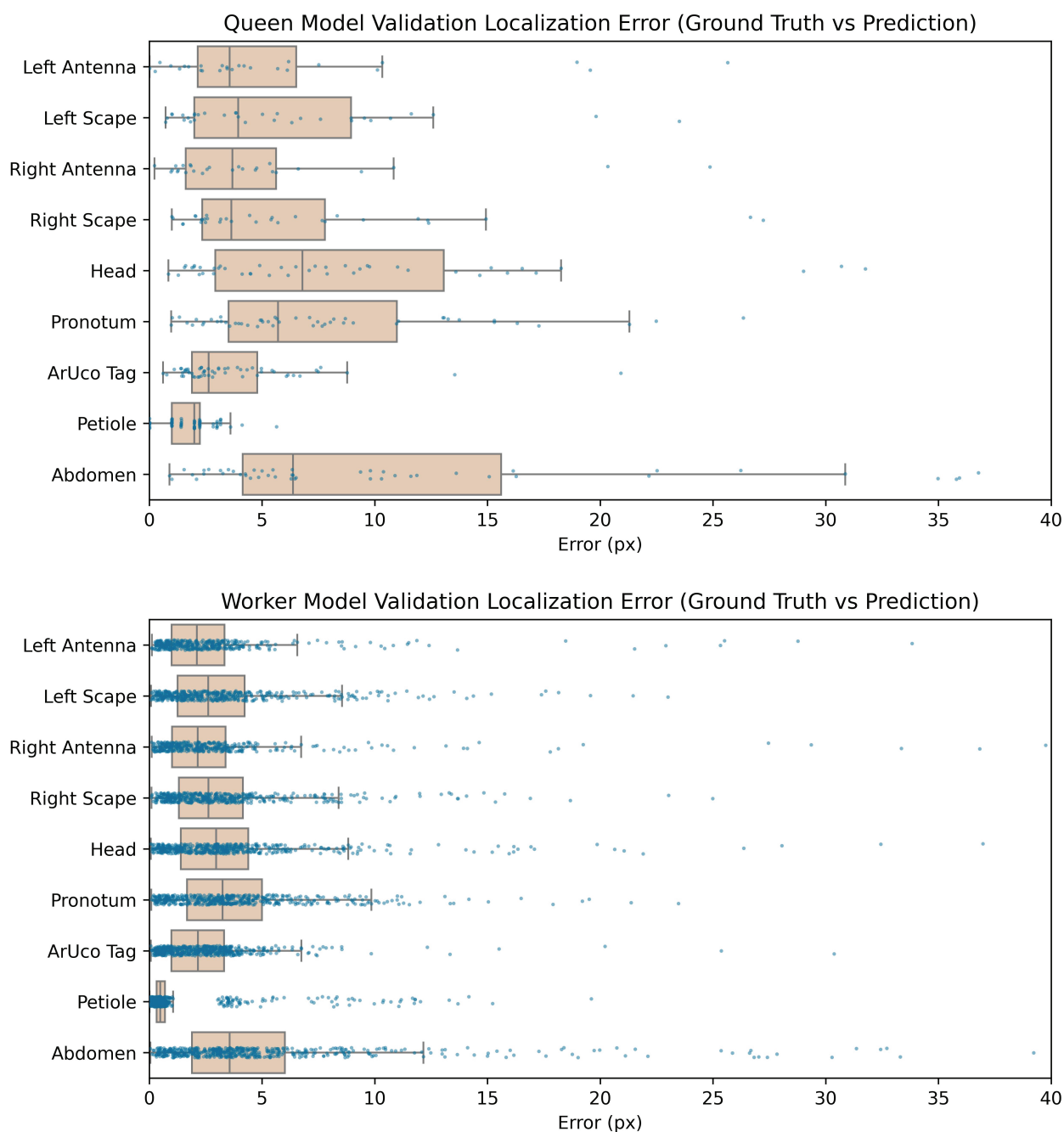
Supplementary Information

Measure	Meaning	Modality
Mean Degree	Average number of interactions per node per hour	Network-Level
Efficiency	Mean distance between any two random nodes, using the inverse of weight as our "barrier" to communication	Network-Level
Degree Assortativity	Enrichment (if positive) or depletion (if negative) of interactions between bees with high degrees or low degrees, relative to mean degree	Network-Level
Hub Bee Assortativity	Enrichment (if positive) or depletion (if negative) of interactions between hub bees or non-hub bees, relative to mean degree	Network-Level
Modularity	Proportion of interactions between bees within a module (identified using networkx's greedy modularity community detector) relative to all interactions	Network-Level
Transitivity	Density of complete triads relative to possible triads within a network	Network-Level
Degree Centrality	Sum of all weighted interactions	Individual-Level
Betweenness Centrality	Probability a given bee is on the shortest path between two other individuals, using the inverse of weight as a "barrier" to communication	Individual-Level
Closeness Centrality	Average distance to any other bee, using the inverse of weight as a "barrier" to communication	Individual-Level
Eigenvector Centrality	Measure of a bee's influence in the network, based on both the number of direct connections it has and the importance of the bees it is connected to	Individual-Level
Movement Percentage	Percentage of the hour a bee is moving above the threshold for movement	Individual-Level
Average Velocity	Average pixels per frame a bee is moving when above the threshold for movement	Individual-Level
Home Range (N90)	Smallest number of 200 pixel by 200 pixel frames which represent 90 percent of a bee's time in a given hour	Individual-Level
Presence	Percent of frames a given node or set of nodes is present in	Individual-Level
Clustering Coefficient	Measure of the extent to which a bee's direct connections are also connected to each other, weighted by strength of the connection	Individual-Level

