

Body size shapes song in honeyeaters

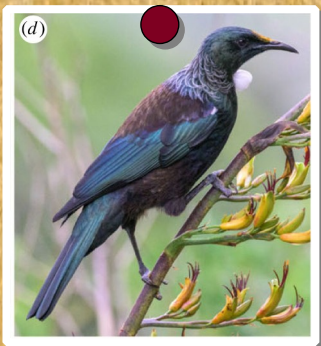
Eleanor M. Hay, Matthew D. McGee, Craig R. White and Steven L. Chown

School of Biological Sciences, Monash University, Melbourne, Victoria 3800, Australia

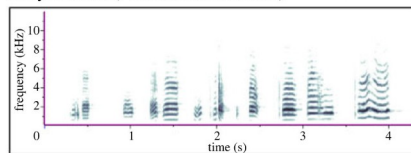
iD EMH, 0000-0003-4211-7349; CRW, 0000-0002-0200-2187

PROCEEDINGS
OF THE ROYAL SOCIETY B
BIOLOGICAL SCIENCES

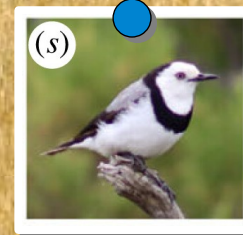
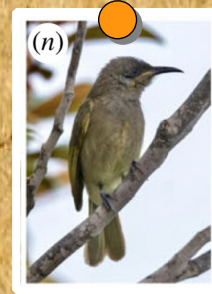
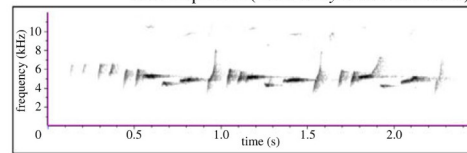
THE
ROYAL
SOCIETY






noisy friarbird (*Philemon corniculatus*)



eastern spinebill (*Acanthorhynchus tenuirostris*)





 Year-round  Breeding
 Non-breeding

54

Genera

191

Species

Honeyeater *noun*

{hon·ey eat·er}

any of a family (Meliphagidae) of oscine birds chiefly of the South Pacific that have a long extensible tongue adapted for extracting nectar and small insects from flowers

{Merriam-Webster Dictionary}

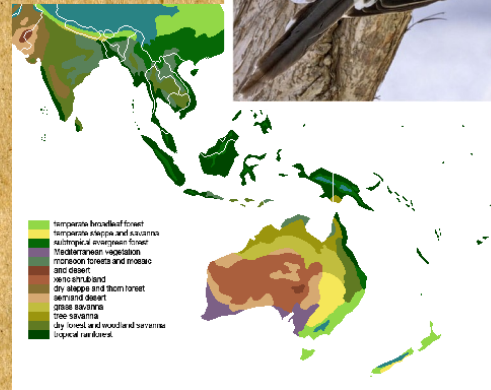
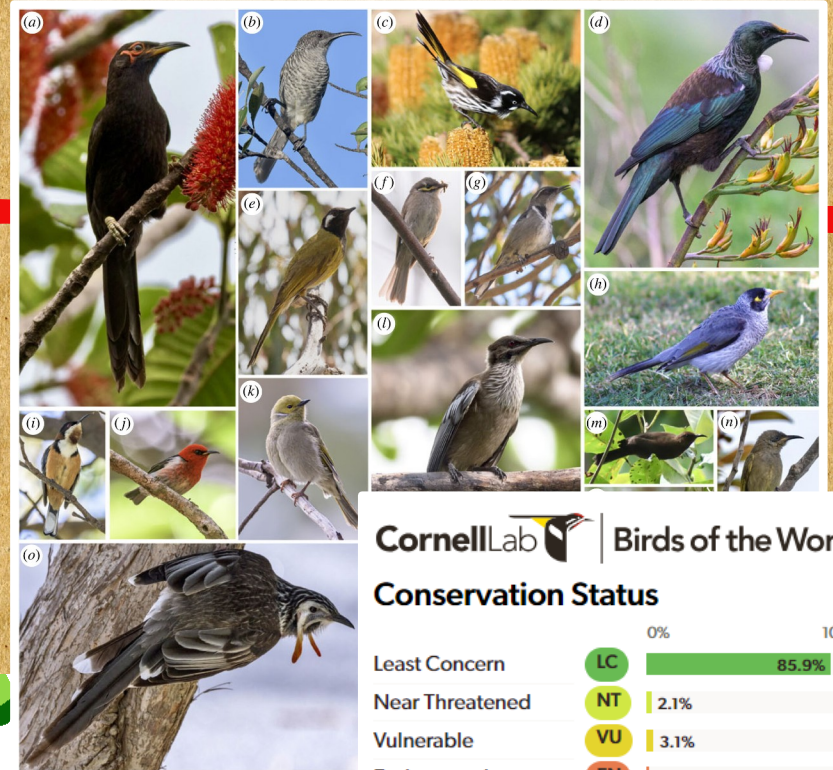
‘succiamiele’

