

# An introduction to moult

by Dr Santi Guallar



Silvereye post juvenile complete moult

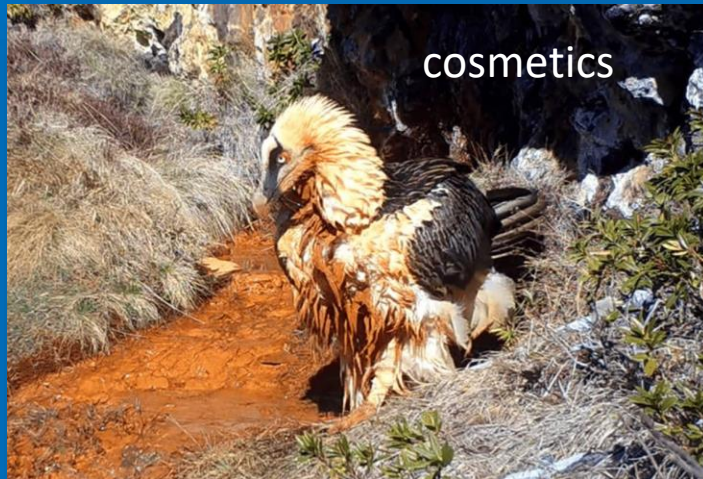
# Plumage function (prequel)

- **Protection:** thermoregulation, solar radiation, waterproofing
- **Locomotion:** flight (type, aerodynamics), swimming
- **Communication:** mate choice, social, camouflage, sound production

Terrill & Schultz 2023. Feather function and the evolution of birds. Biol Rev 98

# What is moult?

- Non-accidental, programmed shedding and replacement of plumage
- Once finished, feathers are **inert** structures although they can change through
- Moult affects other epidermal structures concurrently (claws, outer skin, bill, feet scales)





# Why moulting?

- Maintenance
- Seasonal change
- Maturation

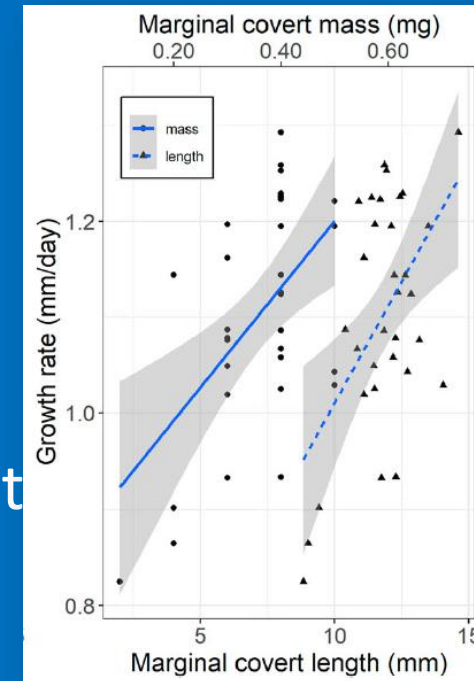


# Costs

- **Energy:** synthesis of keratin (about 10% of body mass)
- **Aerodynamics:** wing and tail gaps (higher effort, higher predation risk, lower foraging efficiency)
- **Heat and water loss:** through increasing peripheral blood circulation