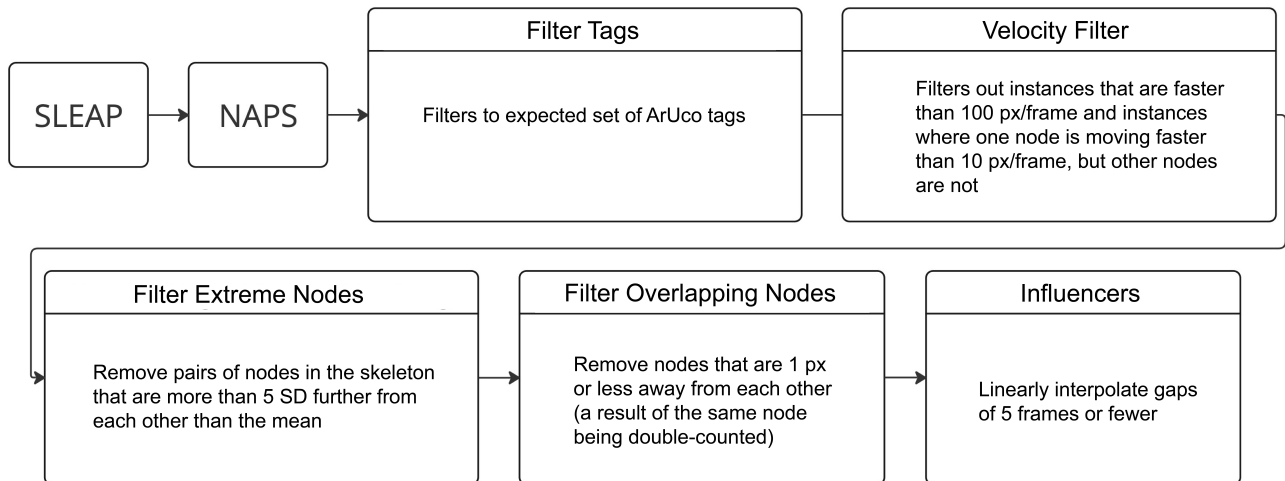
Supplementary Table 1. Individual and network-level parameters measured in this experiment.



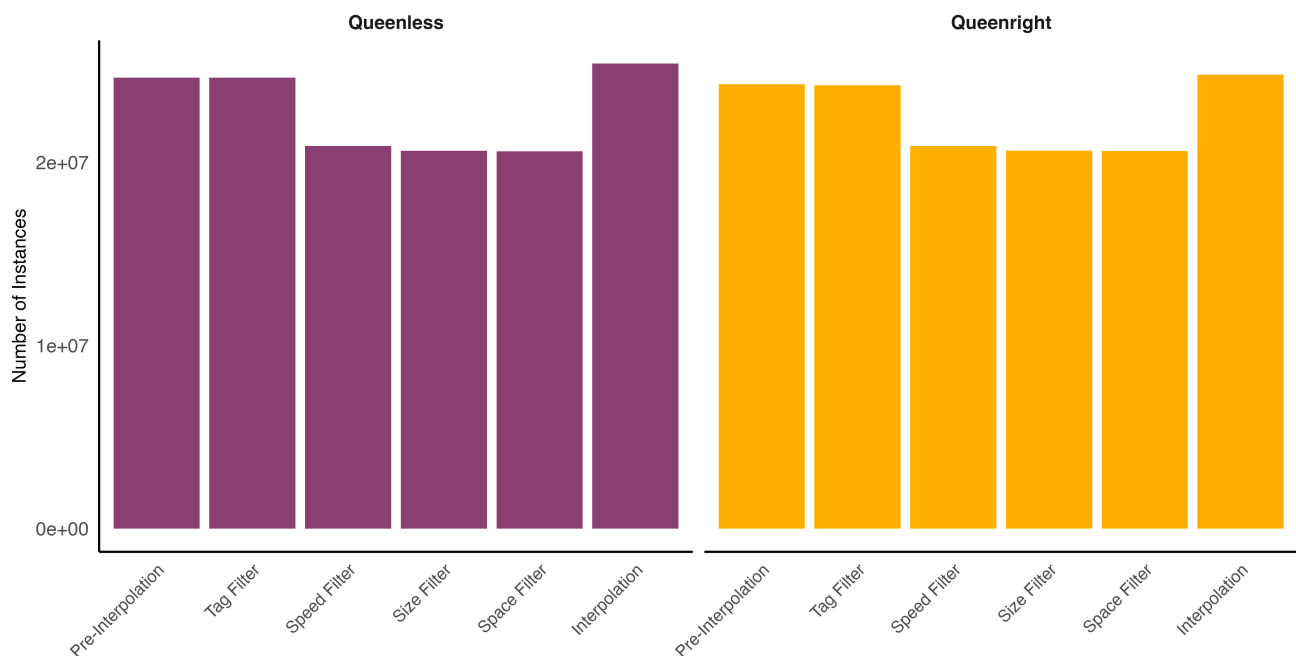
Supplementary Figure 1. Example SLEAP skeletons on queen and worker showing the nine nodes used for analysis.