Ordine: Passeriformes

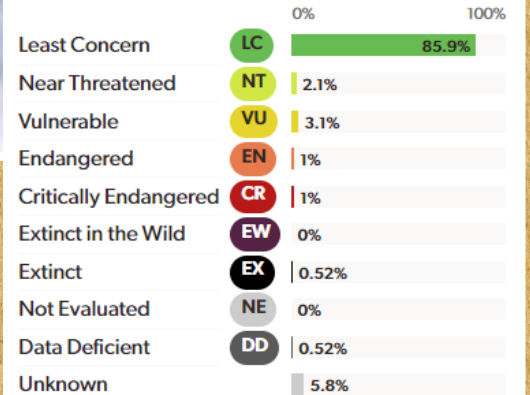
Famiglia: Meliphagidae

Grande diversità interspecifica

- Massa corporea
- Forma del becco
- Grande varietà di ambienti
- Monofiletico



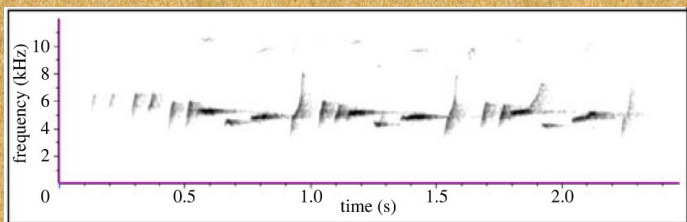
Cornell Lab | Birds of the World Conservation Status



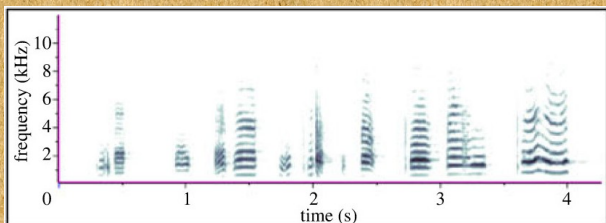
Data provided by IUCN (2023) Red List. [More information](#)

Grande diversità canora

- Imparano i canti
→ trasmissione culturale

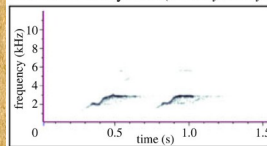


Acanthorhynchus tenuirostris
Spinorinco orientale

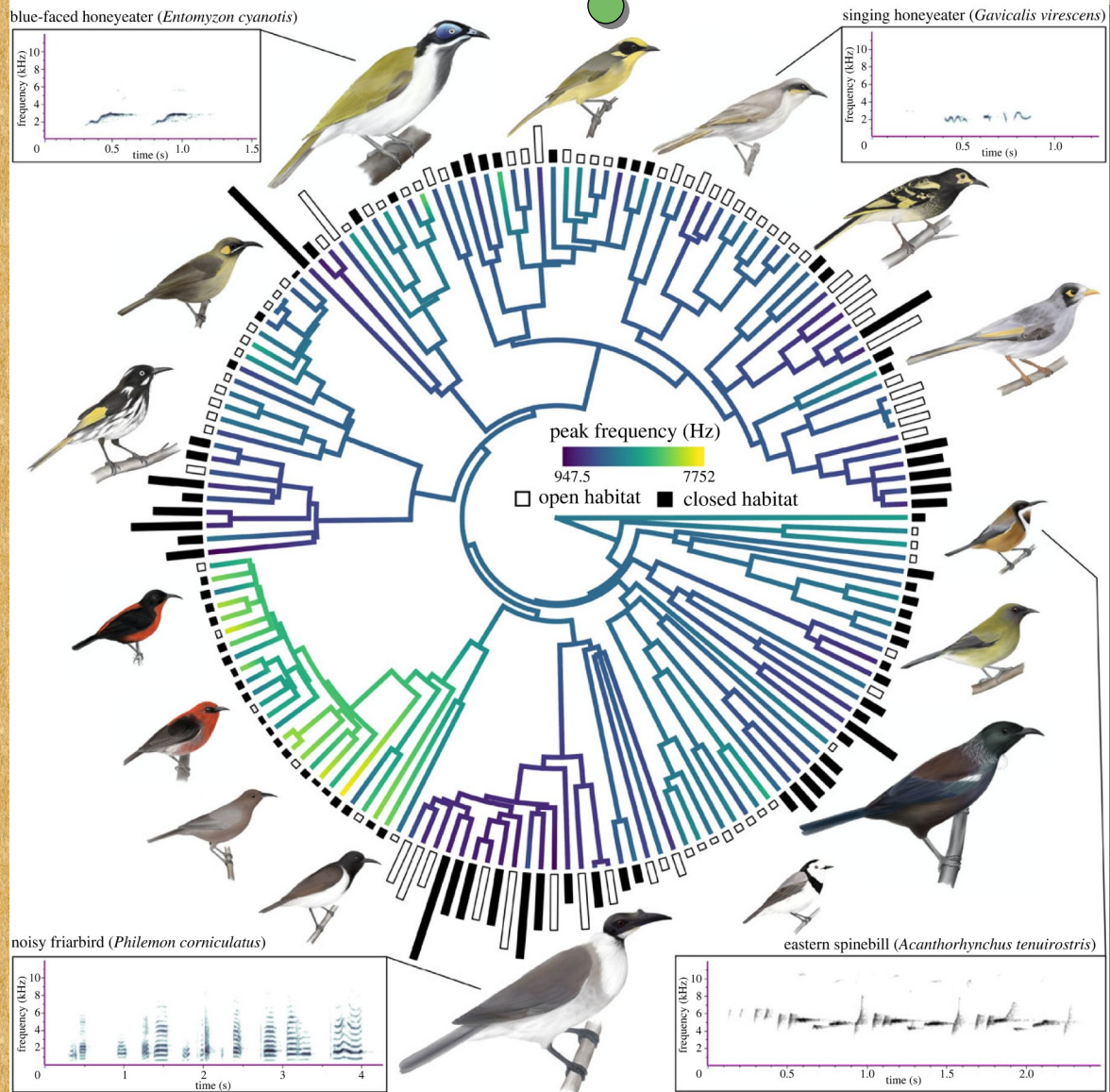
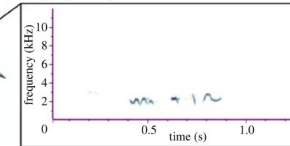


