



New Guinea as a laboratory for avian evolution

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Weird Bird



(Yellow-breasted satinbird, 625-2000m)

Uniqueness

"Physicists and chemists often have genuine difficulty in understanding the biologist's stress of the unique. . . individuality [is] so characteristic of the organic world, where all individuals are unique; all stages in the life cycle are unique; all populations are unique; all species and higher categories are unique; all interindividual contacts are unique; all natural associations of species are unique; and all evolutionary events are unique" (Mayr 1961, "Cause and Effect in Biology", *Science*)

Why is New Guinea's avifauna unique, and why does it matter?

Outline

- ▶ Overview of New Guinea's avian diversity
- ▶ Geography
- ▶ Speciation
- ▶ Macroevolution
- ▶ Conservation

Overview of New Guinea's avian diversity

Q_1 : How do we quantify diversity?

Species and phylogenetic richness



- ▶ 943 species regionally (Gregory 2009)
- ▶ 789 from the mainland (>5% of global total)
- ▶ 2 (or more?) species undescribed
- ▶ 98 families
- ▶ 39 birds-of-paradise

(<https://macaulaylibrary.org/asset/225784281>)

Endemism



- ▶ 406 mainland endemics (>50%)
- ▶ 7 endemic families (Melanocharitidae, Paramythiidae, Cnemophilidae, Rhagologidae, Ifritidae, Eulacestomidae, Melampittidae)
- ▶ 75 endemic species in Bismarcks / Admiralties / Bougainville

(<https://macaulaylibrary.org/asset/184660681>)

Ecological diversity



- ▶ Cassowaries to sunbirds to harpy eagles
- ▶ Coastal mudflats to swamp forest to savannah to glacier line (>4500m)
- ▶ More frugivores than in the American tropics
- ▶ Elaborate plumage possibly a result of reduced pressure from carnivores

(<https://macaulaylibrary.org/asset/90807631>)

Importance to evolutionary thought



- ▶ Ernst Mayr (Modern Synthesis: biological species concept, allopatric speciation)
- ▶ Jared Diamond (*Guns, Germs, and Steel*, but also work on community assembly rules, speciation, biogeography)
- ▶ E.O. Wilson (ants, but taxon cycle, Theory of Island Biogeography)

(<https://doi.org/10.1038/nature03435>)

Geography & Geology

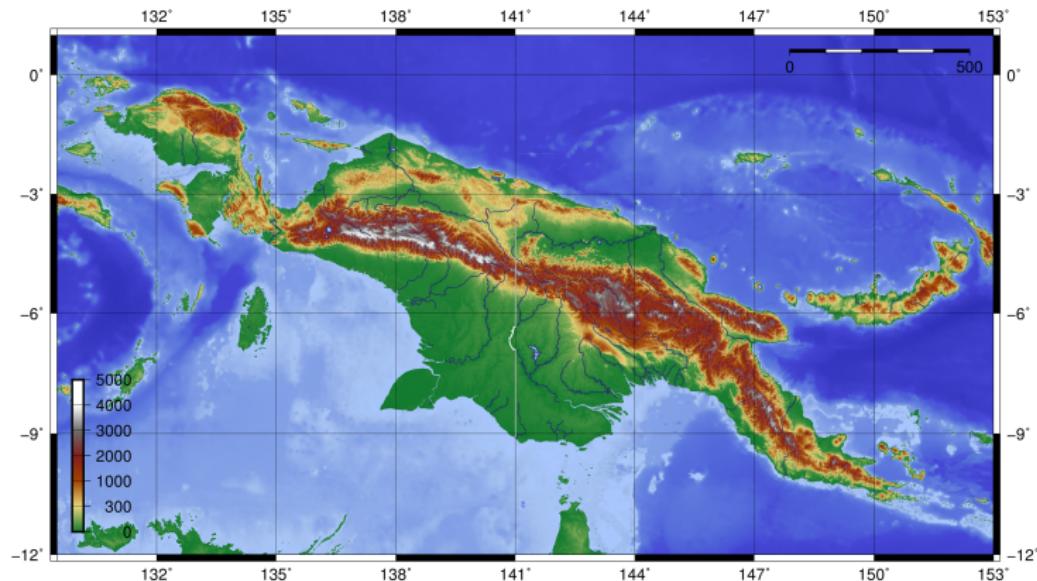
Q₂: What aspects of geography and earth history are associated with diversity?

