

Figure S1. Experimental setup. A *M. stellatarum* is hovering in front of a feeder in the 1.2 m wide test section of the Lund University wind tunnel while two kinematics cameras are recording its flight. Simultaneously a PIV system, consisting of a laser, an aerosol generator (not in view) and four cameras, records the air flow below the moth. The figure is not to scale.

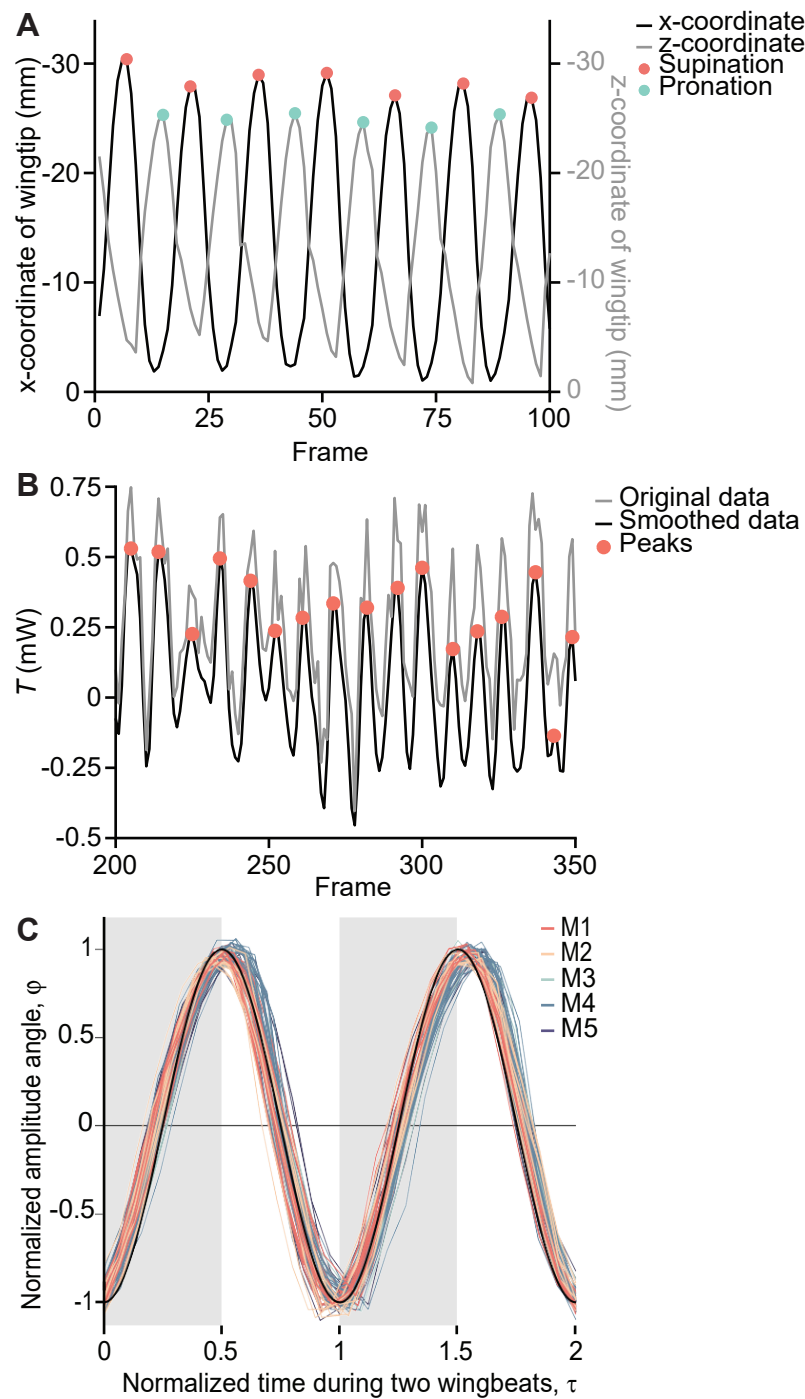


Figure S2. (A) Signals used to determine start of downstroke and upstroke. Start of the downstroke was defined as the minimum z-coordinate, which was the highest point of the wingbeat. Start of the upstroke was defined as the minimum x-value, which represented the forward-most point of the wing tip during a wingbeat. This sequence is based on one flight of individual M1. (B) The signal used for detecting wingbeats (grey line, Eq. 20) along with its smoothed version (black line). The peaks in the smoothed signal, here highlighted by red dots, were interpreted as start and stop of the wingbeats. The moth (individual M1) is here flying at 0.3 ms^{-1} , and consequently we do not expect this component of thrust to average to zero. (C) Normalized stroke angle (φ) over normalized time (τ) of two wingbeats. Included are all wingbeats in the dataset, recorded with the feeder at the default, low position. Black line is a sine wave ($\varphi = \sin(2\pi\tau - \pi/2)$). Grey area is down-stroke, and white area upstroke.