Philemon corniculatus
Uccello frate chiassoso

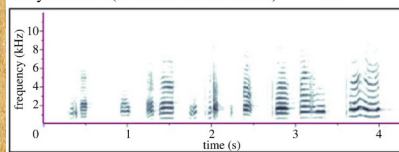
blue-faced honeyeater (*Entomyzon cyanotis*)



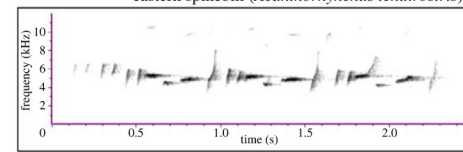
singing honeyeater (*Gavicalis virescens*)



noisy friarbird (*Philemon corniculatus*)



eastern spinebill (*Acanthorhynchus tenuirostris*)



Canti degli uccelli

Segnali acustici che influenzano la sopravvivenza e la riproduzione

Evoluzione

Caratteristiche

influenzate da:

Habitat

Caratteristiche morfologiche

*Frequenza massima
Frequenza minima
Frequenza di picco
Larghezza di banda
Trasmissione
Rilevabilità
Ritmo
Complessità
...*

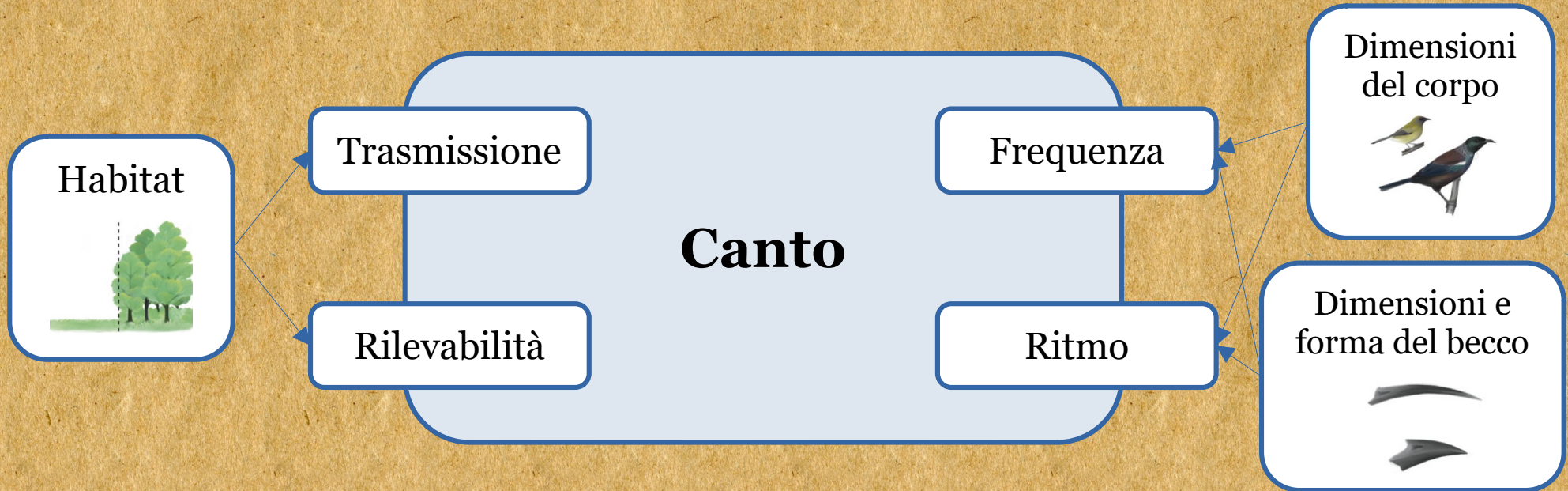
Due ipotesi principali

The **acoustic adaptation hypothesis**

Ipotesi di adattamento acustico

The **morphological constraint hypothesis**

Ipotesi del vincolo morfologico



Due ipotesi principali

Condizioni ambientali



Termoregolazione

The **acoustic adaptation hypothesis**
Ipotesi di adattamento acustico

Morphological constraint hypothesis
Ipotesi del vincolo morfologico



Trasmissione

Rilevabilità

Frequenza

