Supplemental Content

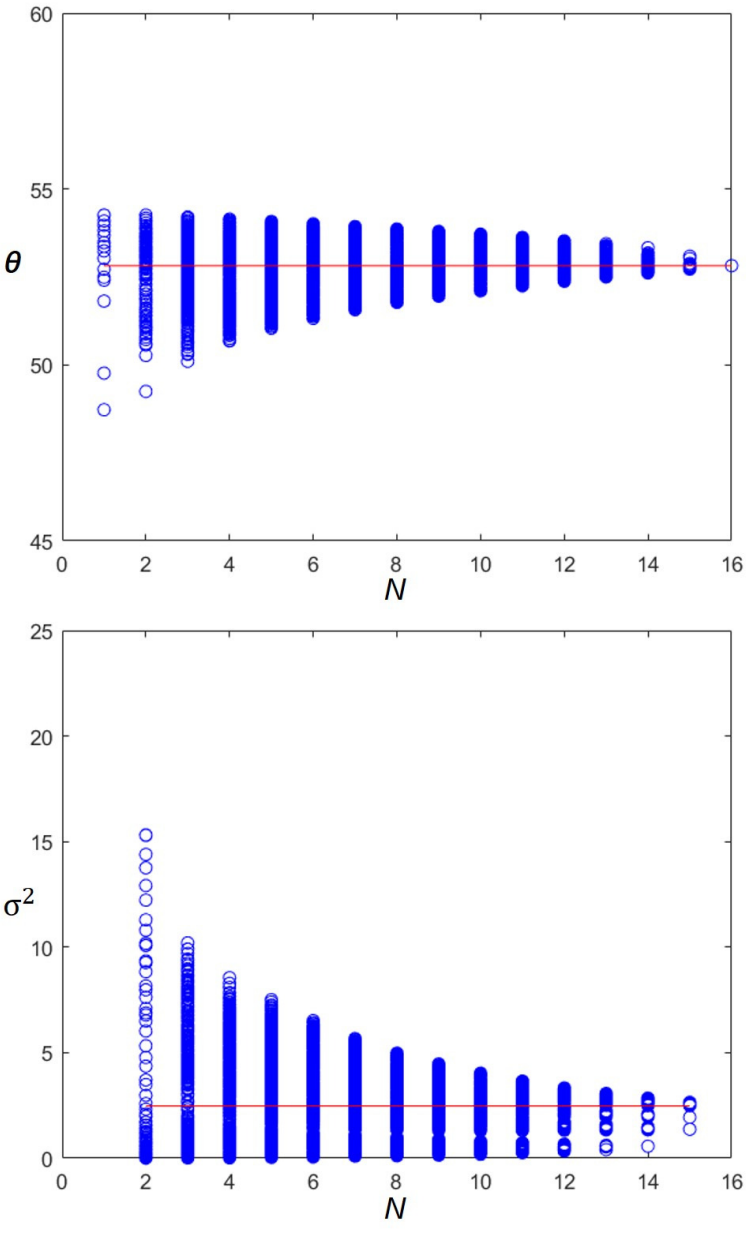

Figure 1: Sample size justification. Rarefaction to assess the effect of family richness on our estimation of variance: Variance σ^2 and θ values calculated for different numbers of sampled moth families (N), with a random sample of N families at each level of rarefaction. Convergence of values can be seen with increased sampling effort.

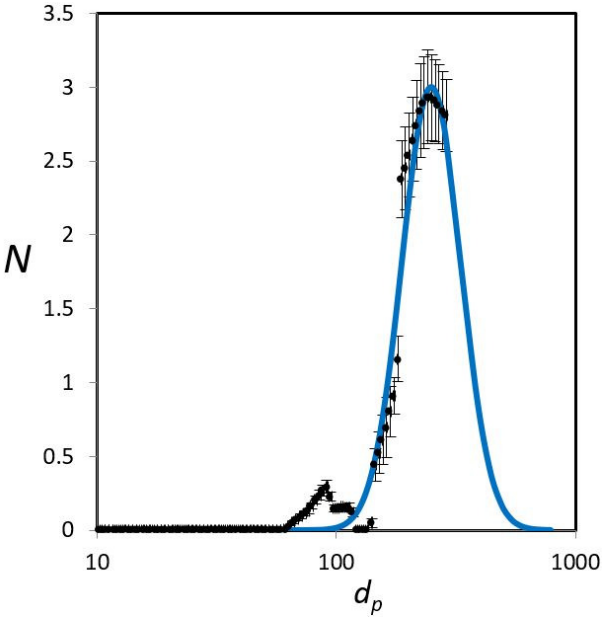

Figure 2: Number distribution N of particles in millions per cm^3 used in experiment by particle diameter in nanometers d_p with log-normal trend in blue.