Geography



(wikipedia)

Geography

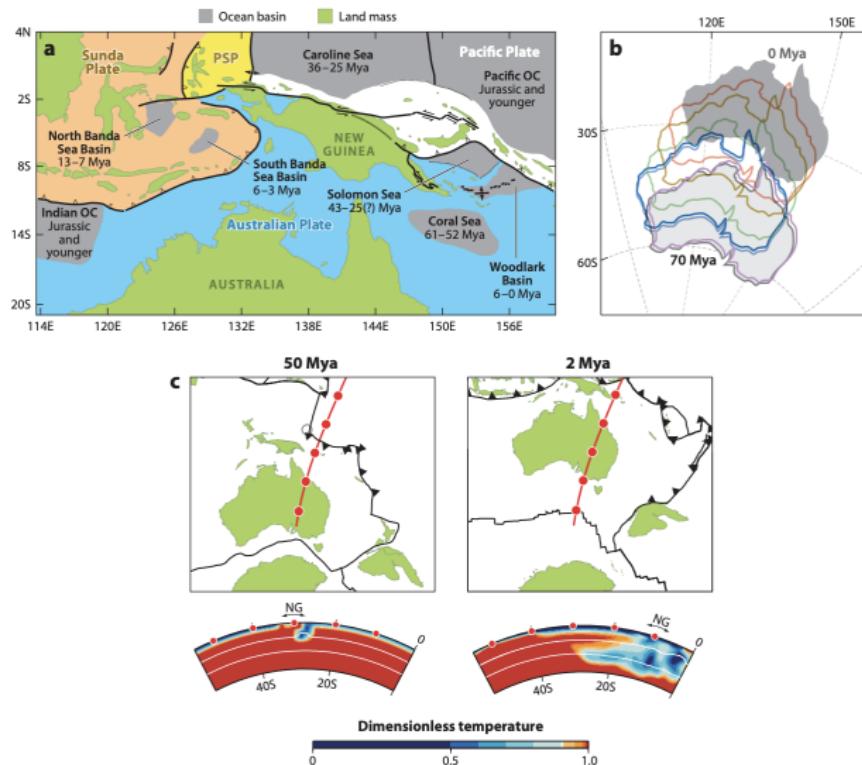


(wikipedia)

Geography

- ▶ High mountains with east-west orientation
- ▶ “Sky Islands”
- ▶ Large lowland basins
- ▶ Major river systems
- ▶ Shallow and deep seas
- ▶ Off-shore islands (land-bridge and oceanic)

Tectonic History

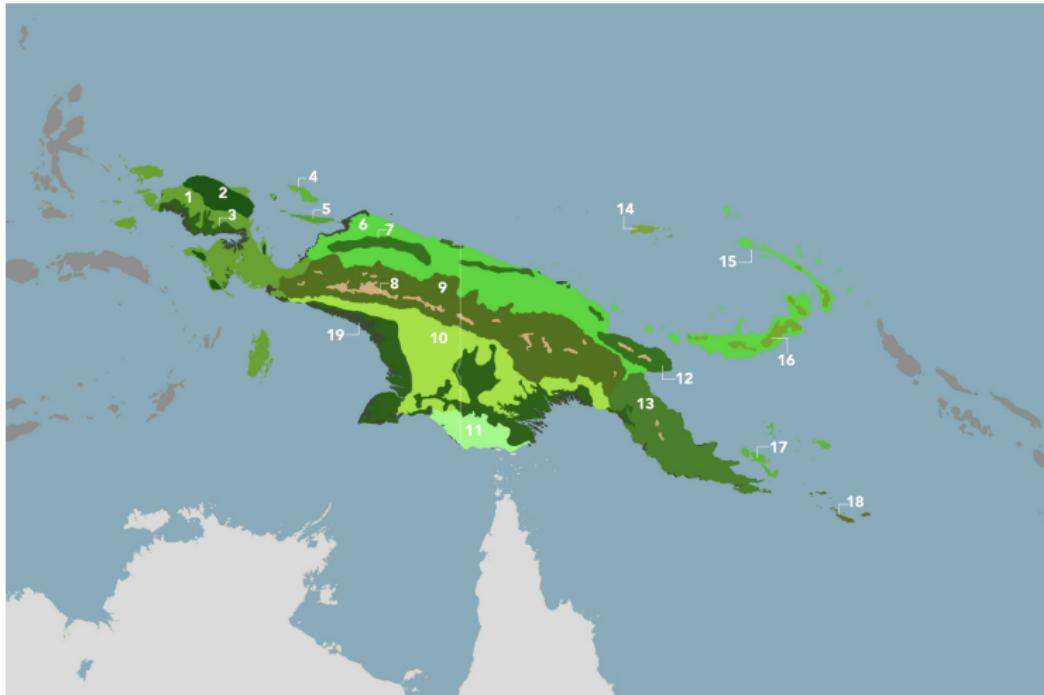


(Baldwin, Fitzgerald, & Webb 2012)