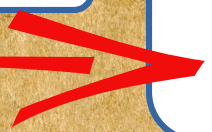
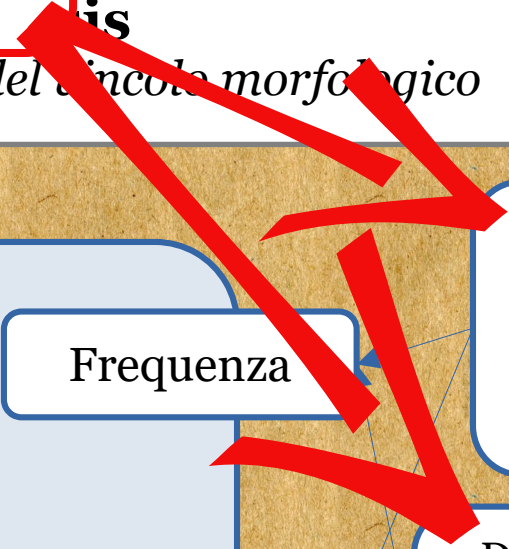
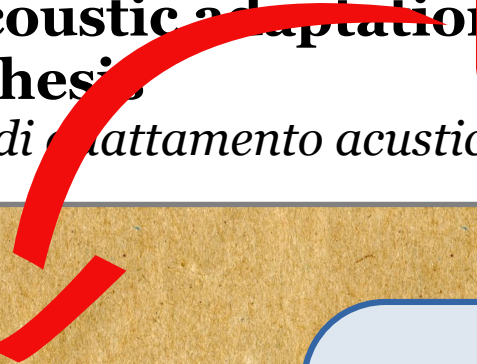
Ritmo

Canto



Disponibilità di cibo

Dieta



Scopo dello studio

Scoprire gli effetti sia dell'habitat che della morfologia sul canto degli uccelli ad una scala macroevoluzionistica, considerando le interazioni e le correlazioni sottostanti tra le variabili

Risultati attesi

Secondo l'ipotesi del vincolo morfologico: taglia corporea vincola la frequenza canora e forma del becco il ritmo

Secondo l'ipotesi di adattamento acustico: uccelli tipici di ambienti chiusi cantano a frequenze più basse e ritmi più lenti

Materiali e metodi

1) RegISTRAZIONI di canti di individui ♂

*Vocalizzazioni con
elementi tonali,
separati da intervalli
maggiori di 1 s*

564 individui di 163 specie (85% dei succiamiele)

1 – 20 registrazioni per specie

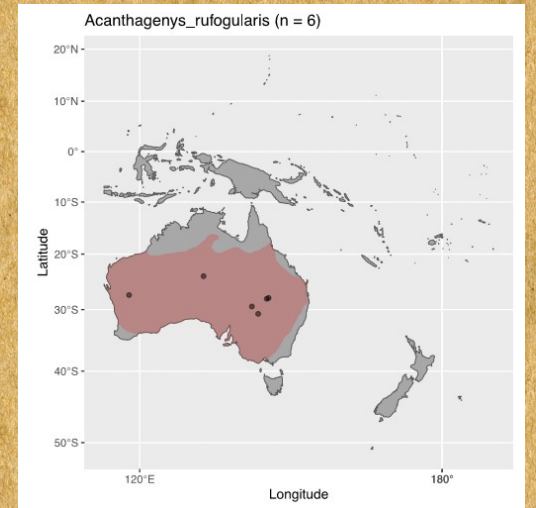
xeno-canto

Sharing wildlife sounds from around the world

Cornell Lab | Macaulay Library

Australian National Wildlife Collection

Avian Vocalizations Center (AVoCet)

