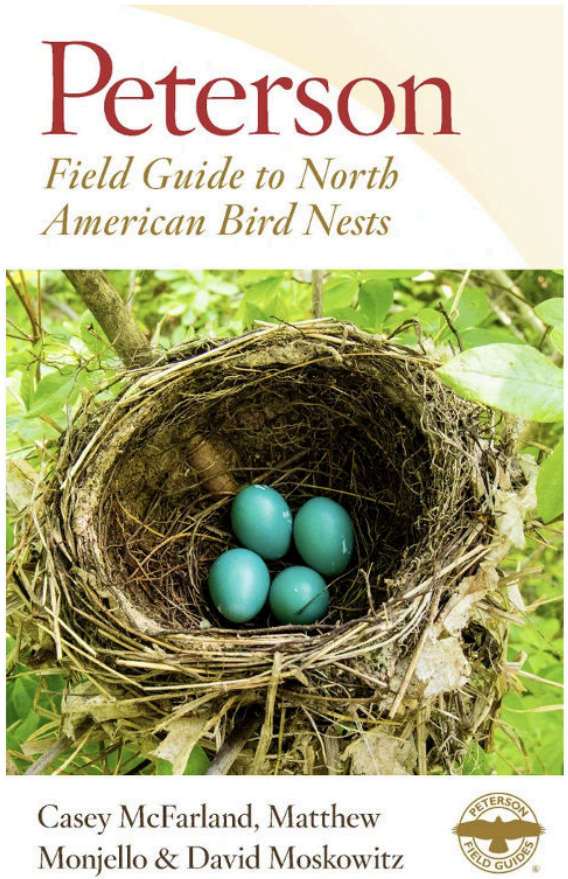


Nests and Incubation

Dr. Ethan Linck
Office: 305 Lewis Hall

Nesting

- No bird gives birth to live young
- Birds prepare nests to **incubate** and **cradle** young, **control microclimate**, and **protect from predators**
- Caring for eggs and young is energetically costly!





(MacFarland et al. 2004; Thomson 1910)

Nest diversity

- Primary nest types: **cavity**, **dome**, **open cup**

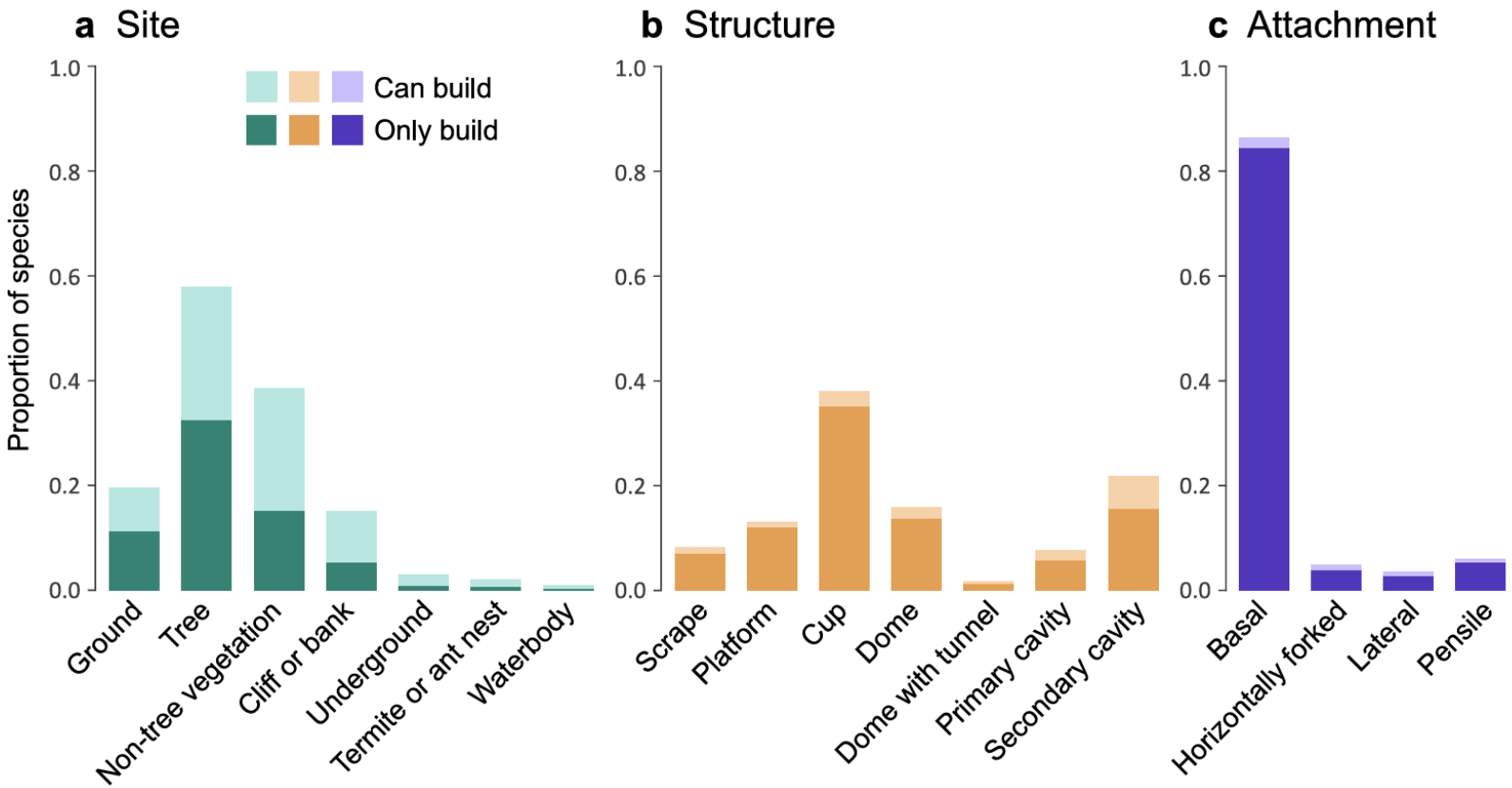


https://www.youtube.com/watch?v=6svAIgEnFvw

(Gill et al. 2019)