Tectonic History

- ▶ Gondwanan isolation
- ▶ Current position at geographic crossroads
- ▶ Collision to form mountain ranges
- ▶ Movement to warmer climates during last ice age
- ▶ “[A]rguably one of the most tectonically complex regions of the world... its tectonic evolution has global significance” (Baldwin, Fitzgerald, & Webb 2012)

19 Major Ecoregions

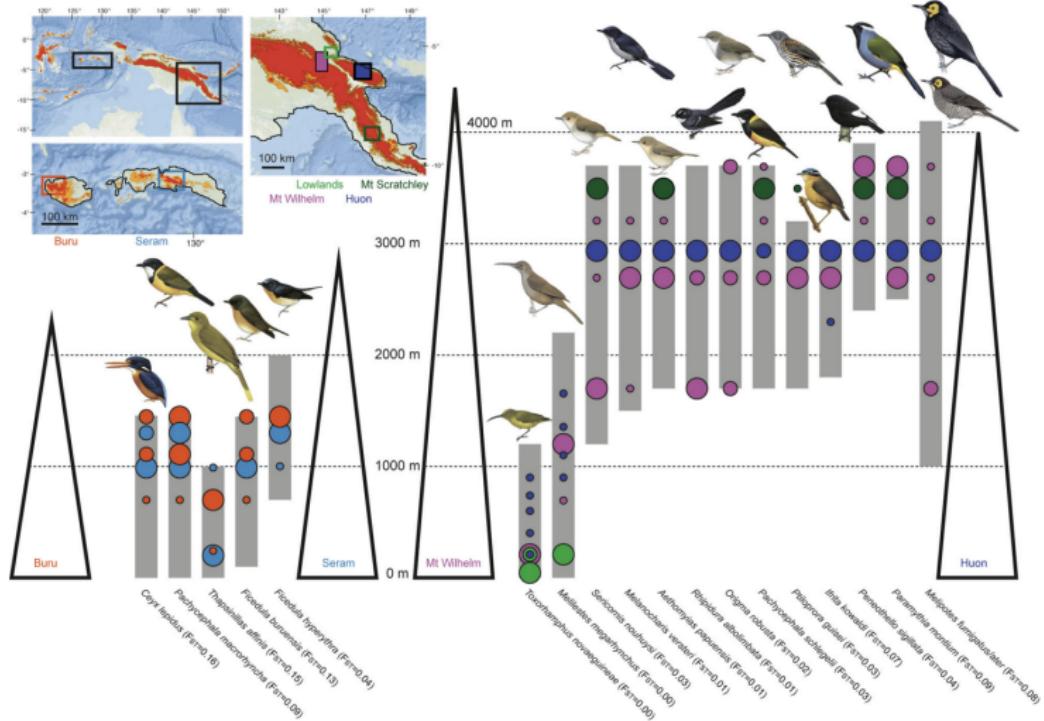


(one earth)

Speciation

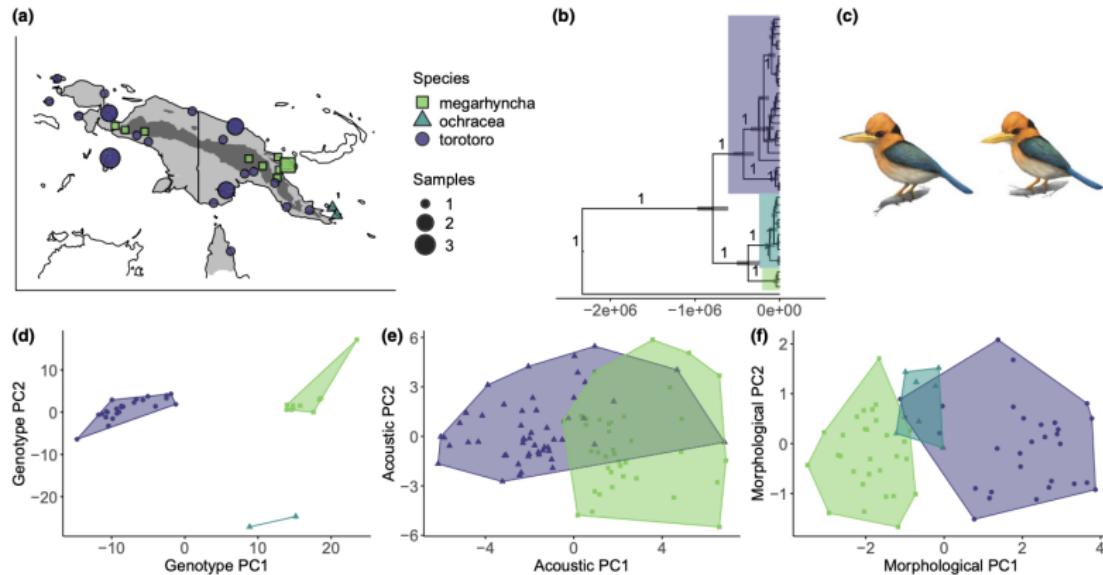
Q₃: How might geography influence speciation?