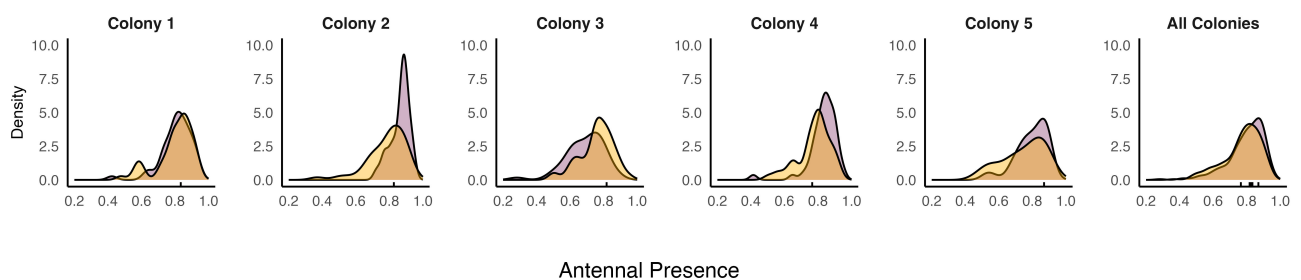
Supplementary Figure 2. SLEAP model metrics for the queen and worker models. For this study, px/mm ratio = 15.5, meaning that nearly all localization errors are at the sub-millimeter level. Box and whiskers plots show median, interquartile range (IQR), and upper and lower limits representing $1.5 \times \text{IQR}$ above or below the upper and lower quartile, respectively. Each dot represents an instance of detection error in a validation frame.



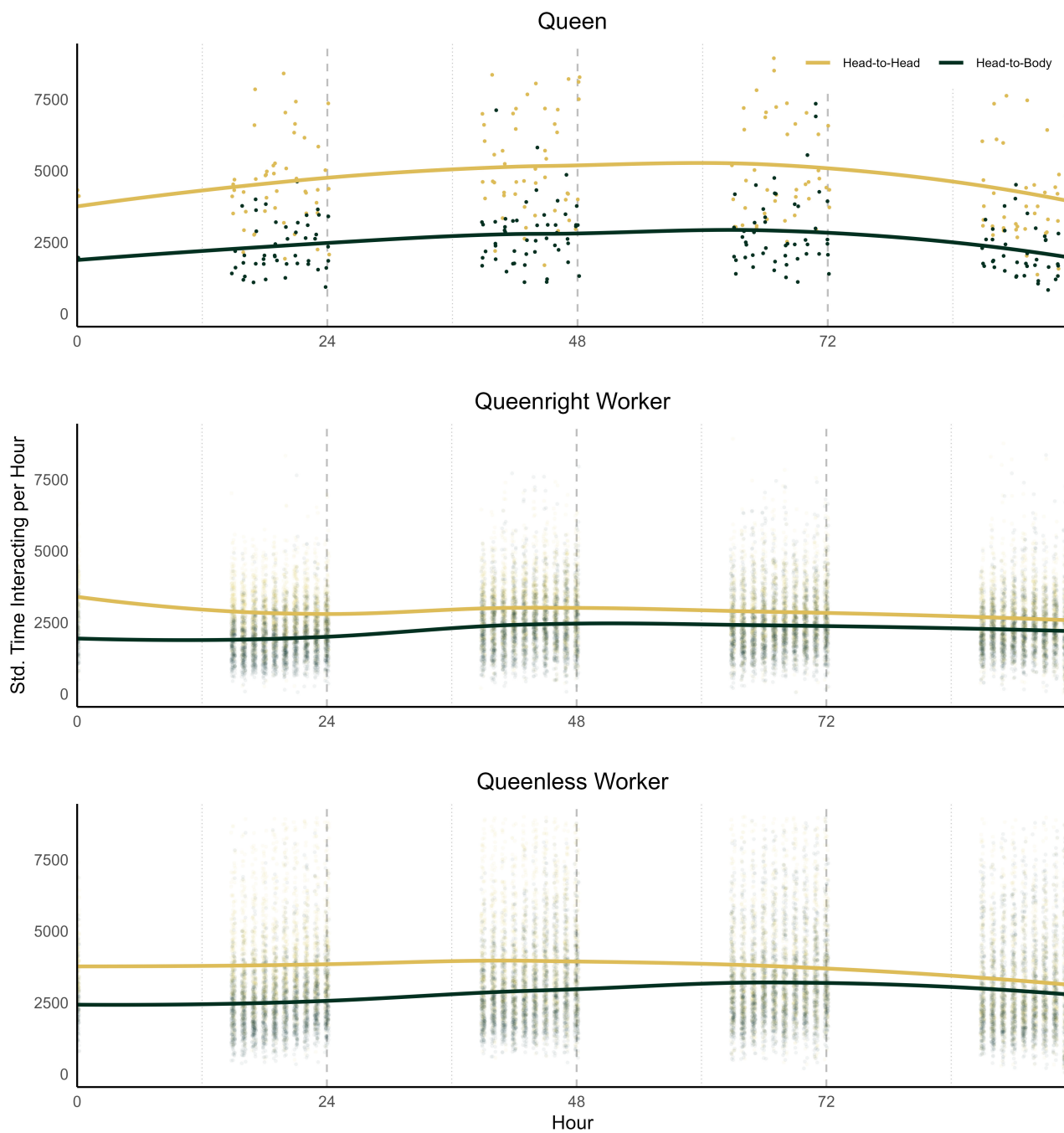
Supplementary Figure 3. Diagram of filtering steps applied after generating NAPS tracks.