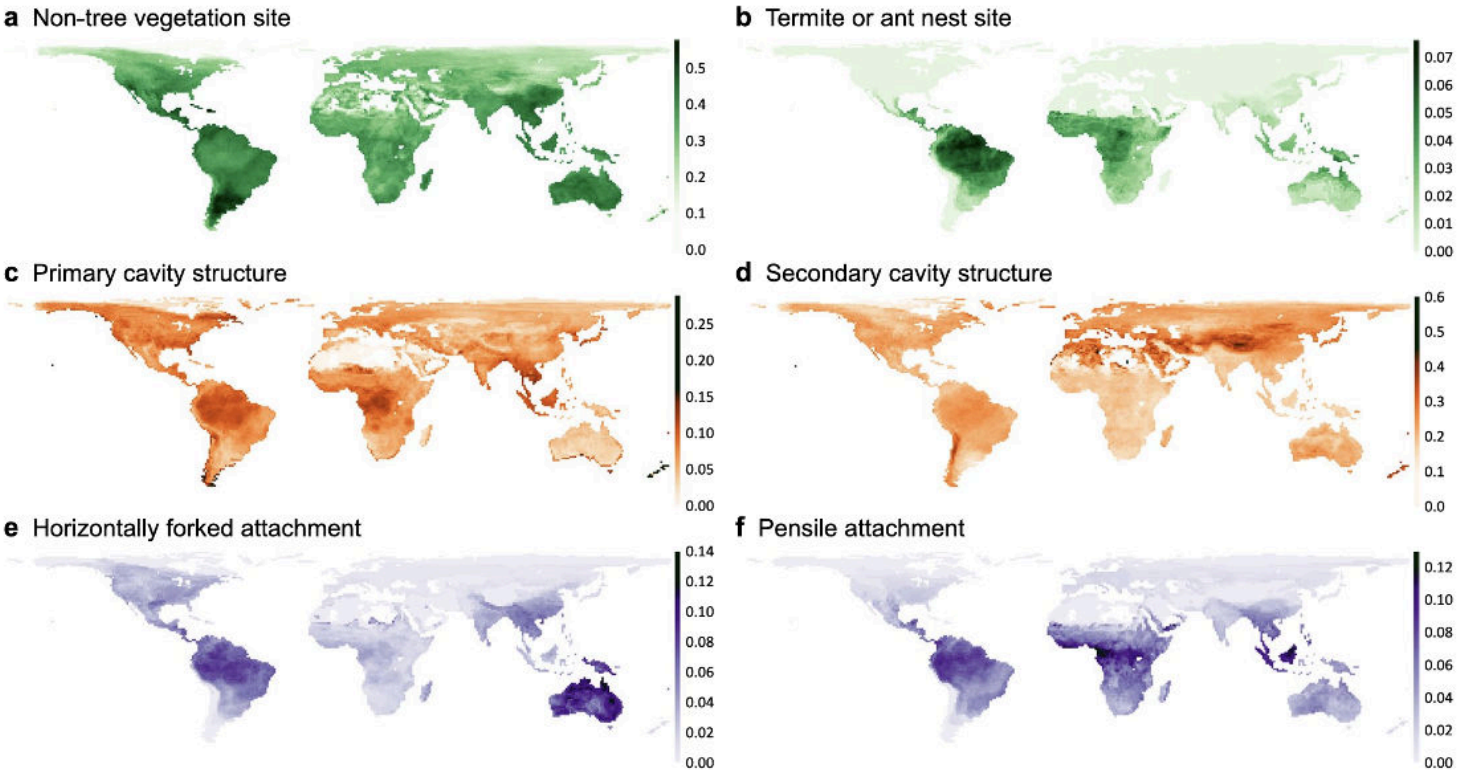
Nest diversity

- Open cup nests in trees with basal support are most common



(Chia et al. 2023)

Which H is consistent with the data below?

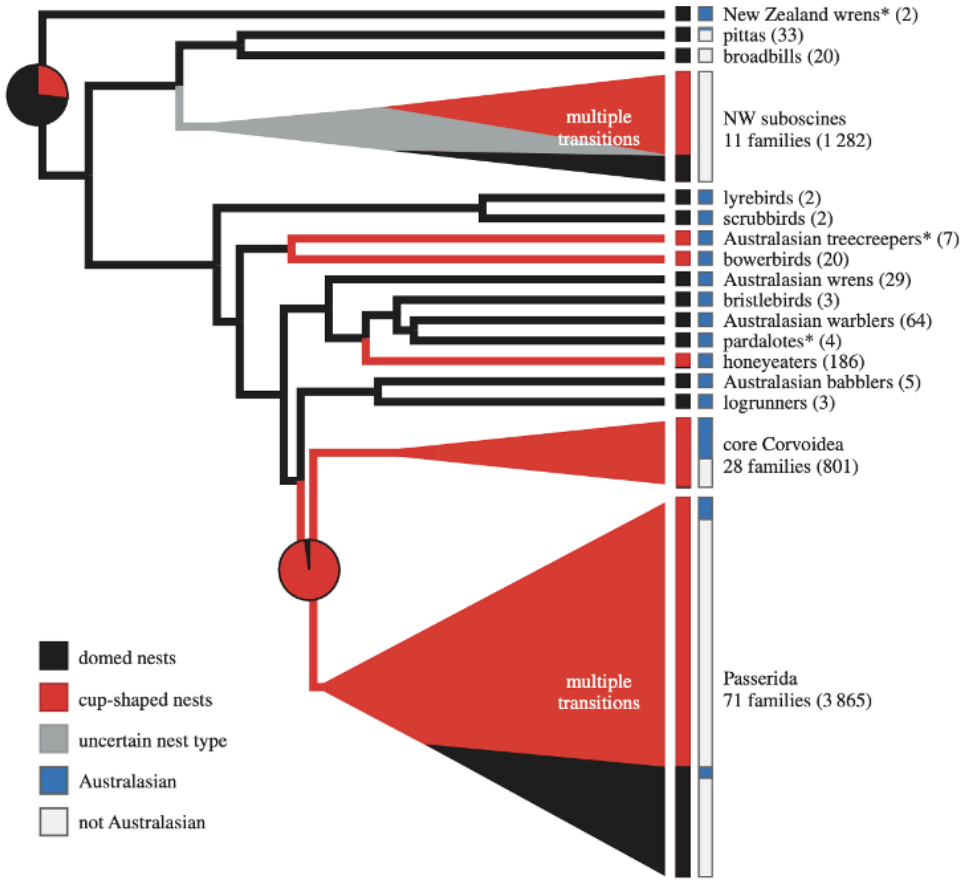


(Chia et al. 2023)

a) Nests in termite colonies are common in the temperate zone
b) Pensile attachments are rare in the tropics
c) Primary cavity nests are common worldwide
d) Australian birds rarely have nests w/ forked attachments