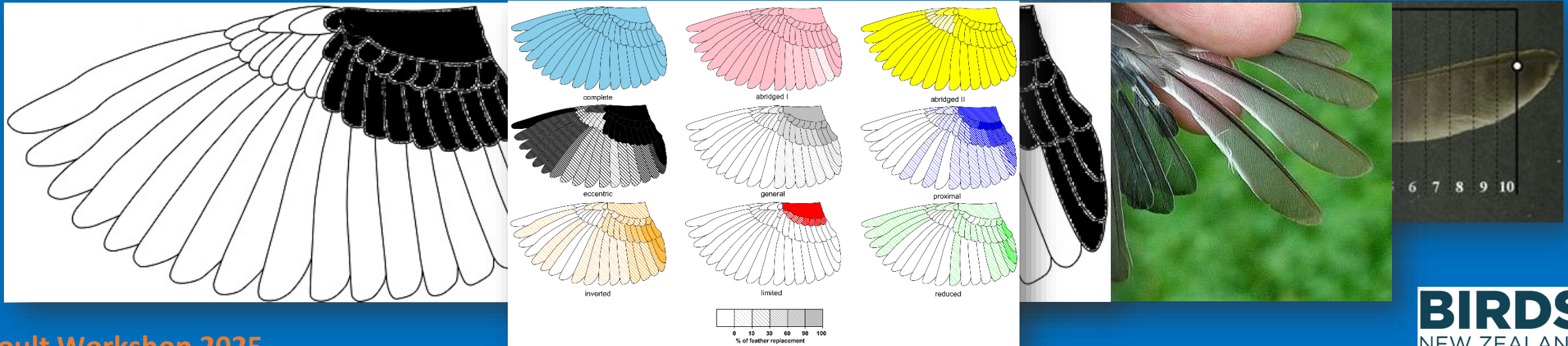
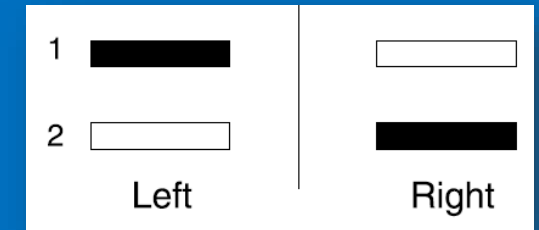
# How it works?

- Feather shedding forced by synthesis of new feather at the follicle
- Allometric scaling: the larger the feather the faster it grows, but at a slower rate than expected (slope < 1)
- Coordination of feather shedding within and among feather tracts (sequence)
- Control of the amount of plumage growing throughout the moult progress (intensity)



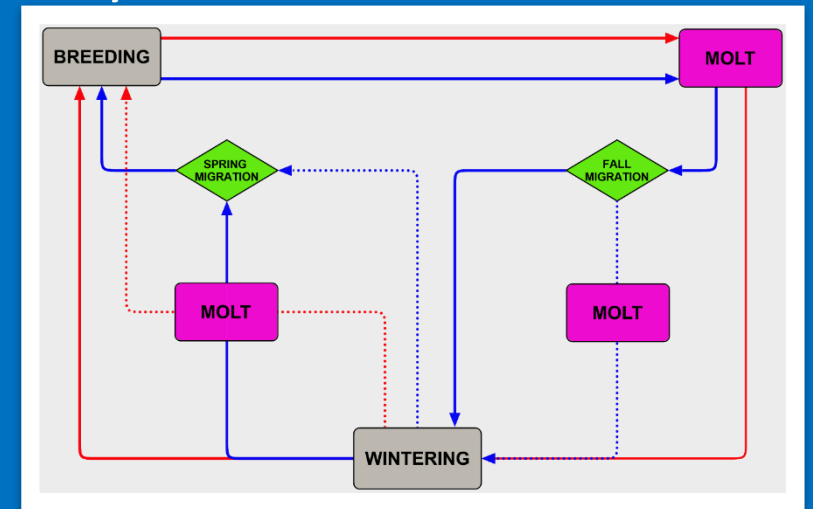
# Components of moult

Process components	Output Components
feather-growth rate	feather structure (density, area, any physical property)
sequence	extent (quantity: area, number of feathers, feather mass)
intensity	lateral symmetry
	final moult phenotype (identity of feathers finally moulted) similar phenotypes can be classified in moult patterns