Allopatric speciation in the highlands



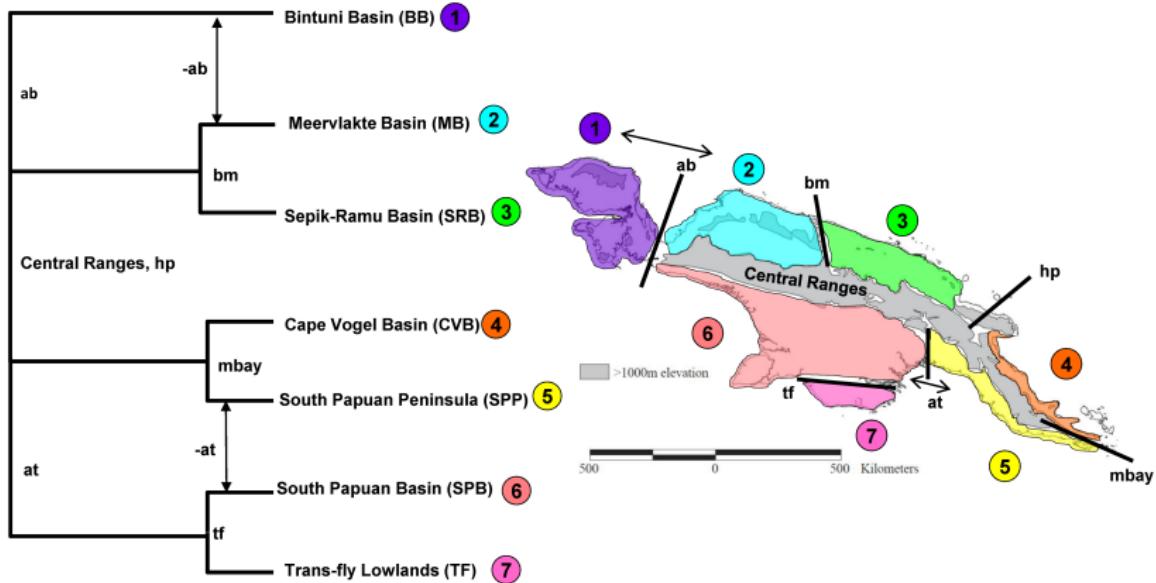
(Pujolar et al. 2022)

Parapatric speciation in the highlands



(Linck, Freeman, & Dumbacher 2020)