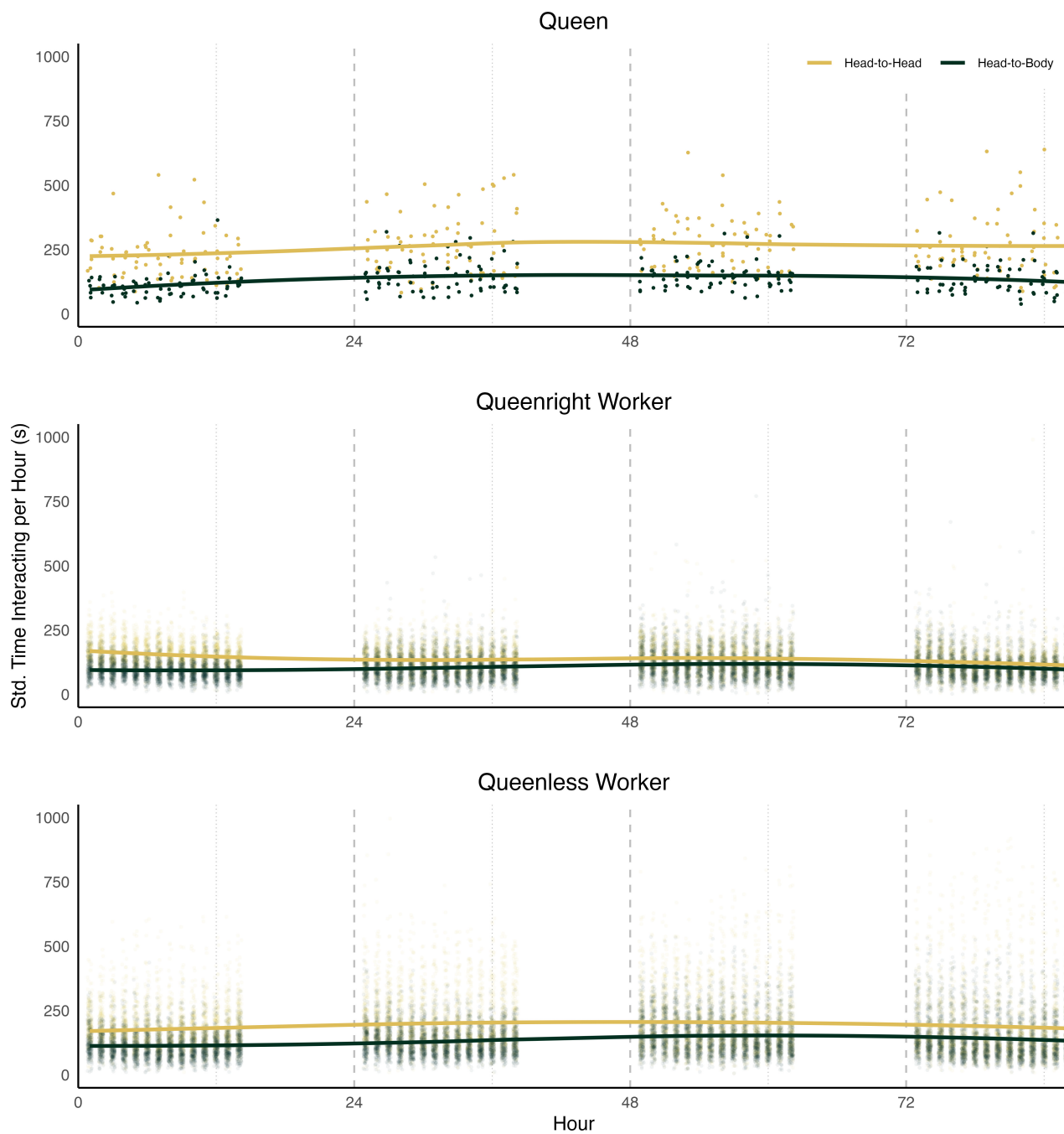
Supplementary Figure 4. Post-filtering bar plot show total number of instances across all bees across all frames during filtering and interpolation steps.



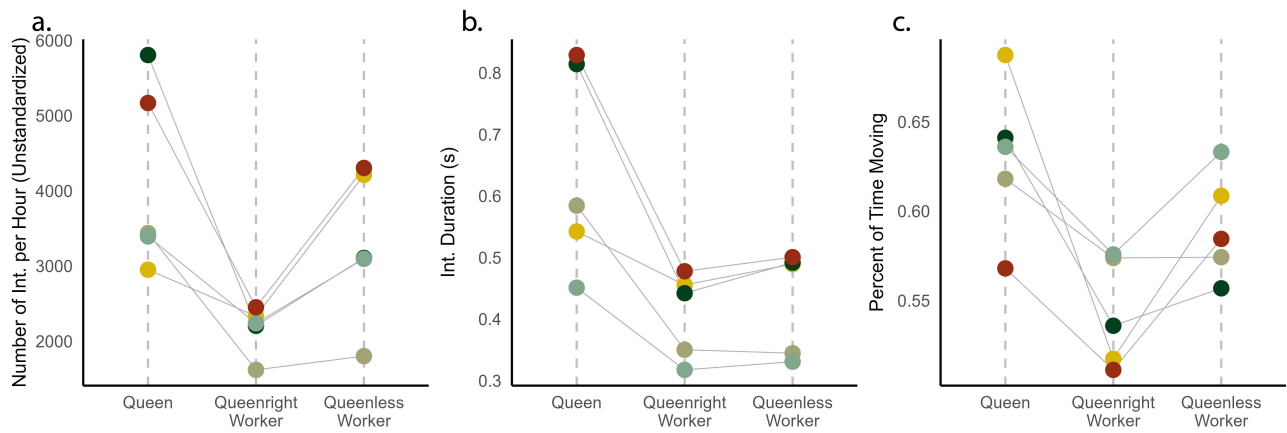
Supplementary Figure 5. Density plots showing antennal presence per colony.