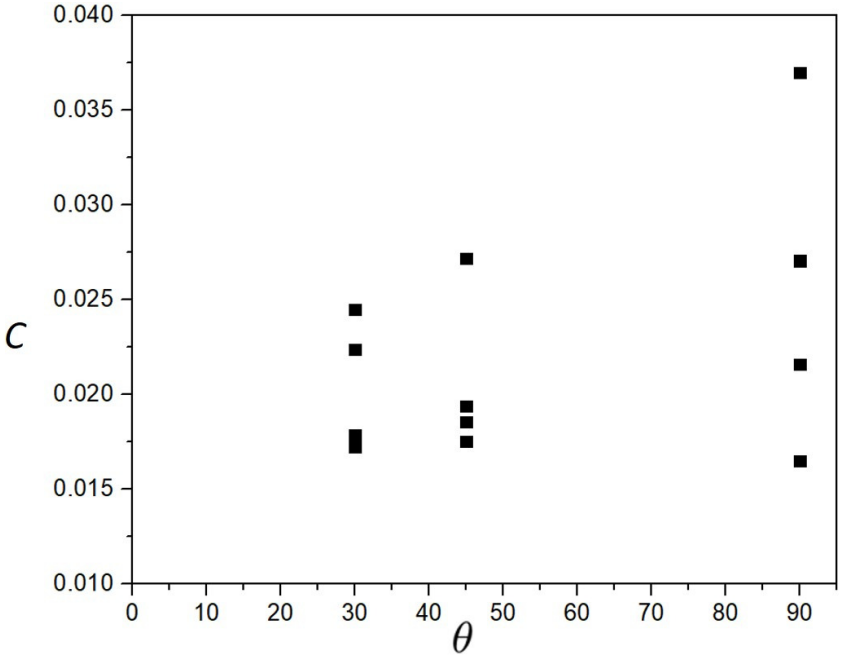

Figure 3: PH strips experimental data: Concentration of hydrogen ions at different cylinder angles. Concentration C is in mol H+ per liter air. Angle of cylinder with respect to bulk flow direction θ is in degrees

Table 1: Variable List

Symbol	Name	Description
A	Projected area	Frontal area of cylinder projected onto y-z plane, in μm^2
A_s	Surface area	Estimated cylinder surface area ignoring end effects
C	Concentration	3×10^9 pheromone molecules per m^3 to elicit moth response
d	Diameter	Moth stalk diameter of 136 ± 36 µm, branch diameter of 43 ± 14 µm, and sensilla diameter of 5.5 ± 1.4 µm.
D	Diffusion coefficients	5.74×10^{-10} m^2/s for humid air in wind tunnel experiment 2.5×10^{-5} m^2/s to 2.5×10^{-6} m^2/s for odor and pheromone
d_c	Collector Diameter	135 µm diameter cylinder used as mimic in wind tunnel experiment
d_p	Particle Diameter	Diameter of drops used in wind tunnel experiment: $2*r_p$
L	Length of cylinder	Fiber length of 3 mm used in wind tunnel experiment
L_b	Branch length	Average length of antennae branch: 750 ± 395 µm
L_s	Sensilla length	Average length of antennae sensilla: 70 ± 25 µm
L_{st}	Stalk length	Average length of antennae stalk: 9 ± 2 mm
M	Mass of moth	Mass of dried moth in grams
N	Number of molecules	Estimated number of pheromone molecules needed to excite
N_b	Total number of branches	Average number of branches per antennae stalk: 85 ± 20
N_s	Total number of sensilla	Average number of sensilla per antennae branch: 28 ± 14
r_p	Drop radius	Radius of drops used in wind tunnel experiment: 5 µm
S_b	Branch spacing	Center to center distance between branches: 116 ± 35 µm
S_s	Sensilla spacing	Center to center distance between sensilla: 24 ± 4.4 µm
t	Travel time	Average time a particle travels next to the collection cylinder
T	Detection time	Estimated time to collect required number of molecules
U	Air velocity	0.5 m/s in wind tunnel experiment. 0.75-1 m/s moth flight
x	Diffusion distance	Distance that a particle can travel by diffusion in a given time
η	Capture efficiency	Single cylindrical collector capture efficiency: 2-2.6
v	Kinematic viscosity	Air kinematic viscosity at room temperature: 1.46×10^{-5} m^2/s
ρ	Density	Air density at room temperature. 1.23 kg/m^3
ϕ	Stalk angle	Angle between stalk and flight direction in x-z plane in degrees
θ	First branch angle	Angle between branch and stalk in x-z plane in degrees
γ	Second branch angle	Angle between branch and stalk in x-y plane in degrees
α	Lingering coefficient	Dimensionless term to account for the deflection of the streamlines that encourages flow to linger around the cylinder
κ	Percent covered	Percentage of fiber covered per second