Passerine nest evolution

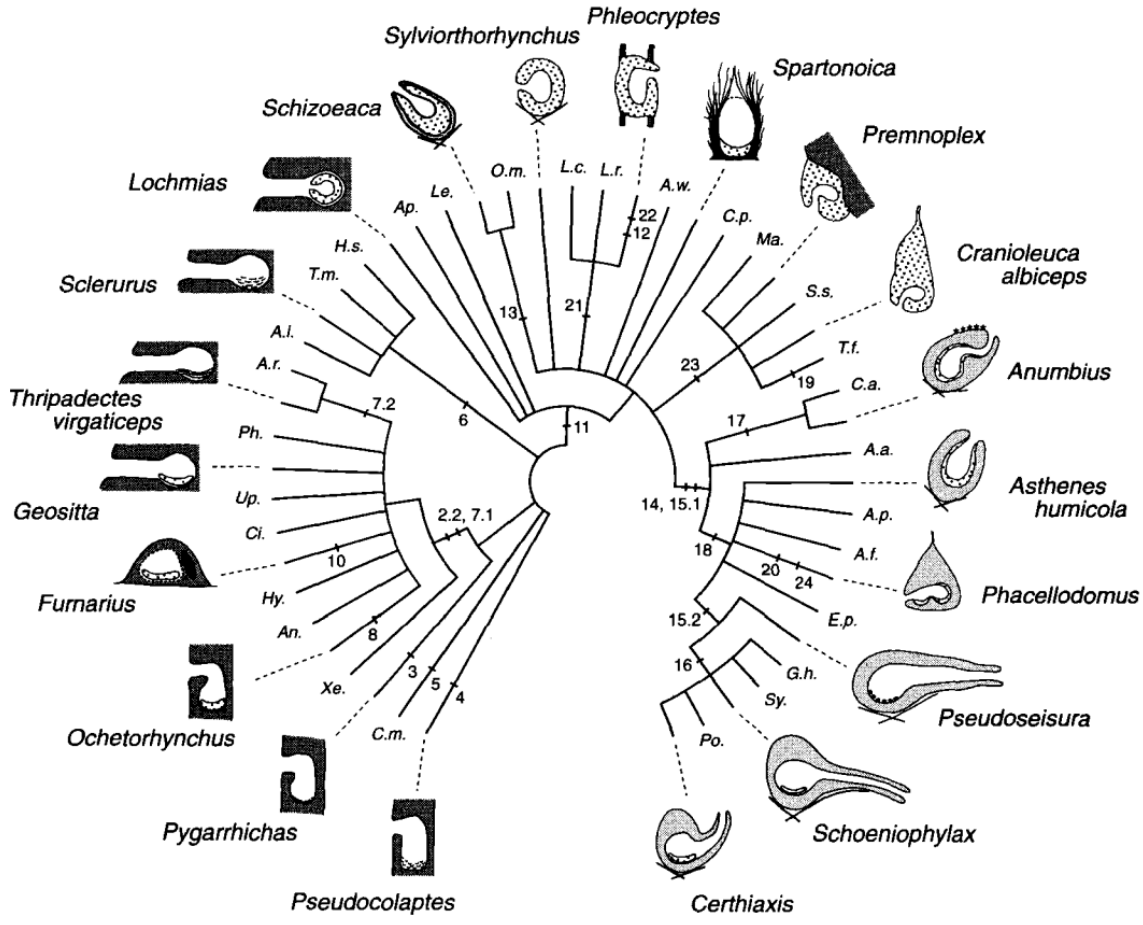
- Domed nests ancestral to passerines
- Open cup nests evolved multiple times in oscines and suboscines



(Price & Griffiths 2017)

Adaptive radiation of nest architecture

- Ancestral Furnariidae (overnbird) cavity nests gave rise to diverse domed nests from vegetation and mud



(Zyskowski & Prum 1999)

Nesting is challenging

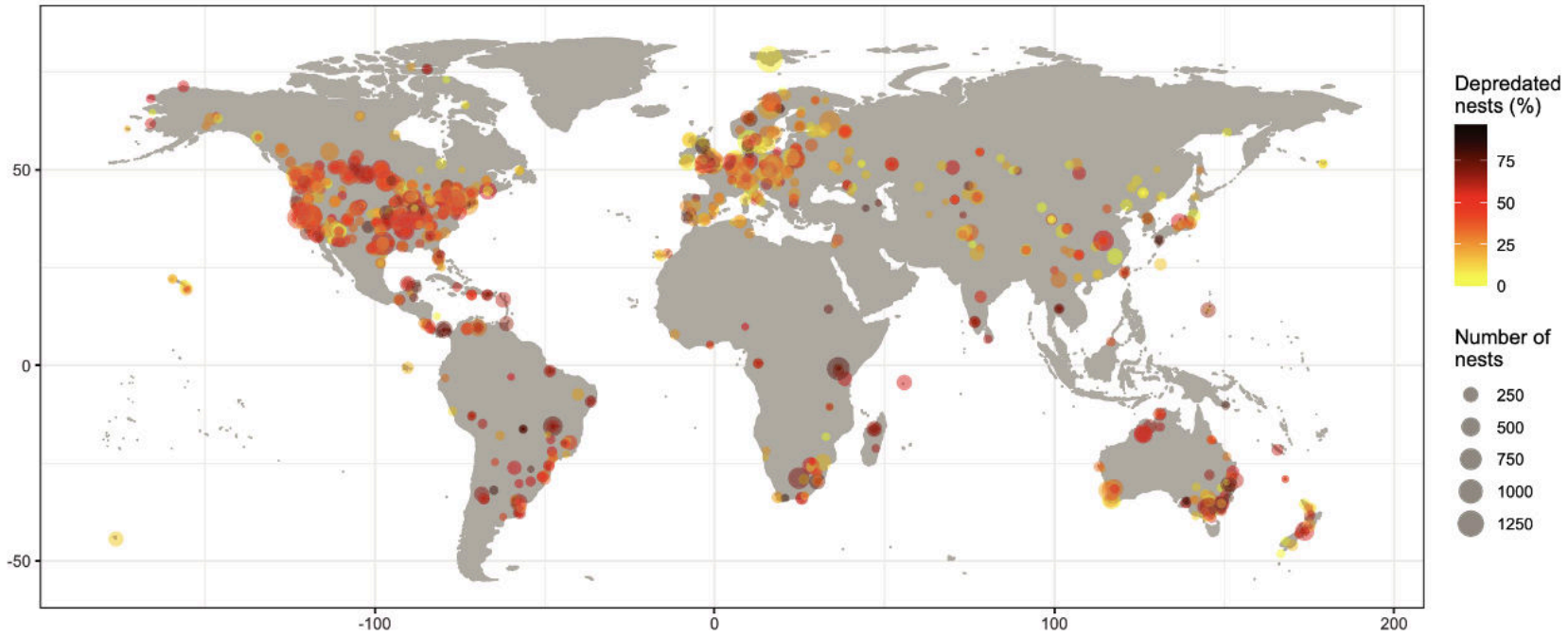
- Selection from nest loss due to **predation**, starvation, desertion, hatching failure, adverse weather



(Lockyer et al. 2013)