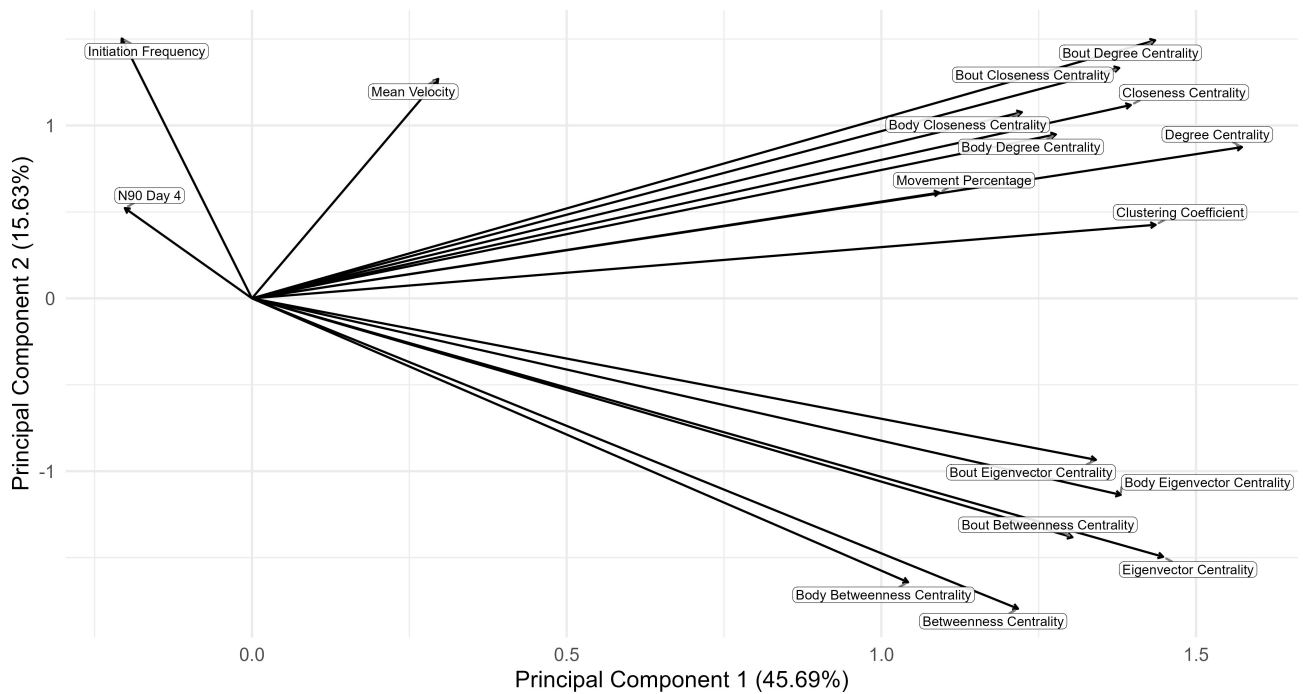
Supplementary Figure 6. Plots showing standardized interacting time per hour for head-to-head and head-to-body across queens, queenright workers, and queenless workers from 9:00-17:00 each day.



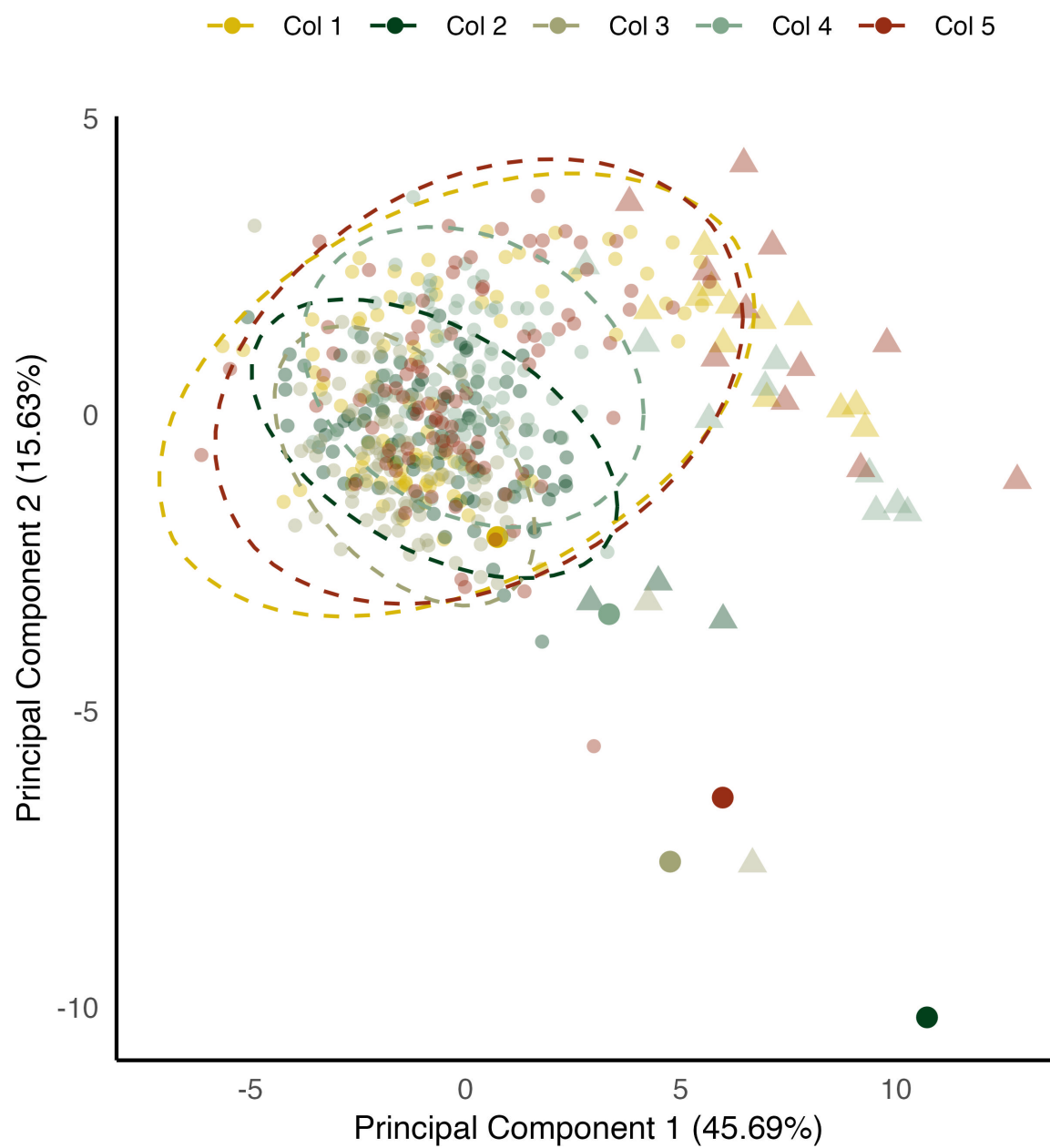
Supplementary Figure 7. Plots showing status (queen, queenright worker, queenless worker) by interactions per hour during nighttime hours