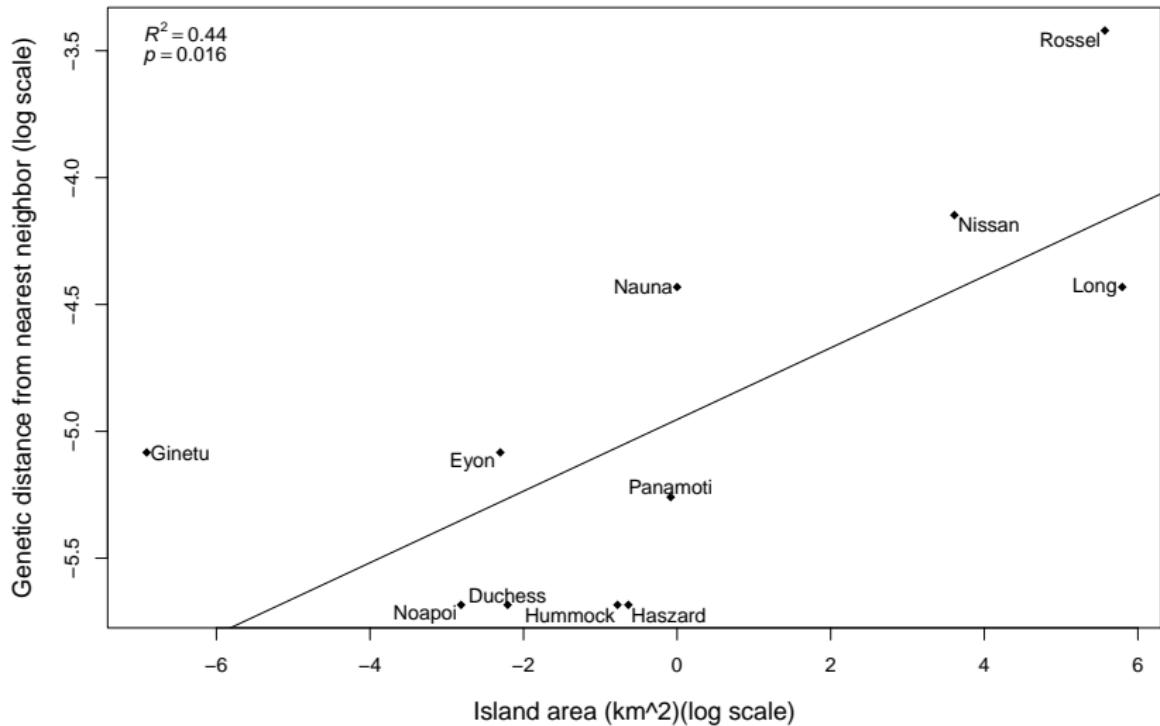
Allopatric speciation in the lowlands



(Denier et al. 2011)

Diversification on islands

Genetic distance from nearest neighbor
as a function of home island area

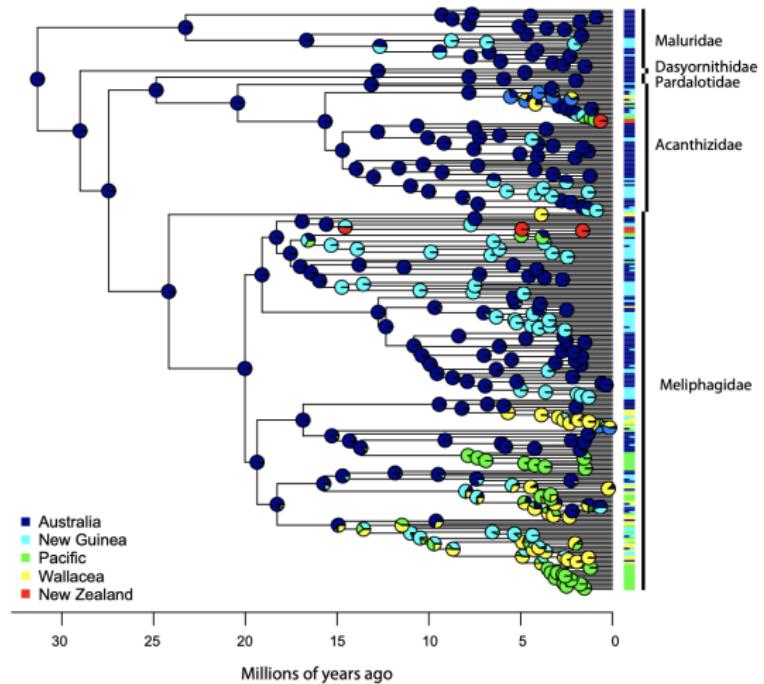


(Linck et al. 2016)

Macroevolution

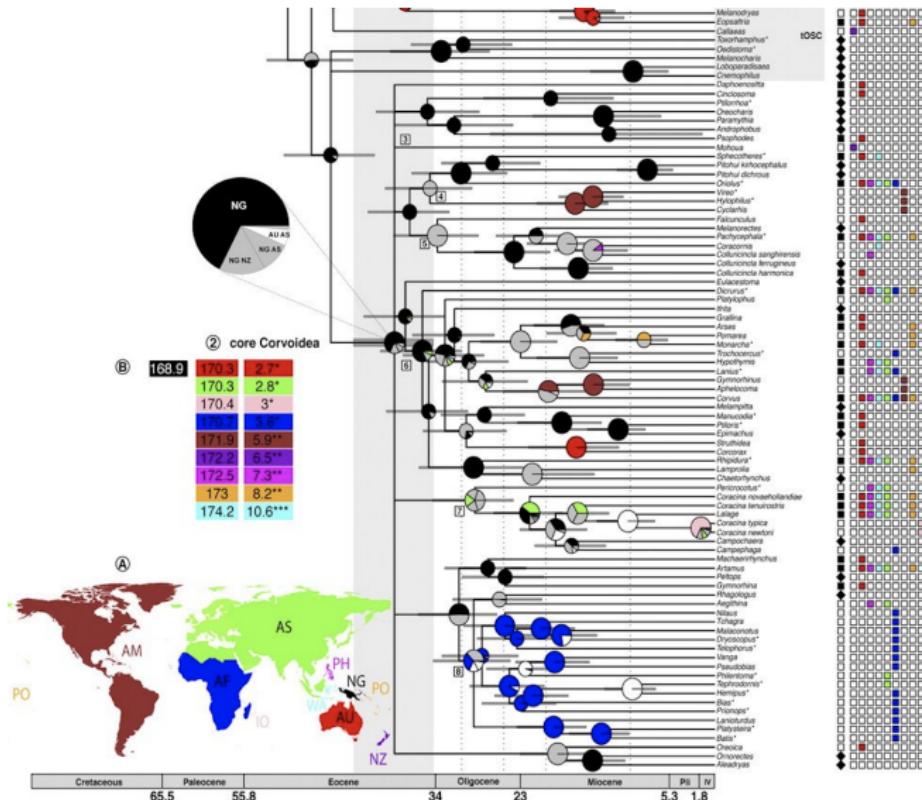
Q₄: Which avifaunas are most similar to New Guinea?