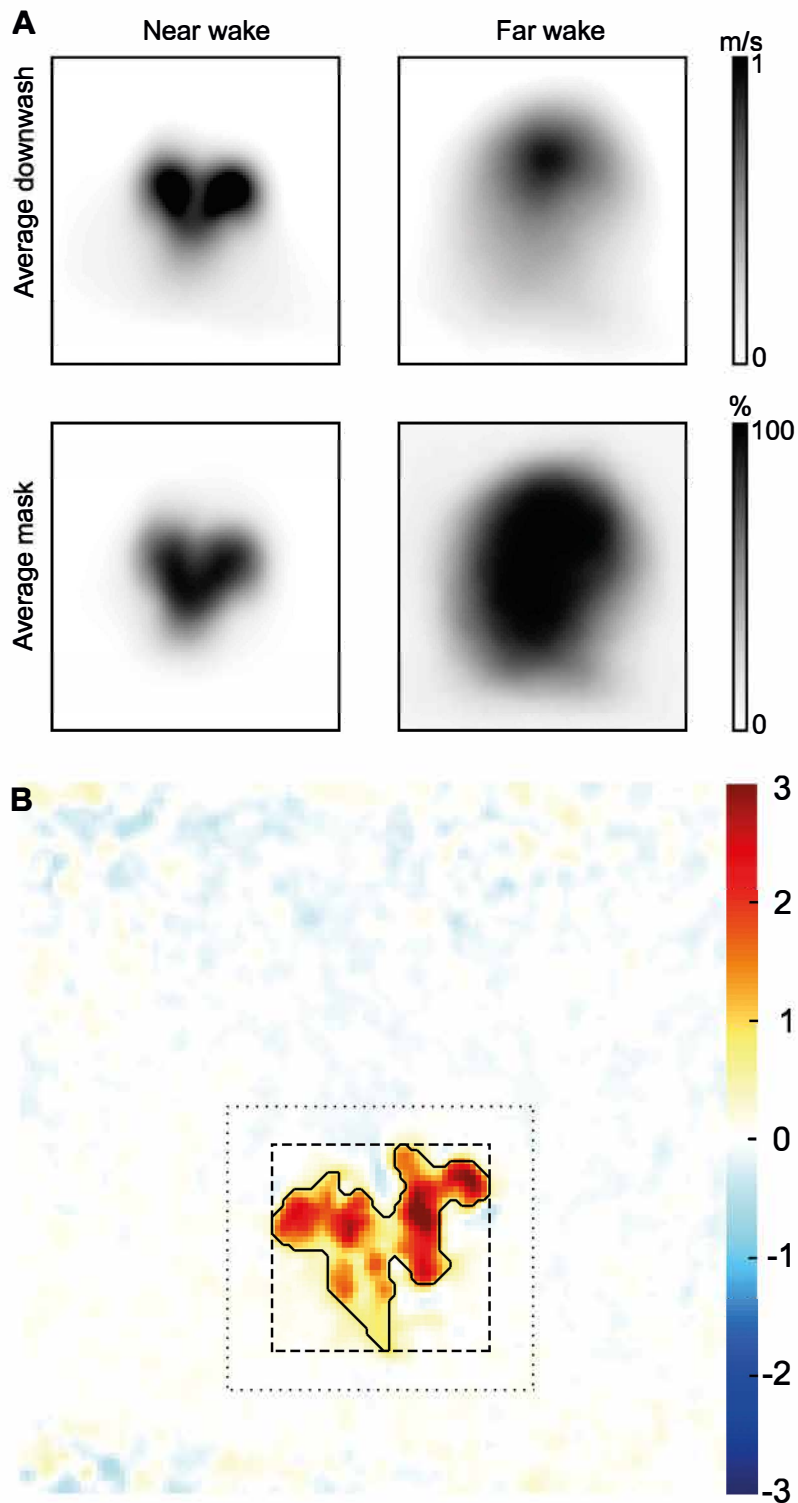


Figure S3. (A) The top row depicts average downwash of all flight sequences in the near and far wake experiments. The images are seen from above, with the moth directed towards the top of the image. The average masks created from the downwash are shown in the second row. The colour represents the percentage of all frames that include a certain pixel in the mask, so that a black pixel is present in 100% of all masks. Before averaging, all wakes were centered. (B) One frame of the w velocity field along with the three versions of wake masking: Black line is the mask used for all calculations, dashed line the tightly fitted rectangle and dotted line a rectangle 40% larger in both directions. Colour bar is in ms^{-1} .