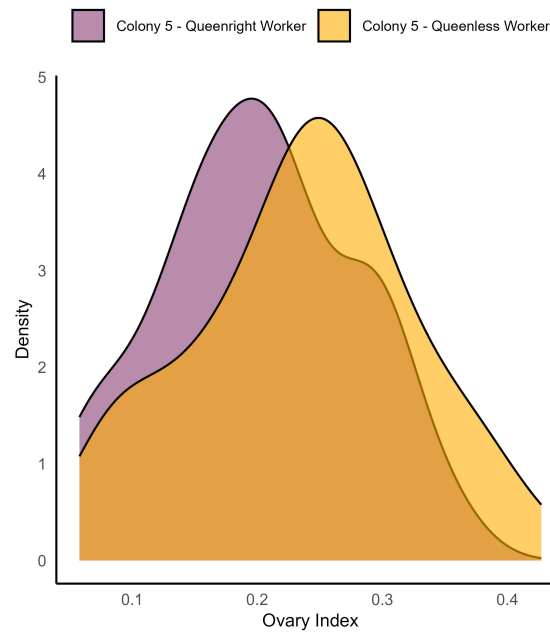
Supplementary Figure 8. Plots showing status (queen, queenright worker, queenless worker) by individual features: interactions per hour (not standardized to antennal presence), interaction duration, and percent of time moving.



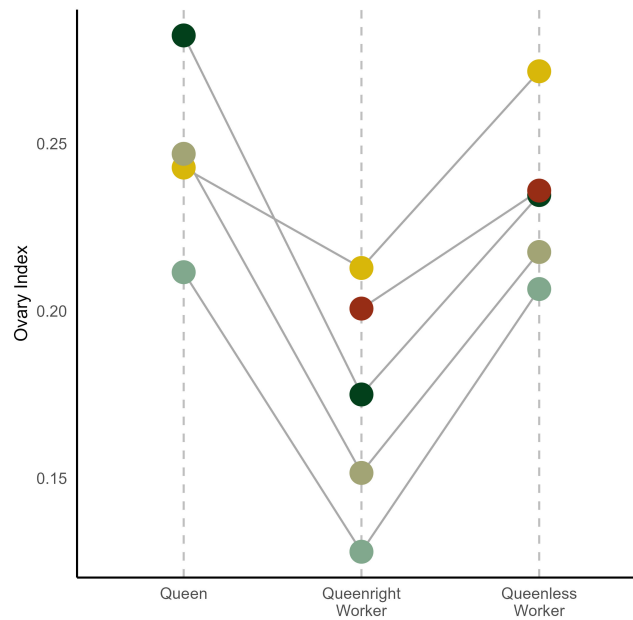
Supplementary Figure 9. Loading plot showing features used to classify hub bees.



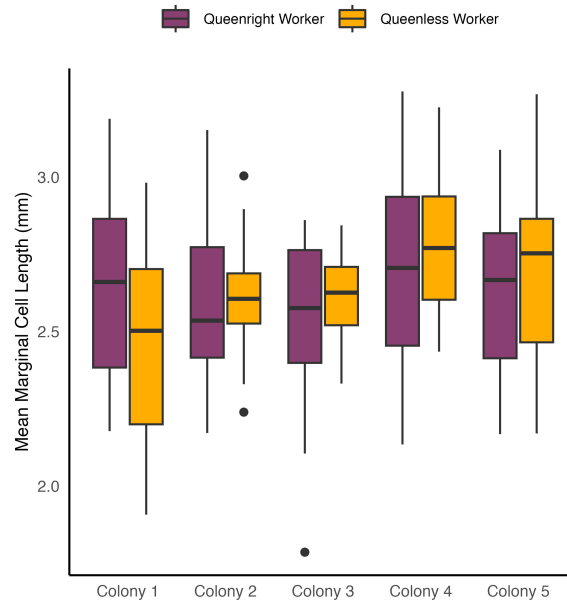
Supplementary Figure 10. PCA plot from Figure 3a colored by colony with queens enlarged. Outlier bees (triangles) were also enlarged