Australasian bird diversity



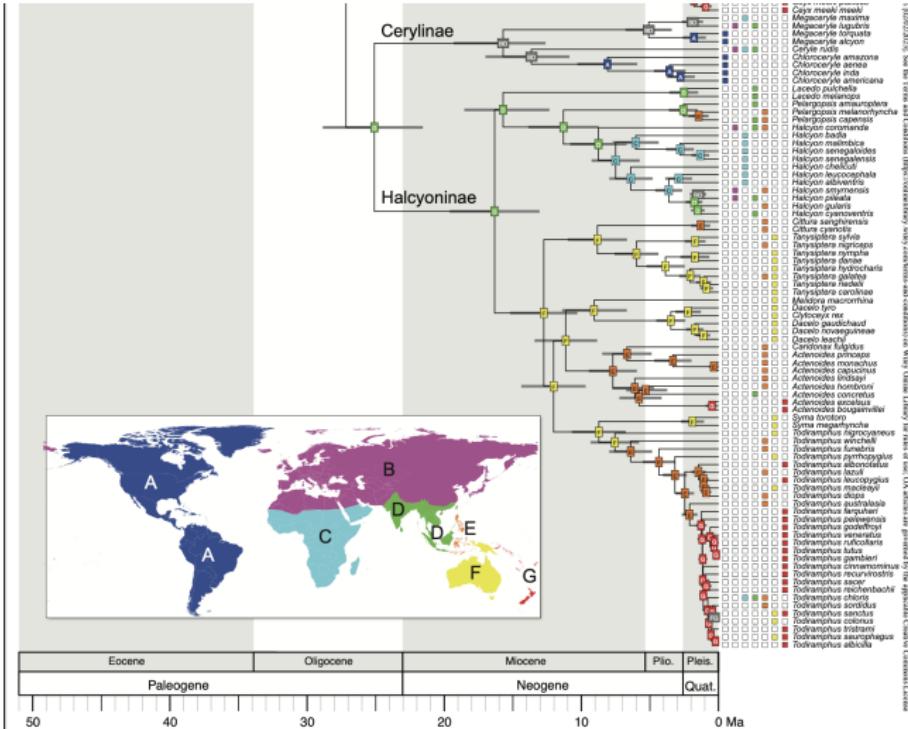
(Marki et al. 2017)

The origin of songbirds



(Jönsson et al. 2011)

Avian diversity in Oceania



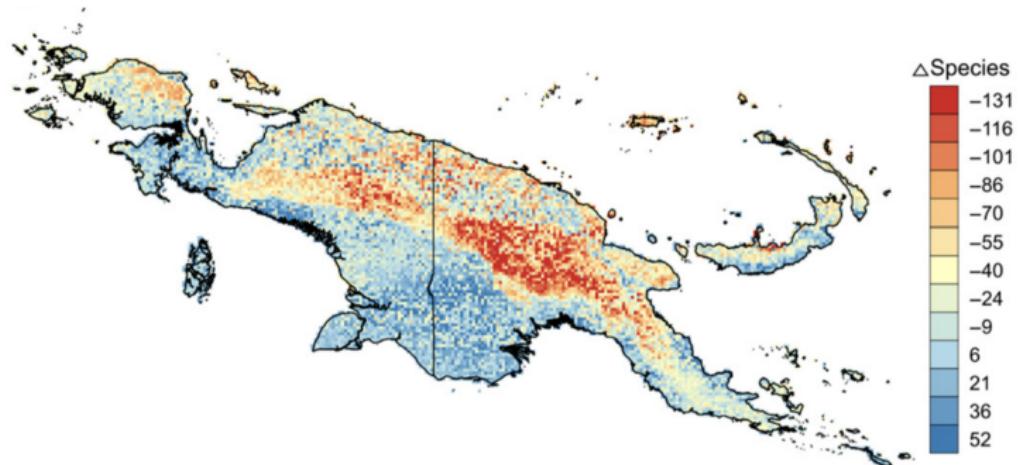
(Andersen et al. 2018)