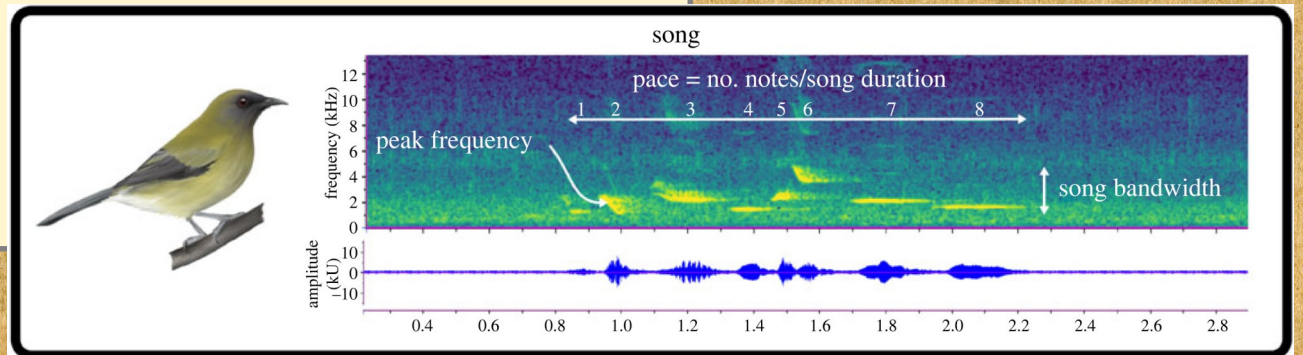
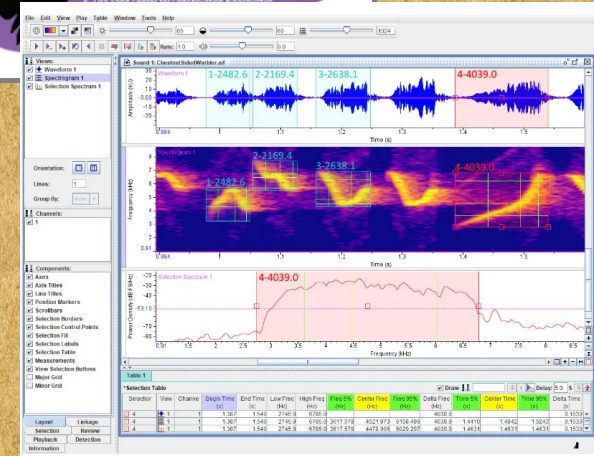


Materiali e metodi

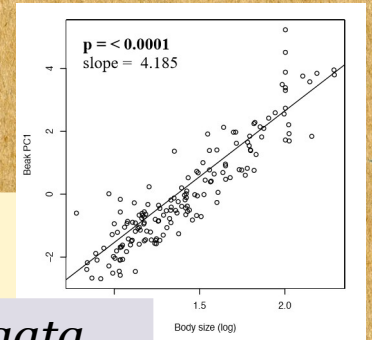
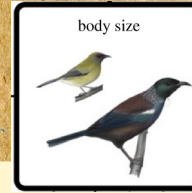
2) Spettrogrammi

- Frequenza di picco
- Frequenza massima
- Frequenza minima
- Larghezza di banda (freq max – freq min)
- Ritmo (n° note/durata del canto)

Media per specie
 Log_{10}



Materiali e metodi



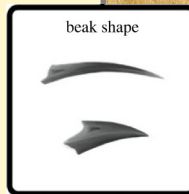
3) Caratteristiche morfologiche (σ^1)

- **Taglia corporea (massa corporea)**
- Larghezza
- Lunghezza del becco
- Profondità

Analisi delle componenti principali (PCA)

Componente PC1 legata alla dimensione del becco

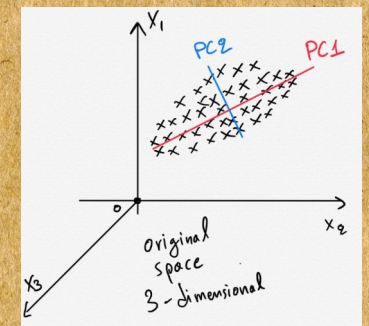
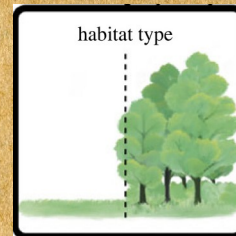
Componente PC2 legata alla forma del becco