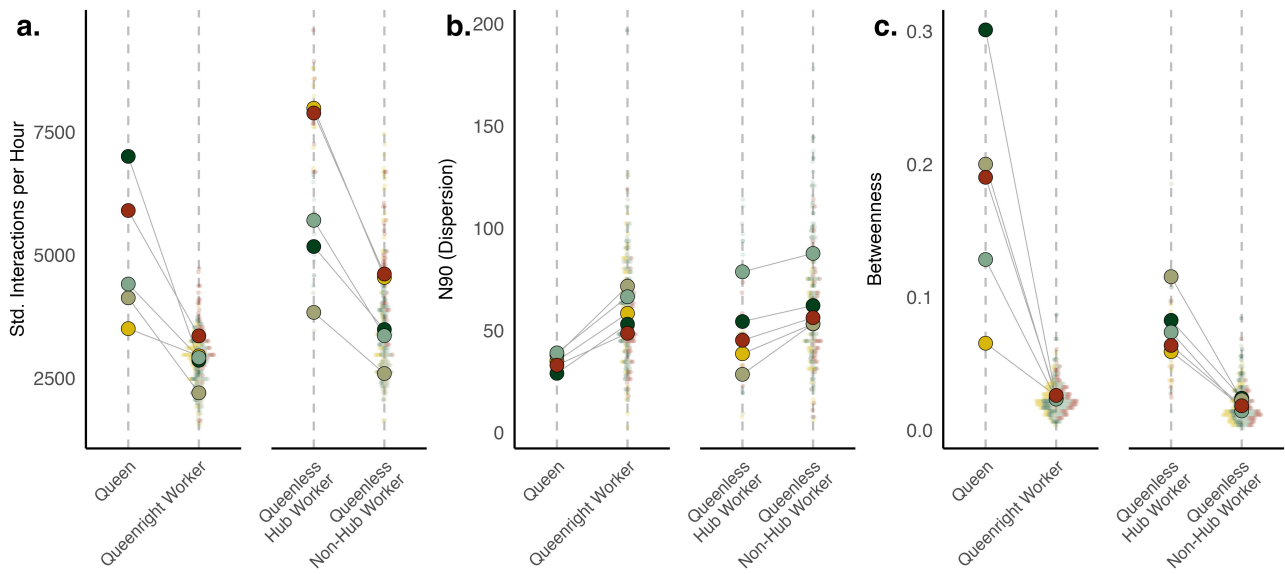
Supplementary Figure 11. Density plot showing ovary index distributions for Colony 5 grouped by queenright, queenless status. We dissected all individuals in a single colony , Colony 5, to validate our initial hypothesis about variation in ovary index.



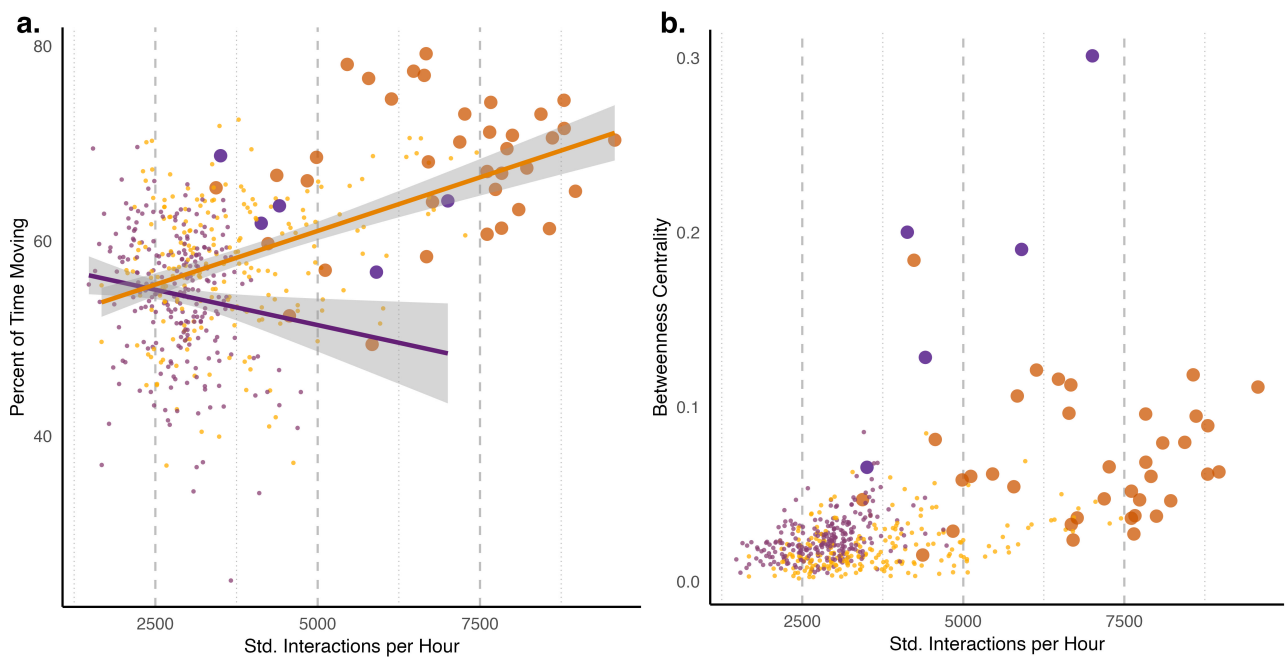
Supplementary Figure 12. Mean ovary index (width of longest ovariole divided by marginal cell length) by queen, queenright worker, queenless worker status colored by colony.