Global patterns of nest predation

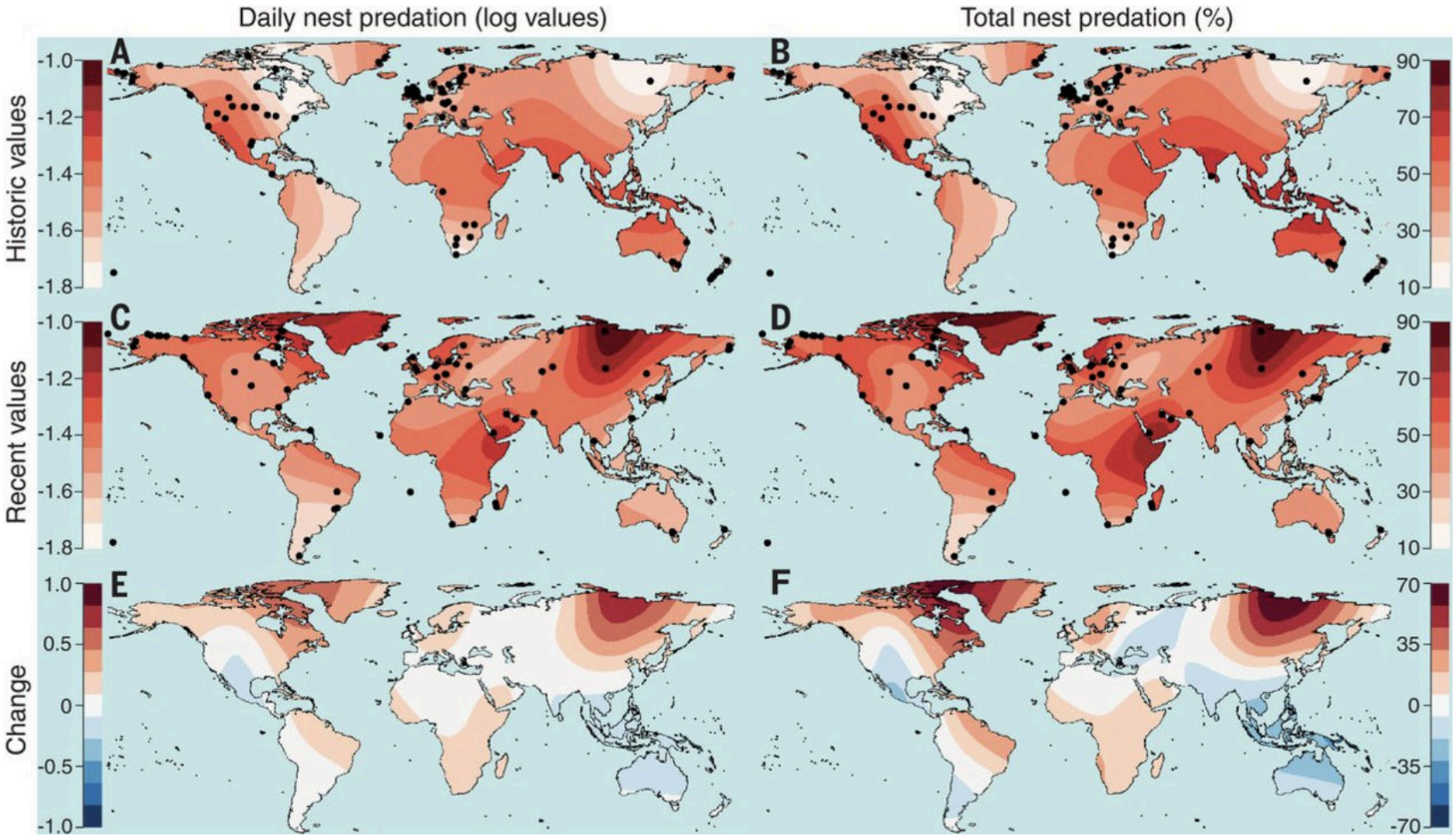
- Highest nest predation rates in the tropics (figure below from songbirds)



(Matysioková & Remeš 2022)

Climate change is flipping nest predation gradients

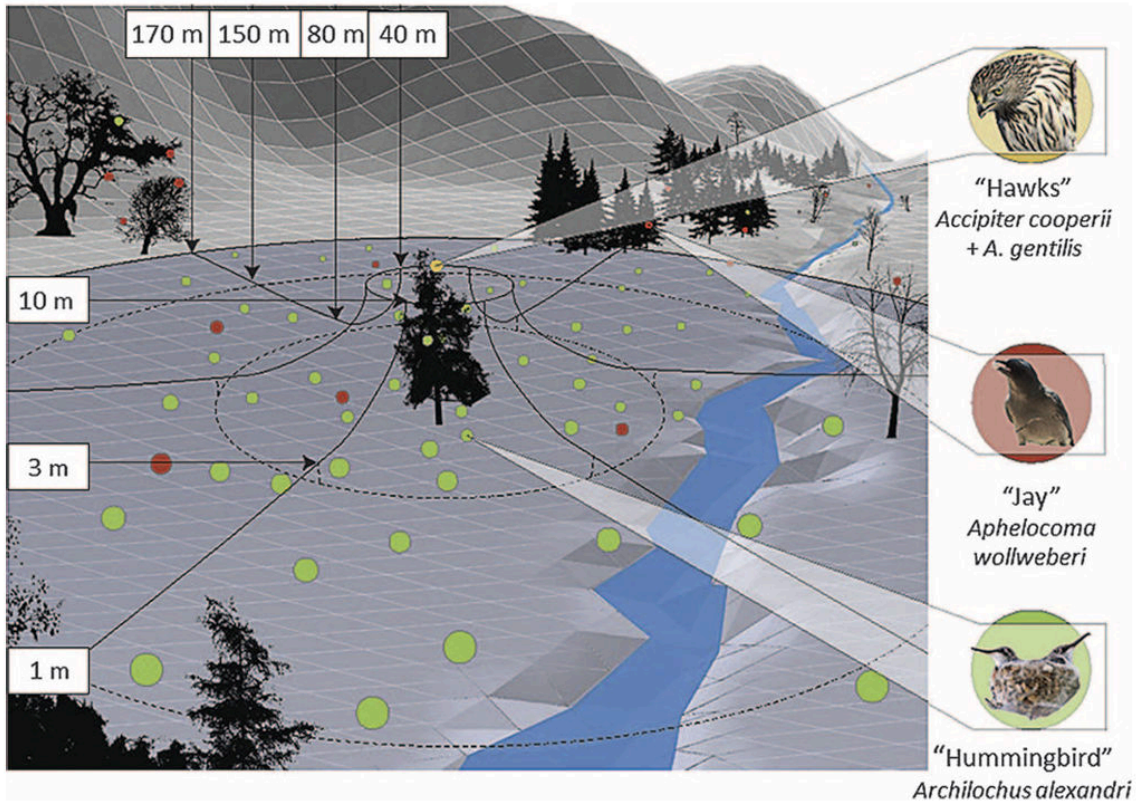
- Highest nest predation rates now in the Arctic for shorebirds
- Causes: declining lemming populations, behavioral shifts in foxes, vegetation changes...



(Kubelka et al. 2018)

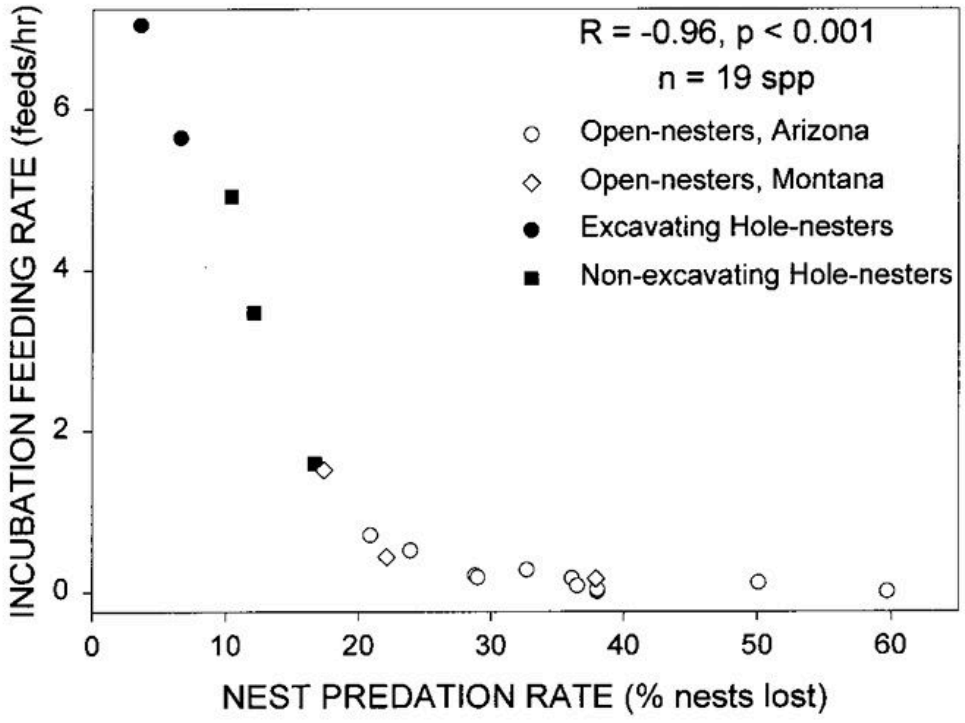
Nest protection by predators

- Black-chinned hummingbirds nest near *Accipter* spp. nests, where Mexican Jays forage higher to avoid predation, finding fewer hummingbird eggs (example of a **trophic cascade**)



(Greeney et al. 2015)

Which H are consistent the following data?