# Annual moult cycle: space and time

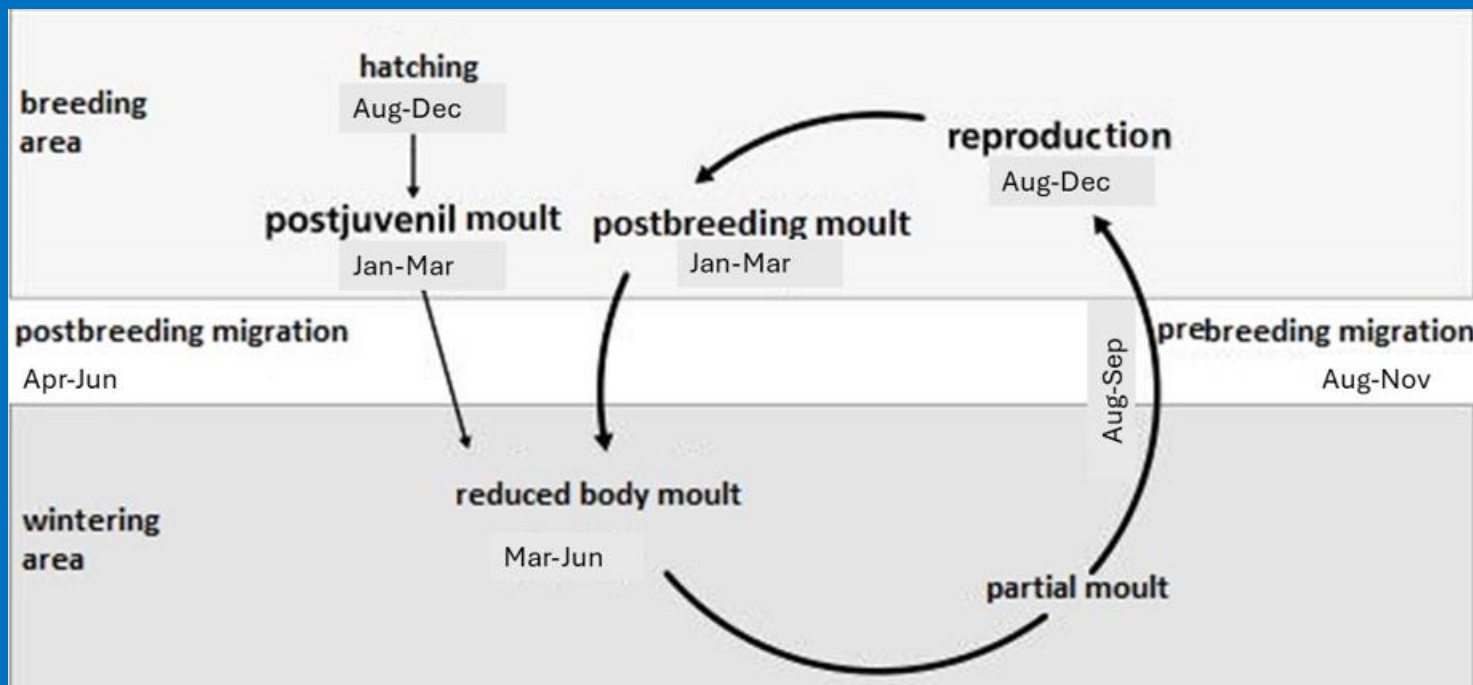
- **Phenology:** circannual periodicity
- **Duration:** increases with size, for similar size increases with flight distance
- **Number of moults:** correlates to complexity of annual cycle
- **Where:** optimisation of available time/resources
- **Variation**  
among populations (eg, migratory vs resident)  
size, natural history, environment, and phylogeny





# Moult strategies: integration

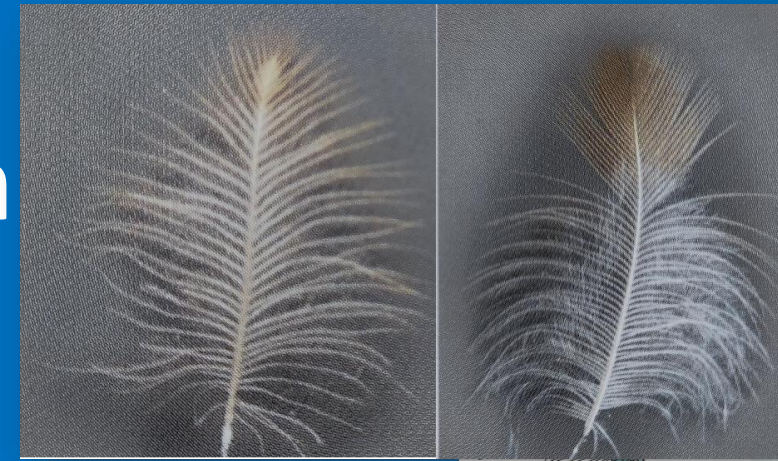
- Strategy (narrow sense): one aspect
  - Extent: PJ moult of fernbirds varies from partial to complete
  - Where: Great reed warblers moult in their breeding area or during migration
- Strategy (broad sense): multiple aspects