Variables and associated values

Table 2: Moth Specimen Information

	Identification	Family	Location	Year
1	Unidentified Blastobasidae sp. 1	Blastobasidae	Heredia, Costa Rica	-
2	Unidentified Blastobasidae sp. 2	Blastobasidae	Heredia, Costa Rica	2003
3	*Apatelodes sp.*	Bombycidae	Heredia, Costa Rica	1999
4	*Apatelodes torrefacta*	Bombycidae	Nantahala region, NC	2015
5	*Zeuzera sp.*	Cossidae	-	-
6	*Inguromorpha itzalana*	Cossidae	Cochise Co, AZ	2010
7	*Symphlebia pyrgion*	Erebidae	Heredia, Costa Rica	2005
8	*Lymantria dispar*	Erebidae	Massachusetts lab	2015
9	*Halysidota tessellaris*	Erebidae	Nantahala region, NC	2015
10	*Apantesis sp.*	Erebidae	Nantahala region, NC	2015
11	*Leucanopsis sp. 1*	Erebidae	Heredia, Costa Rica	2001
12	*Hormisa orciferalis*	Erebidae	Windham Co, CT	2011
13	Unidentified Erebidae sp.	Erebidae	Heredia, Costa Rica	2007
14	*Dasychira pinicola*	Erebidae	Bamstable MA	1995
15	Unidentified Geometridae sp. 1	Geometridae	Nantahala region, NC	2015
16	*Lytrosis unitaria*	Geometridae	Nantahala region, NC	2015
17	*Epimecis hortaria*	Geometridae	Nantahala region, NC	2015
18	*Lytrosis unitaria*	Geometridae	Nantahala region, NC	2015
19	Unidentified Geometridae sp. 2	Geometridae	Nantahala region, NC	2015
20	Unidentified Geometridae sp. 3	Geometridae	Nantahala region, NC	2015
21	Unidentified Geometridae sp. 3	Geometridae	Nantahala region, NC	2015
22	Unidentified Geometridae sp. 2	Geometridae	Nantahala region, NC	2015
23	Unidentified Geometridae sp. 3	Geometridae	Nantahala region, NC	2015
24	Unidentified Geometridae sp. 4	Geometridae	Nantahala region, NC	2015
25	*Lytrosis unitaria*	Geometridae	Nantahala region, NC	2015
26	Unidentified Geometridae sp. 4	Geometridae	Nantahala region, NC	2015
27	Unidentified Geometridae sp. 5	Geometridae	Nantahala region, NC	2015
28	*Itame pustularia*	Geometridae	Nantahala region, NC	2015
29	*Itame pustularia*	Geometridae	Nantahala region, NC	2015
30	*Itame pustularia*	Geometridae	Nantahala region, NC	2015
31	*Anticlea sp.*	Geometridae	Heredia, Costa Rica	2000
32	*Glena cribrataria*	Geometridae	Dukes Co., MA	1998
33	*Caripeta divisata*	Geometridae	Litchfield Co., CT	1998
34	*Aepytus sp. 1*	Hepialidae	Heredia, Costa Rica	2004
35	*Malacosoma americana*	Lasiocampidae	Nantahala region, NC	2015
36	*Euglyphis barda*	Lasiocampidae	Heredia, Costa Rica	2003
37	*Euclea delphinii*	Limacodidae	New London Co, CT	2012
38	*Lagoa crispata*	Megalopygidae	Windham Co, CT	2008
39	*Norape tenera*	Megalopygidae	Cochise Co, AZ	1999
40	*Lirimiris lignitecta*	Notodontidae	-	-
41	*Thyridopteryx ephemeraeformis*	Psychidae	Ohio	2007
42	*Rothschildia sp.1*	Saturniidae	Heredia, Costa Rica	2001
43	*Automeris sp.*	Saturniidae	Nantahala region, NC	2015
44	*Asthenia transversaria*	Saturniidae	Heredia, Costa Rica	2004
45	*Perigonia pittieri*	Sphingidae	Heredia, Costa Rica	2002

Collection information for 45 unique moth specimens spanning 15 families. Information marked with "-" was not supplied when specimen was received. Four additional moths were measured but unidentified.

Table 3: Moth Antennae Dimensions

Dimension	Equation
Stalk Length	$L_{st}=19{,}300M^{0.20}$
Branch Length	$L_b=2{,}070M^{0.28}$
Sensilla Length	$Ls=104M^{0.079}$
Stalk Diameter	$d_{st}=157M^{0.029}$
Branch Diameter	$d_b=63.8M^{0.11}$
Sensilla Diameter	$d_s=5.96M^{0.023}$
Branch Spacing	$S_b=167M^{0.051}$
Sensilla Spacing	$S_s=20.7M^{-0.052}$

Allometric equations of moth antennae dimensions presented in Fig. 2. All dimensions are in micrometers. M represents dry moth mass in grams.

Table 4: Increased path length values

θ	w^*
15	2.00
30	0.69
45	0.28
60	0.12
75	0.06
90	0.00

Dimensionless increase in path length w^* particles must travel around a cylinder held at angle θ into the wind.