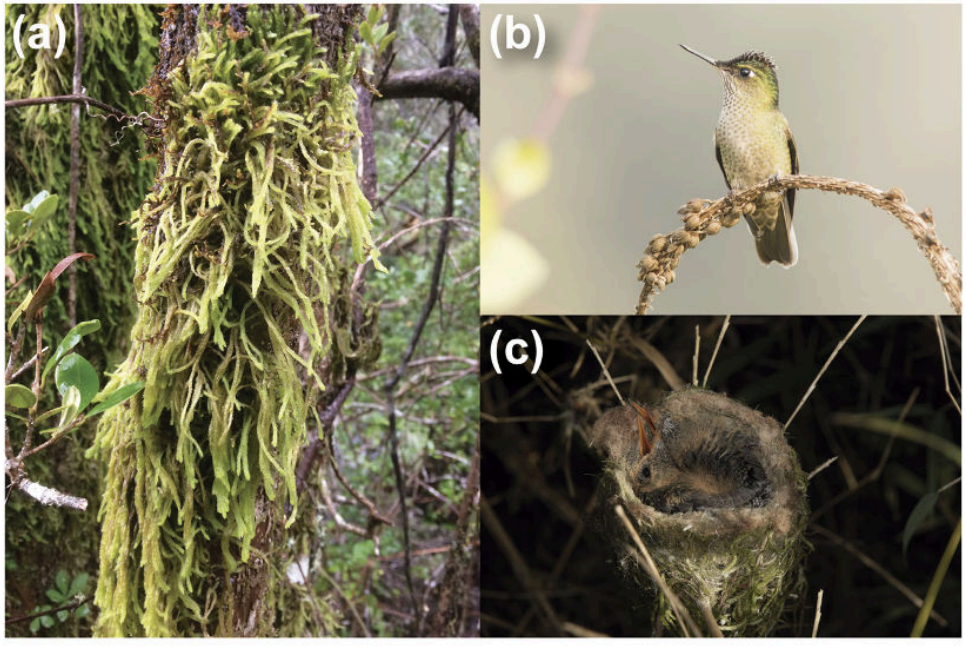


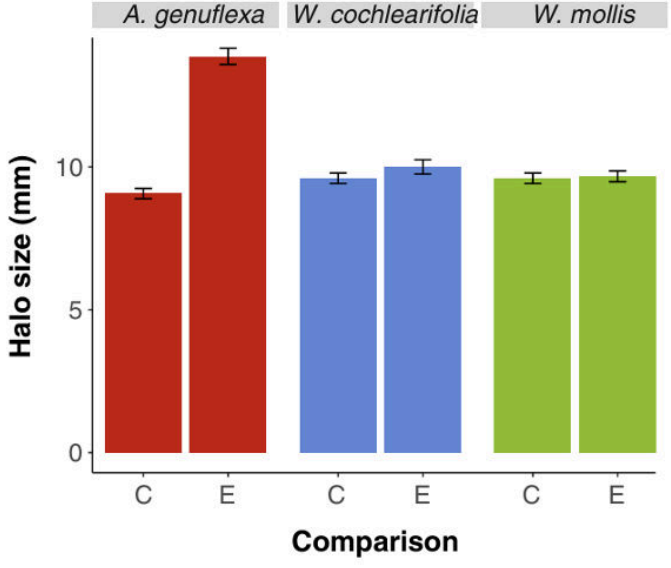
(Martin & Ghalambor 1999)

a) frequently feeding a partner draws predator attention
b) hole nesters are less vulnerable to predation
c) predation is more common in Arizona
d) all of the above

Nests can protect against infection

- Generalist hummingbird Green-backed Firecrown uses a rare moss to build its nest.
- Laboratory assays show it has better anti-microbial propertises (measured by **halo size** on plates than more common species and controls).

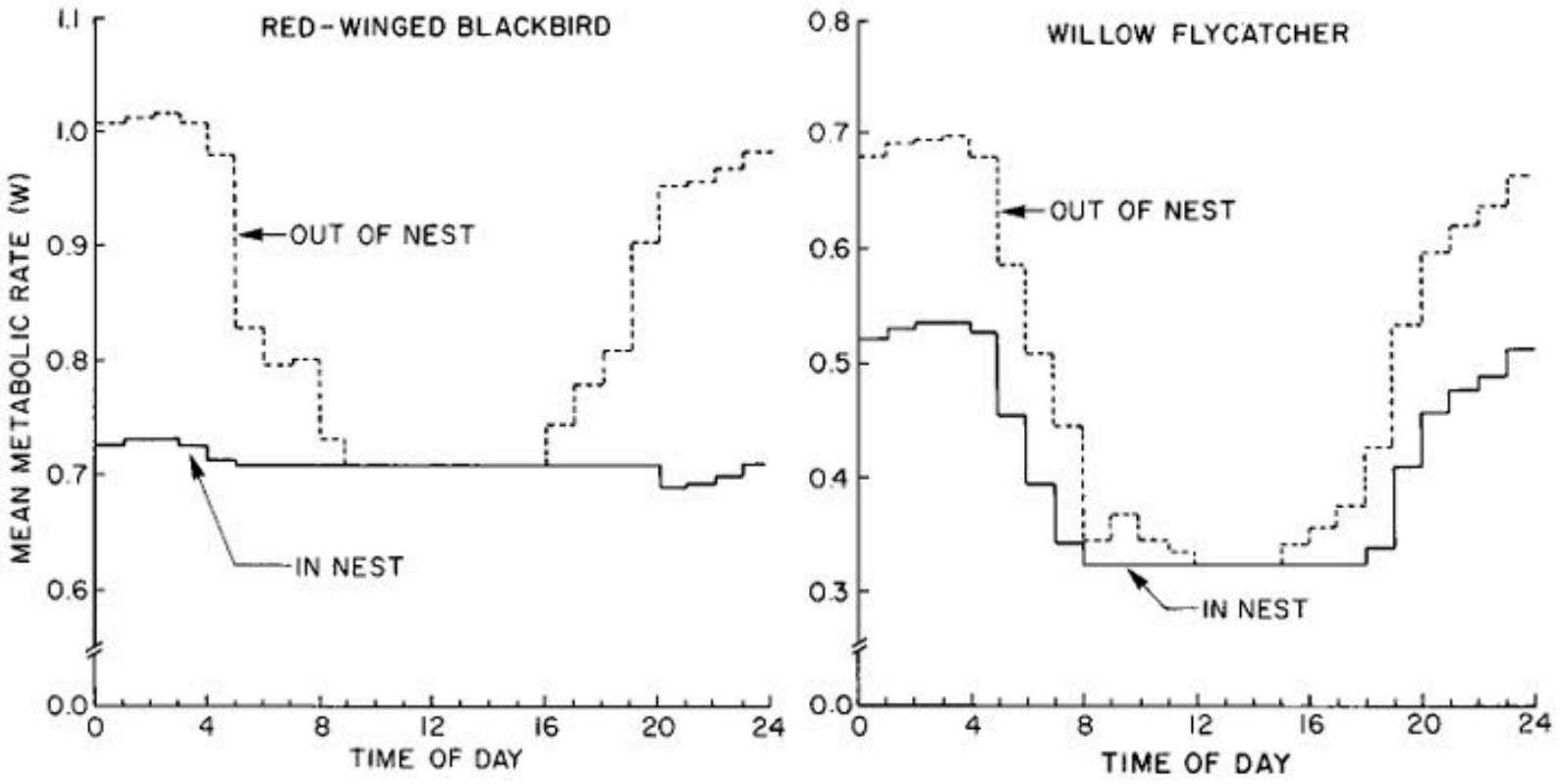




(Fontúrbel et al. 2020)