Biodiversity Conservation

Logging and Oil Palm



Climate Change



(Cámara-Leret et al. 2019)

Climate Change

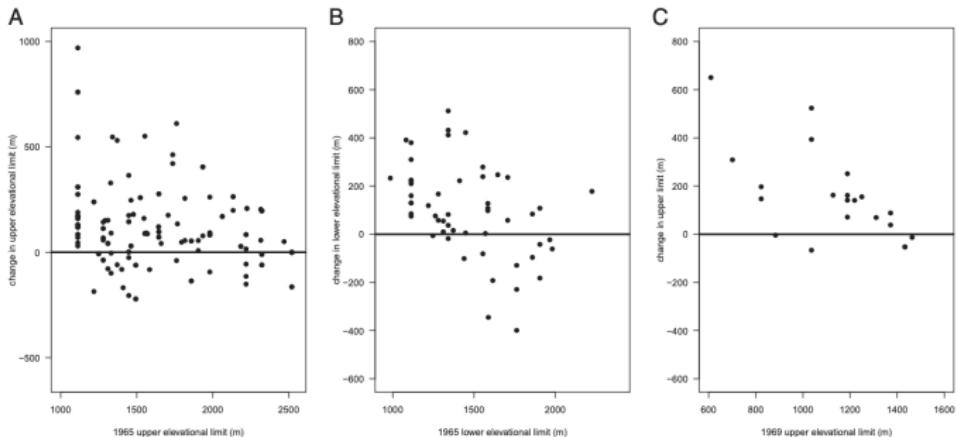
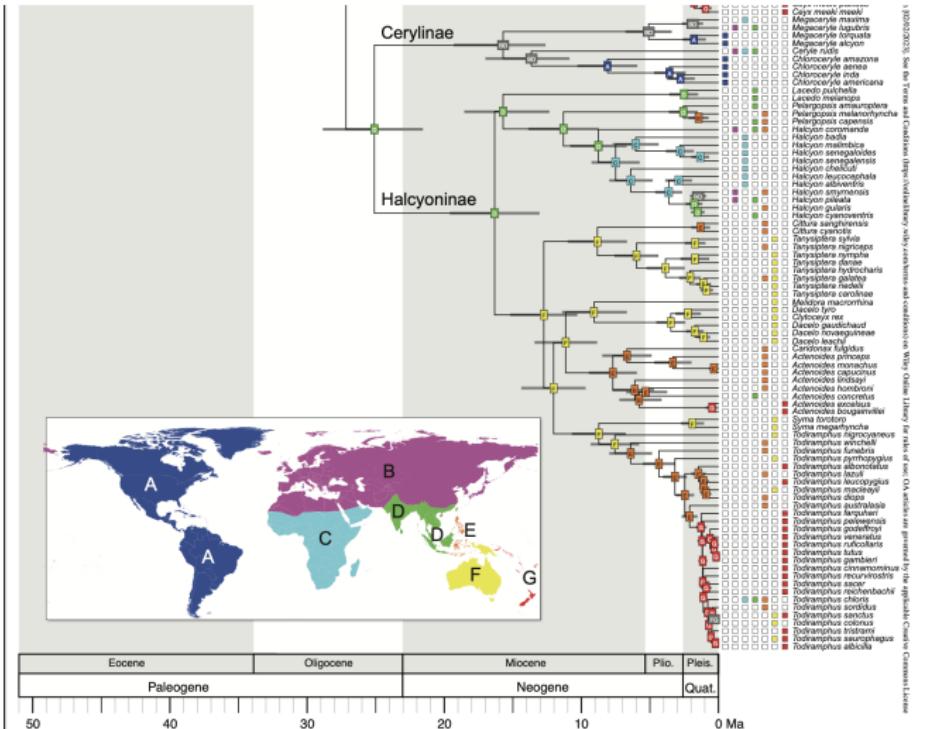