Media e Log_{10}

4) Tipo di habitat

- Fitto
- Semiaperto
- Aperto



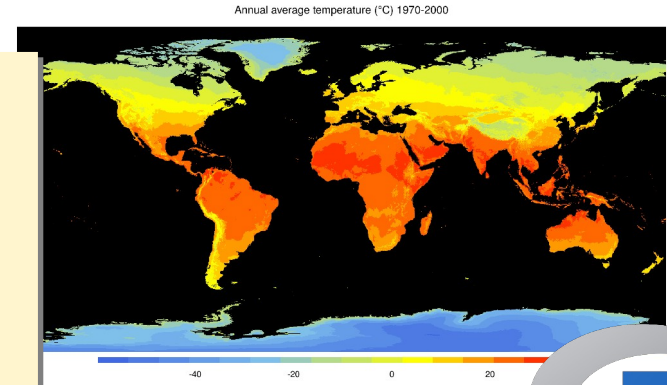
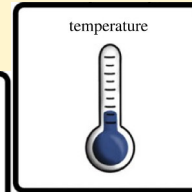
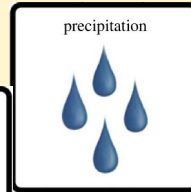
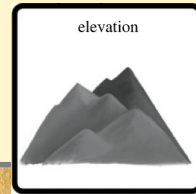
Materiali e metodi

WorldClim - Global Climate Data

Free climate data for ecological modeling and GIS

5) Variabili bioclimatiche negli areali delle specie

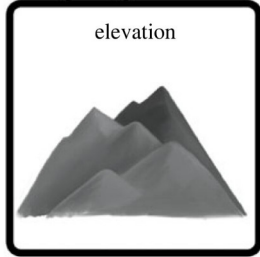
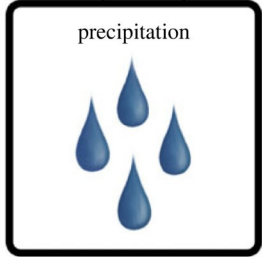
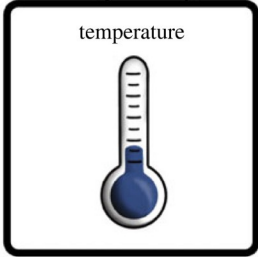
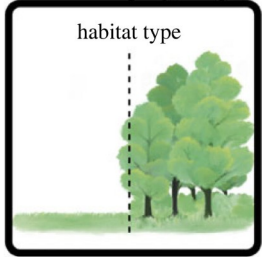
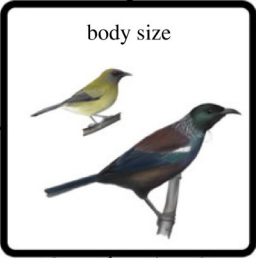
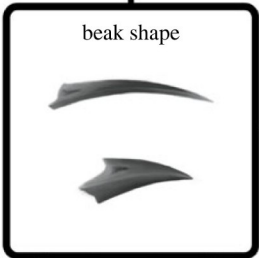
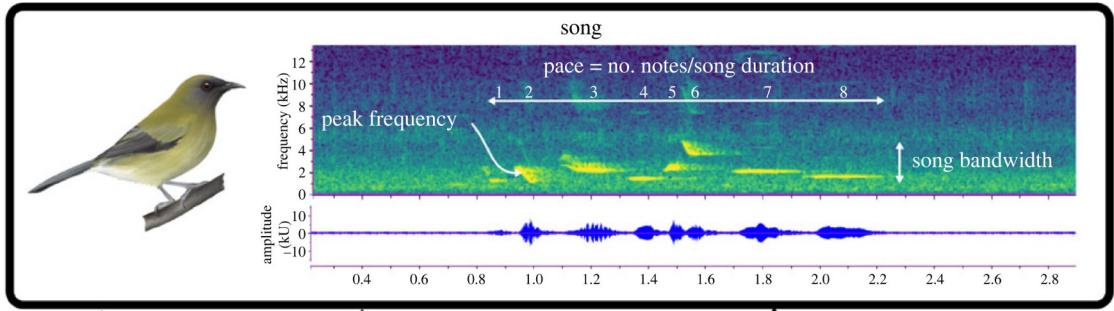
- Temperatura media annua
- Precipitazioni annue
- Altitudine