Nest microclimates impact metabolism

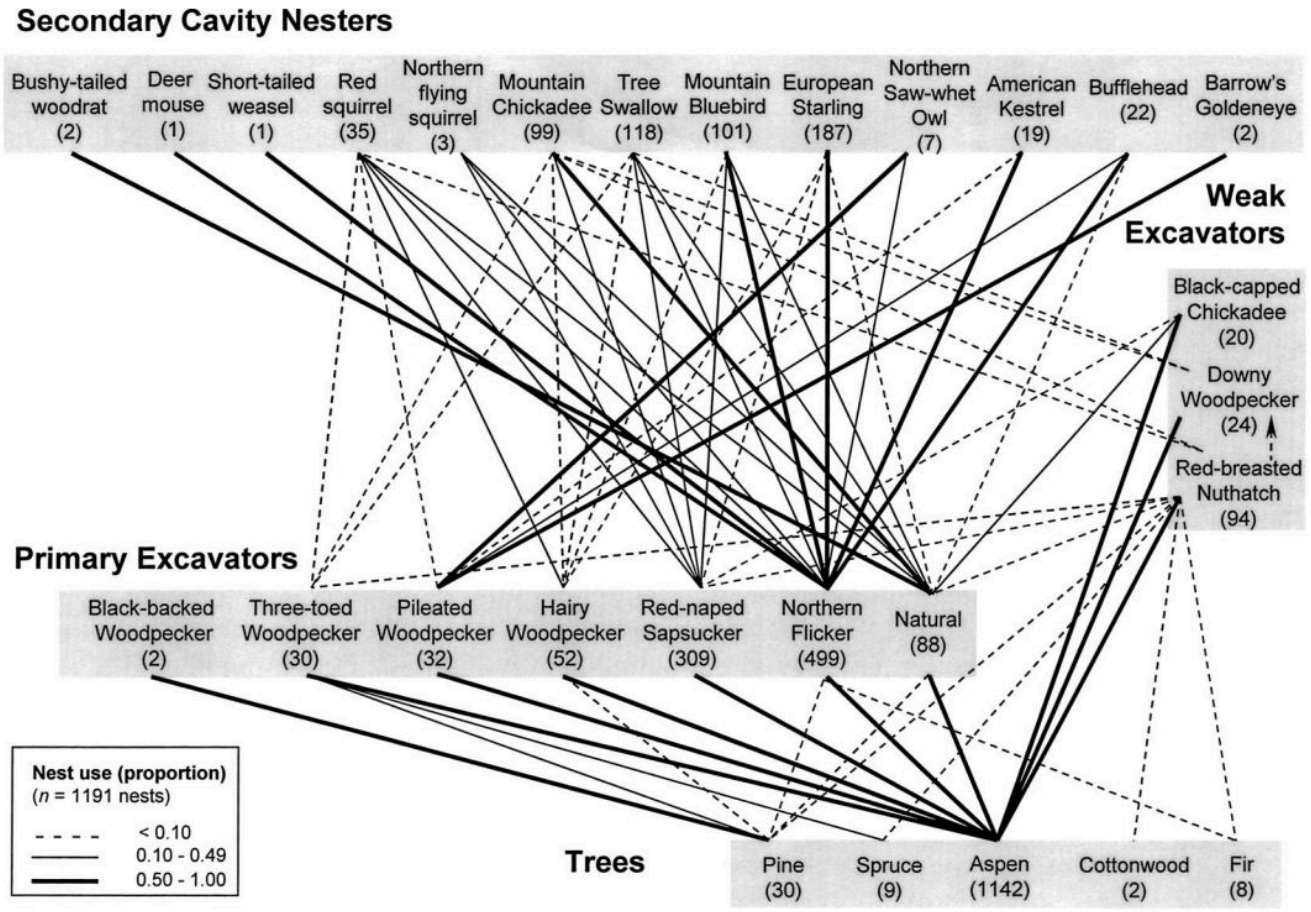
- Mean metabolic rates of birds perched outside nests are higher than those incubating within insulated nests



(Walsberg & King 1978)

Cavity nesting drives competition

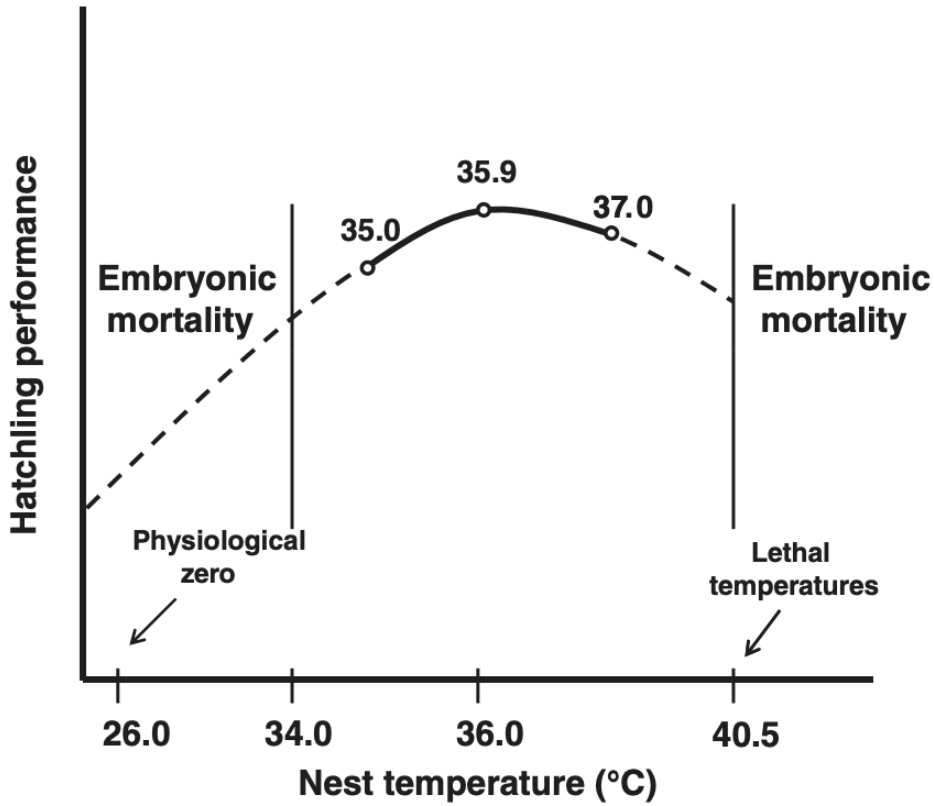
- **Primary cavity nesters** create cavities, while **secondary cavity nesters** use abandoned ones