Long-distance passerine migrant

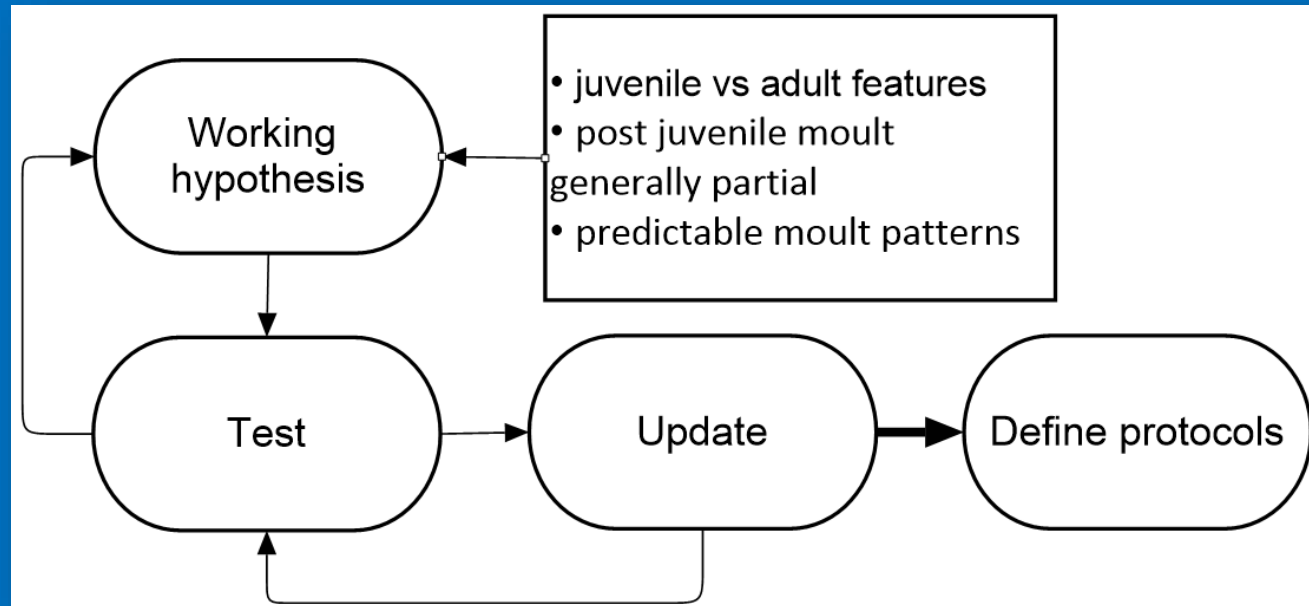
# Application to age determination

- Process components
  - sequence depends on extent: complete moult starts by primaries
- Output components
  - extent typically complete in post breeding moults, partial in post juvenile moults
  - moult limits typical of post juvenile moults, but beware of pre breeding moults
  - juvenile feathers are paler and fluffier



# Application to age determination

- Use previous knowledge (juvenile and adult plumages differ, post juvenile moult generally partial, predictable moult patterns)
- Age determination follows a heuristic iterative approach



# Last but not least

- Apophenia is the phenomenon that attributes to a causality what is merely a coincidence, ie., see patterns or connections that are actually unrelated (like constellations)
- The use of moult to age determination is prone to apophenia. Beware!