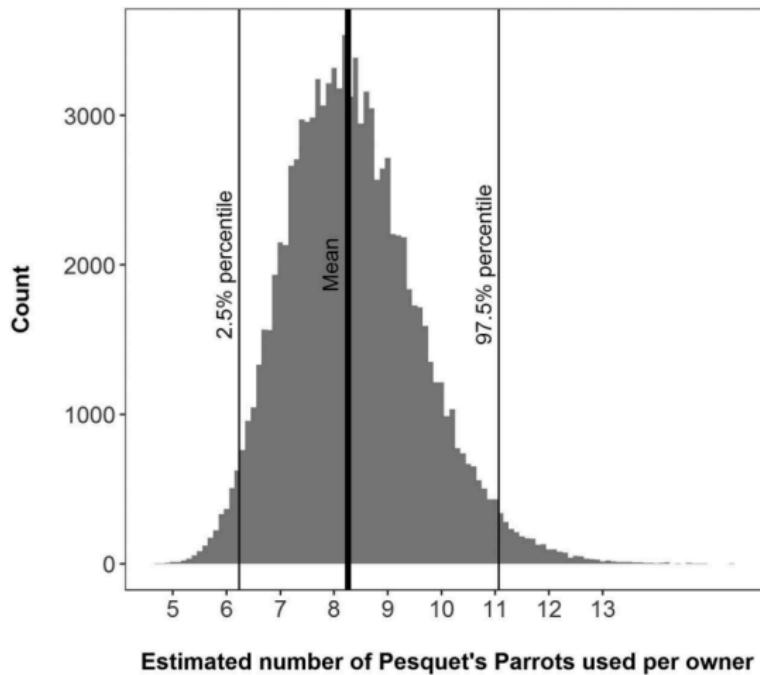
Fig. 2. Changes in species' elevational limits for Mt. Karimui upper elevational limits (A), Mt. Karimui lower elevational limits (B), and Karkar Island upper elevational limits (C). Changes in species' elevational limits between historical and modern resurveys are plotted against historical elevational limits measured in the 1960s (19, 20). Points on the solid zero-change lines represent species with unchanged elevational limits.

(Freeman & Class Freeman 2014)

Cultural significance



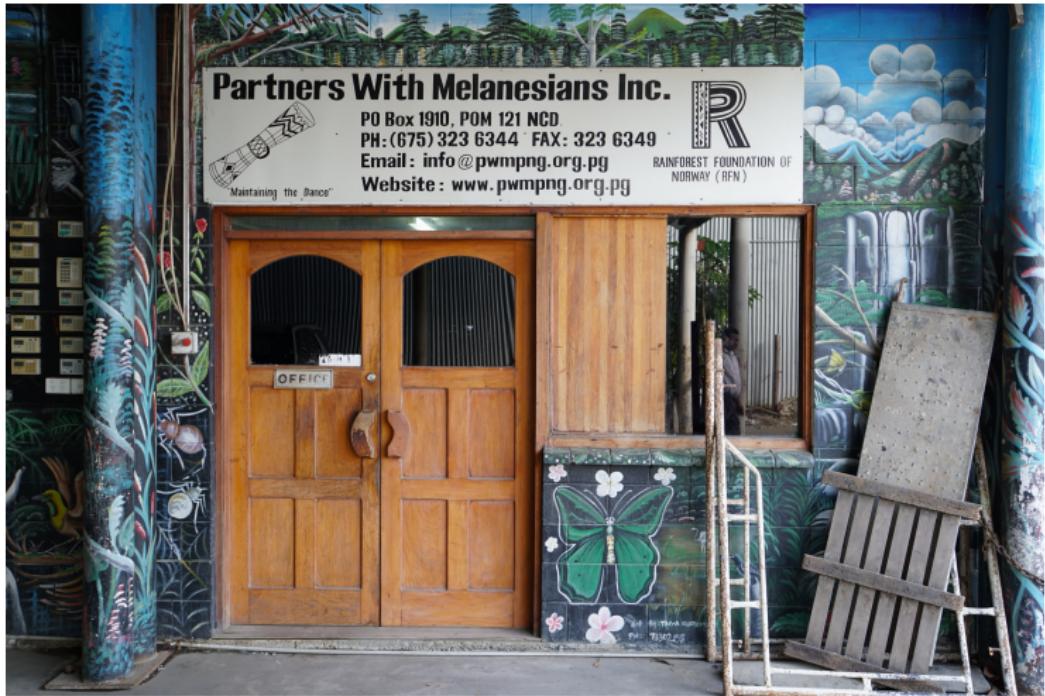
Hunting



45,000+ Years of Habitation



Indigenous Land Tenure & Conservation



Why New Guinea birds?

- ▶ New Guinea's bird diversity is globally important
- ▶ It showcases the speciation process at small scales
- ▶ It has played a role in the global trajectory of avian evolution
- ▶ It has a complex, pressing conservation future

More weird birds



(garnet robin)

More weird birds



(mountain fruit dove)

Thanks + resources

- ▶ People: Stanley Jacobs, Bulisa Iova, Georgia Kapui, Salape Tulai, Jack Dumbacher, Ben Freeman, Kate Schimel, Bruce Beehler, Lisa Dabek
- ▶ Places: The New Guinea Binatang Research Center, University of Washington, California Academy of Sciences
- ▶ Slides & references: https://github.com/elinck/misc_talks/