(Martin et al. 2004)

Incubation

- Eggs must be kept ~37-38°C; bad if <35°C or > 40.5°C
- Lasts anywhere from 10-80 days
- Eggs must be turned and repositioned to balance growth
- Most birds delay incubation until clutch is complete for synchronous hatching



(DuRant et al. 2013)

Brood Patches

- **Brood patches** are patches of featherless skin on the underside of birds that form during nesting season
- Effectively transfers heat to incubate eggs
- Develops on the incubating sex (or sexes); under hormonal control



Brood Patch 1 (Graham Austin)



Brood Patch 2 (Graham Austin)



Brood Patch 3 (Jez Blackburn)



Brood Patch 4 (Graham Austin)

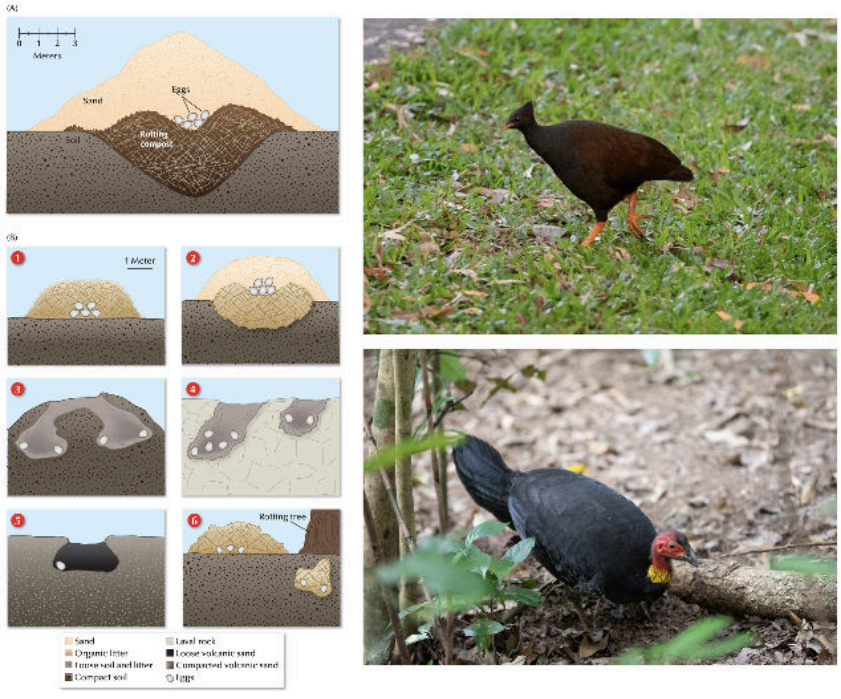


Brood Patch 5 (Graham Austin)

(Deeming & Du Freu 2008)

Megapodes and environmental incubation

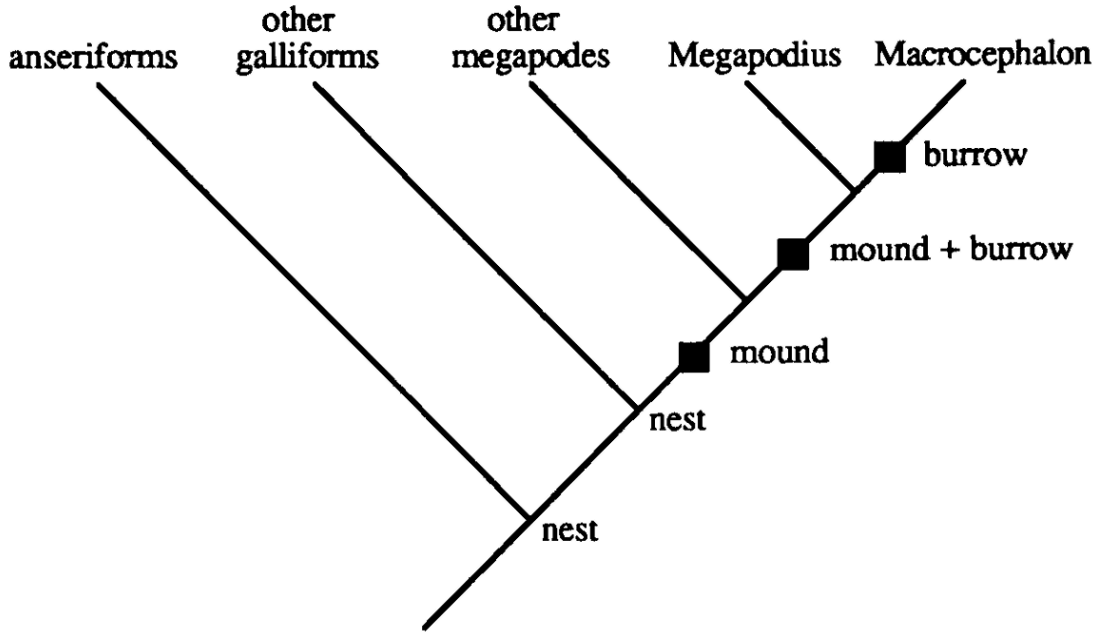
- Megapodes (Galliformes: Megapodiidae) use environmental heat sources to incubate eggs: decomposing leaf litter, geothermal activity, hot sand
- Megapode young are extremely precocial



https://www.youtube.com/watch?v=eIXOF6aSZrs&t=94s

(Gill et al. 2019; *Megapodius reinwardt*, *Alectura lathami*)

Evolution of incubation strategies



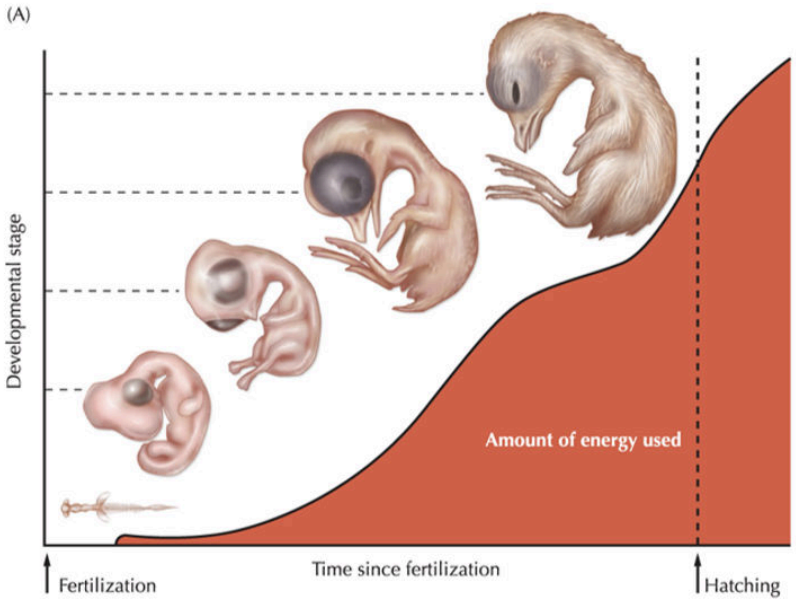
(Dekker & Brom 1992)