6) Filogenesi

species	Peak Freq	Max Freq	Min Freq	Pace	Bandwidth	Beak Length	Beak Width	Beak Depth	Beak REF	Body Size	Body Size REF	Habitat Density	Habitat (Binary)	Temp. Range	Prec. Range	Elev. Range
Acanthagenys_rufogularis	2141.30	3264.16	1542.97	4.96	1721.19	26.09	3.73	5.05	AVONET	47.80	Dunning (2008)	Semi-open	0	21.20	359.54	289.48
Acanthorhynchus_superciliosus	4125.00	5671.88	2156.25	5.95	3515.63	24.52	2.36	2.94	AVONET	9.72	Dunning (2008)	Semi-open	0	16.71	551.09	215.40
Acanthorhynchus_tenuirostris	4527.86	5937.96	3605.92	7.42	2332.03	27.39	2.27	2.86	AVONET	10.44	Dunning (2008)	Semi-open	0	15.42	913.53	376.95
Anthochaera_carunculata	1634.77	3256.20	1030.52	5.01	2225.68	32.27	4.88	6.14	AVONET	106.07	Dunning (2008)	Semi-open	0	17.39	456.25	289.09
Anthochaera_chrysoptera	1934.91	4830.03	950.68	4.99	3879.35	28.81	4.34	6.03	AVONET	67.80	Dunning (2008)	Semi-open	0	14.72	833.10	352.99
Anthochaera_lunulata	1705.08	4414.75	1163.53	5.04	3251.22	34.17	4.37	5.97	AVONET	61.80	Dunning (2008)	Semi-open	0	17.02	501.72	231.76
Anthochaera_paradoxa	2906.25	6703.13	1031.25	6.25	5671.88	32.56	5.04	6.43	AVONET	143.74	Dunning (2008)	Dense	1	10.30	1066.64	413.48
Anthochaera_phrugia	2024.12	3316.11	990.53	3.88	2325.59	21.54	3.26	4.40	AVONET	39.99	Dunning (2008)	Semi-open	0	15.00	786.45	424.37
Anthornis_melanura	2262.56	3383.24	1302.37	4.71	2080.87	20.97	3.08	4.04	AVONET	26.91	Dunning (2008)	Dense	1	9.96	1831.89	523.64
Ashbyia_lovensis	3531.45	3875.98	3014.65	13.38	861.33	13.60	3.05	3.65	AVONET	17.50	Dunning (2008)	Open	0	22.90	169.45	47.66
Bolemoreus_frenatus	3144.10	4636.69	2165.42	6.09	2471.28	26.35	3.53	5.05	AVONET	34.11	Dunning (2008)	Dense	1	22.89	1455.05	400.56
Bolemoreus_hindwoodi	4489.45	6295.90	2503.13	8.33	3792.77	21.05	3.05	4.15	AVONET	22.89	Dunning (2008)	Dense	1	21.36	1359.46	351.50
Caligavis_chrysoptera	3244.37	4388.75	1655.68	5.90	2733.07	16.85	2.55	3.35	AVONET	17.30	Dunning (2008)	Semi-open	0	17.71	690.78	318.03
Caligavis_obscura	2960.45	6342.77	2123.14	4.25	4219.63	26.40	3.16	4.37	AVONET	26.40	Dunning (2008)	Dense	1	23.65	3038.23	662.13

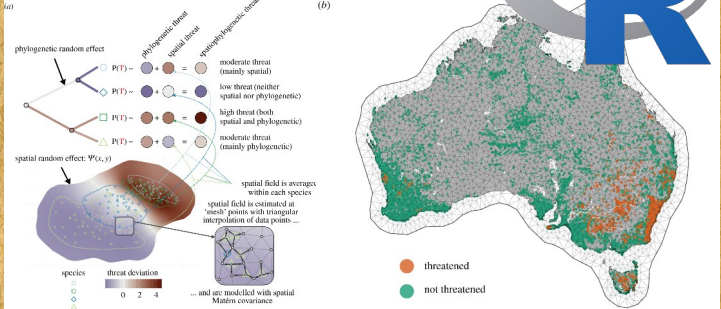




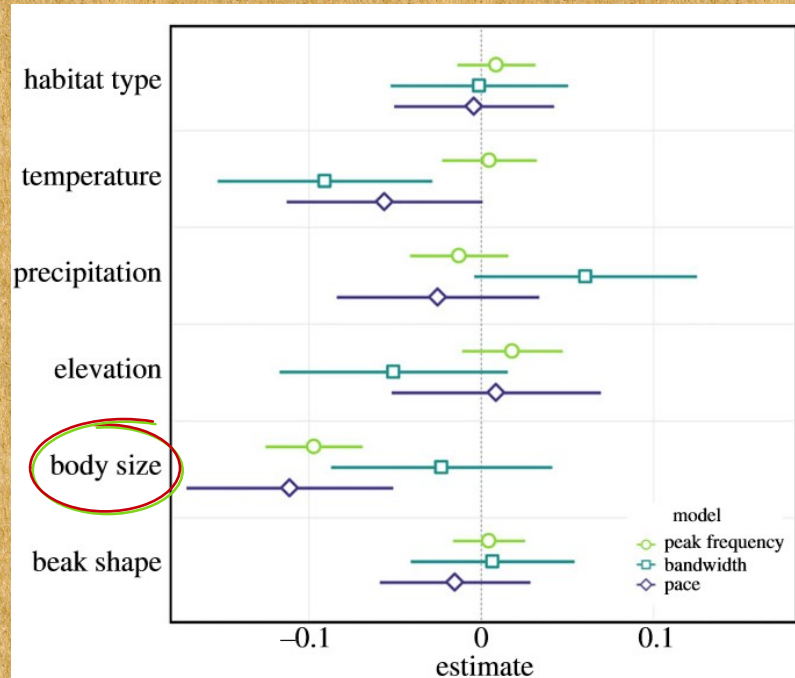
Modelli di regressione filogenetica (PGLS)

