Supplementary Information

Paleoatmosphere facilitates a gliding transition to powered flight in Eocene bats

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Supplementary Table 1. Flapping flight characteristic of *Onychonycteris finneyi* estimated using Flight 1.25[13] with 40 g (and 44 g) in normodense and hyperdense atmospheric conditions.

Flapping flight features	**Normodense conditions (1 bar)**	**Hyperdense conditions (1.6 bar)**
Maximum rate of climb (m/s)	0.27 (0.23)	0.34 (0.31)
Mechanical power (W)	0.46 (0.54)	0.36 (0.43)
Specific work in myofibrils (J/kg)	33.1 (34.5)	29.8 (31)
Wingbeat frequency (Hz)	5.3 (5.5)	4.4 (4.6)
Minimum power speed (m/s)	6.1 (6.3)	4.8 (5)
Maximum range speed (m/s)	11.1 (11.4)	8.9 (9.1)

Supplementary Table 2. Flapping Flight Characteristics of Model 4 as compared with *Onychonycteris finneyi* considering a reconstruction of body weight at 40 g versus 10% heavier at 44 g, calculated using Flight 1.25[13].

Patm bar	**Min Power air speed m/s**	**climb m/s**	**Power W**	**Work myofibrils J/kg**	**Wing beat Hz**	**Min Power air speed m/s**	**climb m/s**	**Power W**	**Work myofibrils J/kg**	**Wing beat Hz**
Model 4	**40g**					**44 g**				
1	6,8	-0,36	0,77	49,9	6,9	7,1	-0,44	0,81	52,8	7,2
1.6	5,4	-0,06	0,61	43	5,8	5,6	-0,15	0,71	45,2	6,0
fossil	**40 g**					**44 g**				
1	6,1	0,27	0,46	33,1	5,3	6,3	0,23	0,54	34,5	5,5
1.6	4,8	0,34	0,36	29,8	4,4	5	0,31	0,43	31	4,6

Supplementary Table 3. Glide features of Models 1-to-4 and the full-winged *Onychonycteris* using Flight 1.25[13], in two contrasting PATM conditions (normodense at 1 bar and hyperdense at 1.6 bar), mass reconstructed at either 40 g or 44 g. Shaded cells indicate values calculated with a wing drag coefficient of 0.1. Turn radius is at 24° bank.