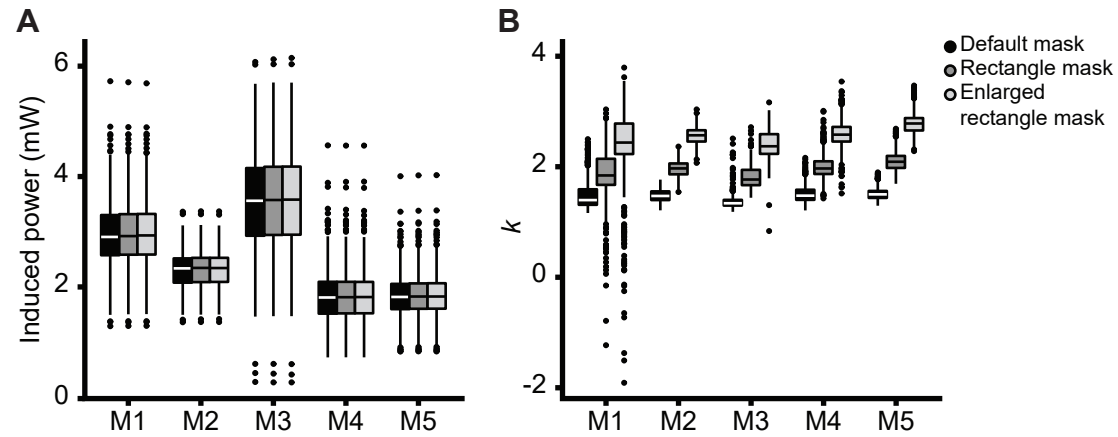


Figure S4. Induced power (A) and k (B) estimated from the PIV data, using three different mask sizes (see Fig. S5). Each wingbeat represents one data point.

Table S1. Morphological characteristics of the individuals used: weight (*W*) estimated from average lift with standard deviation (s.d.) of measurements, wing area (*S*), wing span (*b*), mean wing chord (*c*), aspect ratio (*AR*) estimated sensu Pennycuick 1968 and number of sequences (# seq) used in the analyses for each of the moths at the different feeder locations.

Individual	<i>W</i> (mN)		<i>S</i> (mm ²)	<i>b</i> (mm)	<i>c</i> (mm)	<i>AR</i>	# seq	# seq	# seq
	avg.	s.d.					Low feeder <i>Kin</i>	Low feeder <i>PIV</i>	High feeder
M1	3.1	0.64	411	49.2	8.4	5.9	5	6	
M2	3.0	0.38	356	43.4	8.2	5.3	3	2	
M3	3.7	0.67	339	46.2	7.3	6.3	4	4	
M4	2.5	0.58	291	43.6	6.8	6.2	6	4	3
M5	2.4	0.45	327	45.5	7.3	6.1	5	4	3

Table S2. Average and standard deviation of kinematic parameters measured in sequences with the standard feeder placement (40 mm above laser sheet): wingbeat frequency (f), wingbeat amplitude (Φ), stroke plane angle θ and body angle β . Lower part of the table shows average of kinematic parameters measured in sequences with the standard feeder placement ("low") as well as with the feeder placed 140 mm above the sheet ("high")

	Individual f (Hz)		Φ (°)		θ (°)		β (°)	
	avg.	s.d.	avg.	s.d.	avg.	s.d.	avg.	s.d.
M1	68.9	5.3	96.4	8.0	33.4	6.8	34.8	8.5
M2	69.2	4.3	96.3	5.2	32.4	3.2	28.7	3.7
M3	83.3	3.6	82.2	3.8	30.8	2.2	36.4	2.7
M4	75.4	4.5	91.7	6.8	34.5	4.6	39.1	4.7
M5	74.9	3.8	89.5	6.3	33.2	4.9	39.4	4.7
	Low	High	Low	High	Low	High	Low	High
M4	75.4	80.2	91.7	97.8	34.5	19.6	39.1	52.3
M5	75.0	75.0	92.1	92.1	31.7	31.7	37.9	37.9