Clarification of Human Bipedal Efficiency

The concept that human bipedal efficiency was key to success on the savanna can be misleading. When combined with heat dissipation advantages it becomes robust a fact that has been well established but often the emphasis is misplaced. As illustrated in the chart below, the locomotive advantages are only modest, and largely disappear with time and distance.

Locomotive Efficiency Comparison (10 km, Relative to Body Weight)

Species	Mode	Speed (km/h)	Time for 10 km (hours)	Locomotion Cost (kcal/kg/hour)	BMR (kcal/kg/hour)	Total Cost (kcal/kg/hour)	Total Energy for 10 km (kcal/kg)
Human	Walking	5	2.0	0.50–1.00	1.0	1.50–2.00	3.00–4.00
Goose	Flying (V-formation)	50	0.2	5.50–9.00	3.5–4.0	9.00–13.00	1.80–2.60
Caribou	Trotting	10	1.0	3.00–5.00	0.8–1.0	3.80–6.00	3.80–6.00

Key Insights

- **Humans:** Slowest (2 hours), but low locomotion and BMR costs result in moderate energy use (3.00–4.00 kcal/kg). Efficient for short distances, but time-intensive.
- **Geese:** Fastest (0.2 hours), with high hourly costs (9.00–13.00 kcal/kg/hour), but lowest total energy (1.80–2.60 kcal/kg) due to short travel time.
- **Caribou:** Moderate speed (1 hour) and higher total costs (3.80–6.00 kcal/kg), due to higher locomotion demands and moderate BMR.
- **Efficiency Ranking (for 10 km):** Geese are most efficient (lowest kcal/kg), followed by humans, then caribou, when time is considered, as faster travel reduces the impact of BMR.

Why Humans Found a Niche on the Savanna

Thermoregulation is Key: Humans' ability to sweat and walk upright enables sustained activity in 30–40°C heat, unlike big cats, which overheat after sprints; geese, whose flight is heat-limited; or caribou, which overheat due to their fur. This allows humans to hunt or scavenge during midday, when big cats rest in the shade to avoid hyperthermia. It is a niche created by heat dissipation, not locomotive efficiency.
Note: Geese and caribou were selected because of their known migratory efficiency. While they may not represent typical savanna life, it is unlikely that similar animals living on the savanna would be significantly more efficient.

This insight that heat dissipation is key opens up opportunities for expanded hypotheses.

Human Heat Dissipation Advantage in Europe

Neanderthals, despite their strength and cold-adapted physiology, were especially vulnerable to climate change. Their stocky build and limited sweating may have made them heat-intolerant. Unlike modern humans, who could remain active in the midday sun, Neanderthals may have been forced to rest during peak heat hours to avoid hyperthermia, reducing their foraging and migratory windows.

These rest periods may have come at a cost. Predators such as lions, leopards, and hyenas present even in Ice Age Europe were most active at dawn, dusk, and nighttime. This created a constraint beyond just poor night vision in hominins. If Neanderthals couldn’t move during the hottest hours, unlike humans, and couldn’t safely forage during low-light hours, unlike big cats, their safe window for activity effectively vanished.

Even a short, week-long heatwave would significantly reduce long-term viability, leading to weakness from reduced calorie intake and increased exposure to predators for animals not adapted to heat. In contrast, humans could adapt to cold conditions using clothing, fire, and migration.

The question becomes, why not just migrate north? The obvious answer is that after glacial retreat, it may have taken decades to centuries for plant life and prey populations to recover. This ecosystem lag, the delay between warming climate and ecological stability, would have made food supplies patchy.

Small differences in survivability over time can determine the difference between extinction and adaptation. Gross estimates of those differences are useful as a thinking tool, as illustrated below.

Speculative Species Breakdown

Species	Migration (km/day)	Net Energy (kcal/kg/day)	Survival (0 kcal/day, days)	Viability
Humans	10–20	+18 to +32	64–78	High
Neanderthals	5–10	–5 to +8.8	52–76	Low
Caribou	50–100	+24 to +36	59–94	High

Conclusion:

Humans’ ability to operate in heat, thus avoiding predators, combined with cold adaptation via clothing, ensured consistent food acquisition. Neanderthals' likely susceptibility to hyperthermia and food scarcity, unlike caribou’s migratory resilience, amplified their subsistence fragility, which may have been a contributing factor to their extinction. Traditional efficiency metrics miss these ecological dynamics, underscoring thermoregulation and predator avoidance as pivotal to human survival.