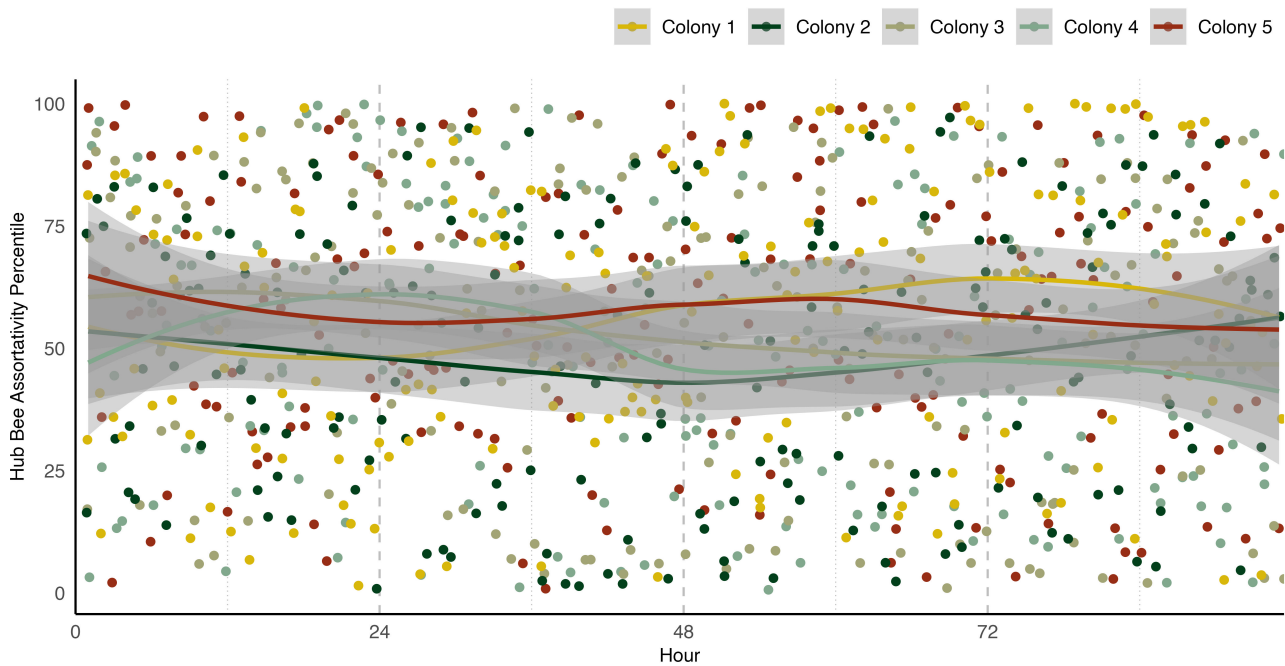
Supplementary Figure 13. Box plots showing mean marginal cell lengths by queenright (purple)/ queenless (orange) status and source colony.



Supplementary Figure 14. Key network parameters standardized interaction rate (a), dispersion (b), and betweenness centrality (c) in queens, queenright workers, queenless hub workers, and queenless non-hub workers. Large dots show colony means and smaller dots show individual measurements for the parameters.

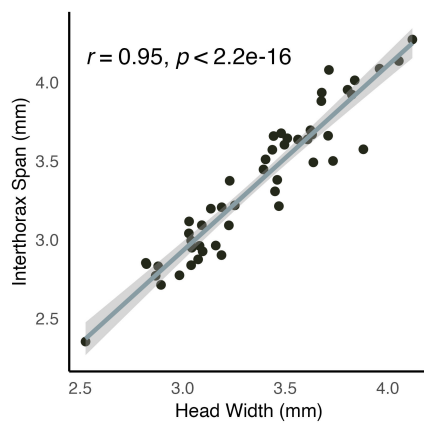


Supplementary Figure 15. (a) Percent of time moving by standard interactions per hour and (b) betweenness centrality by standard interactions per hour. Purple corresponds to queenright individuals and orange to queenless, enlarged purple dots are queens and enlarged orange dots represent queenless hub bees.

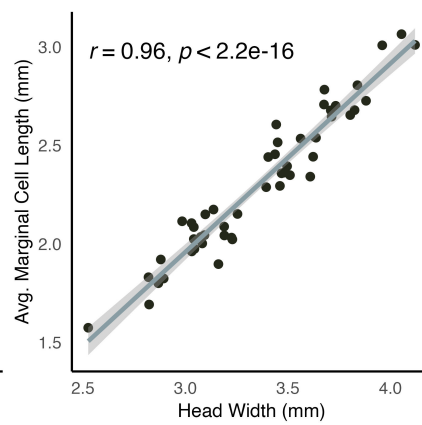


Supplementary Figure 16. Assortativity between hub bees in queenless colonies over time. Colonies are split by color and LOESS fit for each colony is shown.

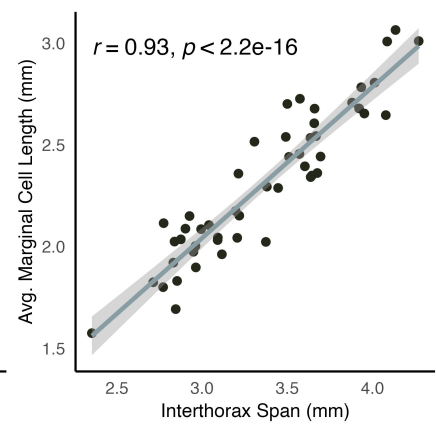
a.



b.



c.



Supplementary Figure 17. Scatter plots showing relationships between size measurements. (a) Scatter plot showing relationship between interthorax span (mm) and head width (mm). (b) Scatter plot showing relationship between average marginal cell length (mm) and head width (mm). (c) Scatter plot showing relationship between average marginal cell length (mm) and interthorax span (mm).