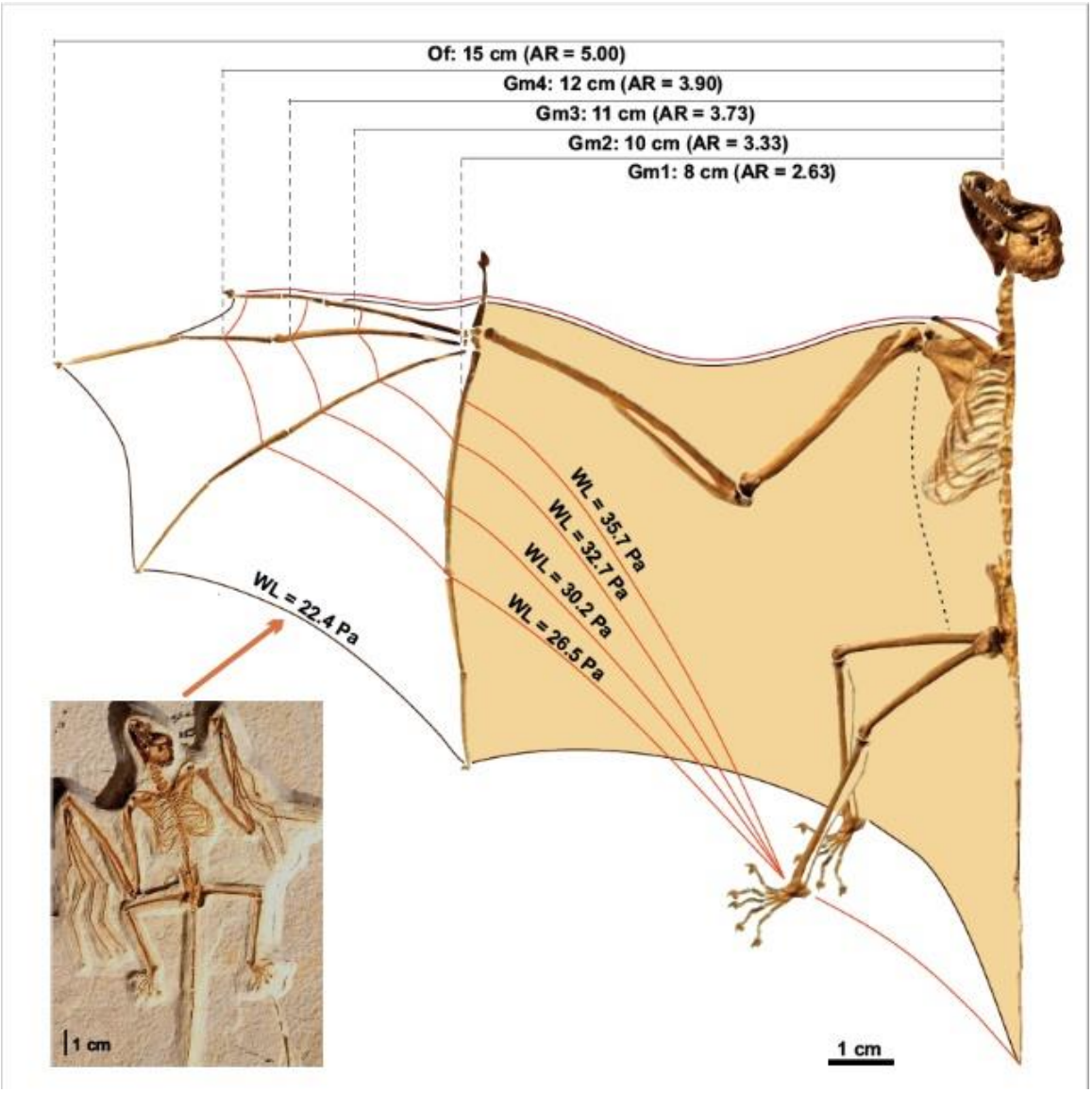
Modelled 40 g specimen	**PATM bar**	**GR**	**Best Glide Speed m/s**	**Sink Rate m/s**	**Impact speed m/s**	**Turn Radius m**
Model 1	1	2.93	6.4	2.19	6.8	4.85
	1.6	2.93	5	1.71	5.3	3.07
Model 2	1	3.37	5.7	1.69	5.9	4.42
	1.6	3.37	4.5	1.33	4.6	2.73
Model 3	1	3.61	5.3	1.47	5.5	4.01
	1.6	3.61	4.2	1.16	4.4	2.57
Model 4	1	3.72	5	1.34	5.2	3.62
	1.6	3.72	4.1	1.05	4	2.26
Model 3	1	4.6	6.2	1.23	6.4	4.2
	1.6	4.6	5.2	1.13	5.3	2.88
Model 4	1	4.78	5.8	1.21	6	3.62
	1.6	4.78	4.8	1	4.9	2.55
Fossil	1	5.7	5	0.88	5.1	3.07
	1.6	5.7	4.1	0.72	4.2	2.1
Modelled 44 g specimen	**PATM bar**	**GR**	**Best Glide Speed m/s**	**Sink Rate m/s**	**Impact speed m/s**	**Turn Radius m**
Model 1	1	2.92	6.6	2.26	7	5.3
	1.6	2.92	5.2	1.78	5.5	3.42
Model 2	1	3.36	6	1.78	6.2	4.85
	1.6	3.36	4.7	1.4	4.9	3.1
Model 3	1	3.6	5.6	1.56	5.8	4.42
	1.6	3.6	4.5	1.32	4.7	3.07
Model 4	1	3.9	5.1	1.4	5.3	4.21
	1.6	3.9	4.1	1.11	4.2	2.4
Model 3	1	4.58	6.5	1.42	6.7	4.62
	1.6	4.58	5.4	1.18	5.6	3.07
Model 4	1	4.75	6.1	1.28	6.2	4.01
	1.6	4.75	5	1.05	5.1	2.73
Fossil	1	5.67	5.2	0.92	5.3	3.42
	1.6	5.67	4.3	0.76	4.4	2.26

Supplementary Table 4. Wing parameters estimated for the full-winged fossil *Onychonycteris finneyi* (averaged between holotype and paratype) and intermediate models 1-to-4.

Model	**Complete Wing Area (m^2)**	**Wingspan (m)**	**Aspect Ratio**
Model 1	0.0110	0.17	2.63
Model 2	0.0120	0.20	3.33
Model 3	0.0130	0.22	3.73
Model 4	0.0148	0.24	3.90
Onychonycteris	0.0175	0.30	5.14

Supplementary Table 5. Comparison of simulated flight speeds, Minimum Power (VmP) and Maximum Range (Vmr), in m/s, as calculated using Flight 1.25[13] with observed airspeed in selected bat species.

Species	Mass (kg)	VmP	Vmr	observed airspeed	Source
Rousettus aegyptiacus	0.120	6.7	11.8	9.0	ref. 4
Cynopterus brachyotis	0.032	5.1	9.2	5.5	ref. 56
Glossophaga soricina	0.011	4.5	8.4	7.0	ref. 56
Tadarida brasiliensis	0.012	4.4	7.9	8.3	ref. 56



Supplementary Figure 1. Reconstructed aerofoil in *Onychonycteris finneyi* (full contour, modified from ref. 2) stretching the hindleg as seen in the profile of extant gliders (12). Models (Gm 1-to-4) are illustrated overlapping in red contour with indicated half wingspan (b/2), aspect ratio (AR) and wing loading (WL). The functional handwing is unshaded and anatomically it includes the dactylopatagium (membrane between digits 2-to-5) and propatagium brevis (membrane between digits 1-to-2). The shading in the wing includes the propatagium longus, plagiopatagium and uro-patagium (the basic gliding *bauplan*) and indicates aerofoil surface without handwing using the hingleg posture unmodified from the fossil. Inset: photograph of paratype American Museum of Natural History AMNH 142467.