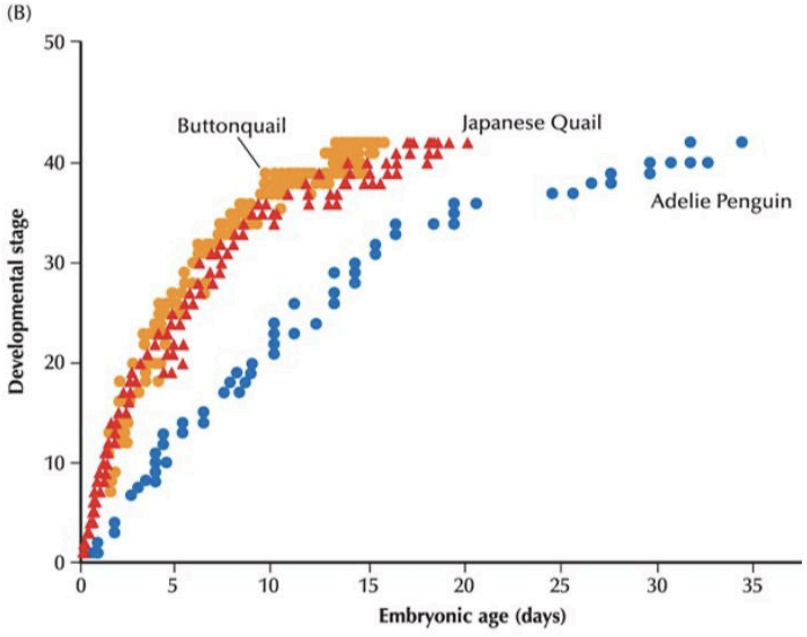
Megapode nesting is. . .

a) derived
b) basal (or "primitive")
c) neither

Embryonic Development

- Developmental stages are the same across species, but time spent in each stage can differ
- Incubation periods correlated with adult longevity, precocial young, reduced predation risk



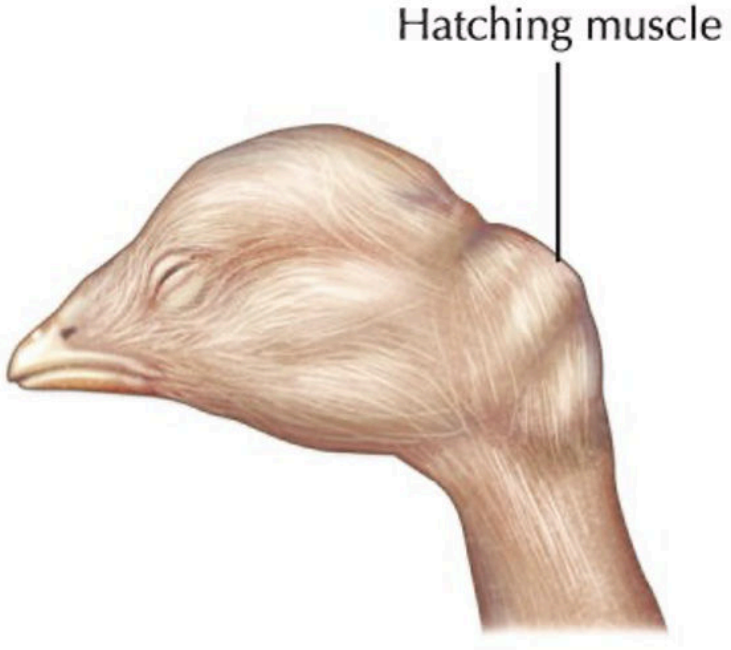


(Gill et al. 2019)

Hatching

- Facilitated by temporary **egg tooth** (L) and **hatching muscle** (R)





(Wikipedia; Gill et al. 2019)

References

- Title slide species: *Grus paradiseus*, *Bucorvus abyssinicus*, *Veniliornis callonotus*, *Spindalis portoricensis*
- McFarland, C., Monjello, M., & Moskowitz, D. (2021). Peterson Field Guide to North American Bird Nests. Mariner Books.
- Gill, F. B., Prum, R. O., & Robinson, S. K. (2019). Ornithology (4th ed.). W. H. Freeman.
- Thomson, A. L. (1910). Britain's birds and their nests. W. & R. Chambers.
- Chia, S. Y., Fang, Y. T., Su, Y. T., Tsai, P. Y., Hsieh, C., Tsao, S. H., ... & Tuanmu, M. N. (2023). A global database of bird nest traits. Scientific Data, 10(1), 923.
- Price, J. J., & Griffith, S. C. (2017). Open cup nests evolved from roofed nests in the early passerines. Proceedings of the Royal Society B: Biological Sciences, 284(1848), 20162708.

References

- Zyskowski, K., & Prum, R. O. (1999). Phylogenetic analysis of the nest architecture of Neotropical ovenbirds (Furnariidae). The Auk, 116(4), 891-911.
- Lockyer, Z. B., Coates, P. S., Casazza, M. L., Espinosa, S., & Delehanty, D. J. (2013). Greater sage-grouse nest predators in the Virginia Mountains of northwestern Nevada. Journal of Fish and Wildlife Management, 4(2), 242-255.
- Matysioková, B., & Remeš, V. (2022). Stronger negative species interactions in the tropics supported by a global analysis of nest predation in songbirds. Journal of Biogeography, 49(3), 511-522.
- Kubelka, V., Šálek, M., Tomkovich, P., Végvári, Z., Freckleton, R. P., & Székely, T. (2018). Global pattern of nest predation is disrupted by climate change in shorebirds. Science, 362(6415), 680-683.

References

- Greeney, H. F., Meneses, M. R., Hamilton, C. E., Lichter-Marck, E., Mannan, R. W., Snyder, N., ... & Dyer, L. A. (2015). Trait-mediated trophic cascade creates enemy-free space for nesting hummingbirds. Science advances, 1(8), e1500310.
- Martin, T. E., & Ghalambor, C. K. (1999). Males feeding females during incubation. I. Required by microclimate or constrained by nest predation?. The American Naturalist, 153(1), 131-139.
- Fontúrbel, F. E., Osorio, F., Riffo, V., Nuñez, M., Bastias, R., & Carvallo, G. O. (2020). Mamma knows best. Ecology, 101(7), 1-4.
- Walsberg, G. E., & King, J. R. (1978). The energetic consequences of incubation for two passerine species. The Auk, 95(4), 644-655

References

- Martin, K., Aitken, K. E., & Wiebe, K. L. (2004). Nest sites and nest webs for cavity-nesting communities in interior British Columbia, Canada: nest characteristics and niche partitioning. The condor, 106(1), 5-19.
- DuRant, S. E., Hopkins, W. A., Hepp, G. R., & Walters, J. R. (2013). Ecological, evolutionary, and conservation implications of incubation temperature-dependent phenotypes in birds. Biological Reviews, 88(2), 499-509.
- Deeming, D. C., & Du Feu, C. R. (2008). Measurement of brood patch temperature of British passerines using an infrared thermometer. Bird Study, 55(1), 139-143.
- Dekker, R., & Brom, T. (1992). Megapode phylogeny and the interpretation of incubation strategies. Zoologische Verhandelingen, 278(2), 19-31.