Modelli spaziofilogenetici

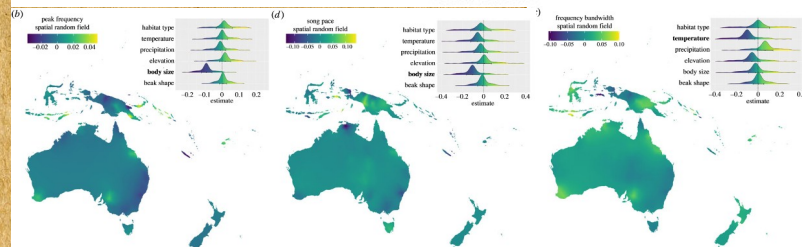
Modelli evoluzionistici



Risultati

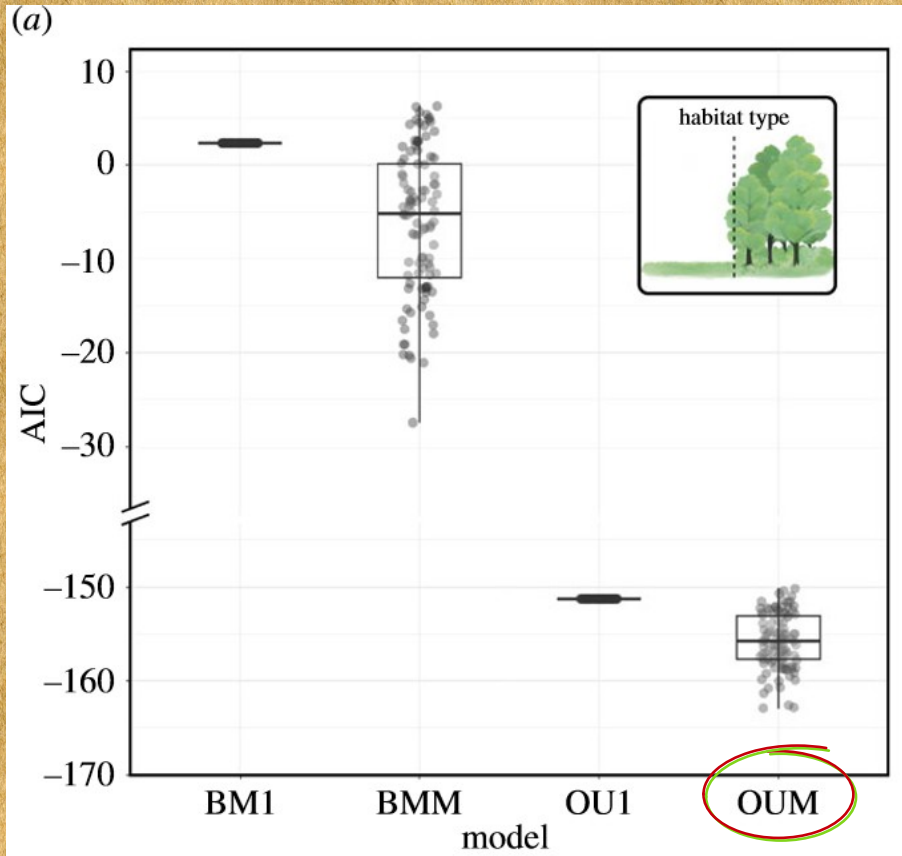


- Frequenza di picco e ritmo negativamente correlata alla massa corporea
- Nessuna influenza della forma del becco e del tipo di habitat
- *Larghezza di banda negativamente correlata alla temperatura?*
- *Frequenza di picco correlata all'altitudine?*
- *Ritmo correlato alla temperatura?*



- Massa corporea positivamente correlata alle precipitazioni e maggiore in ambienti fitti

Risultati



- *Modelli evolutivisti*

Modello migliore indica che il canto si sia evoluto verso due diversi optima in ambienti chiusi e aperti

Frequenza, larghezza di banda e ritmo tendono a essere selezionati verso valori più bassi in habitat chiusi

Evoluzione del canto negativamente correlata all'altitudine

Discussione

Probabile
risposta a
gradienti di
aridità

Precipitazioni



Forma del becco



Canto



Dimensioni
del corpo



Frequenza
di picco



Ritmo

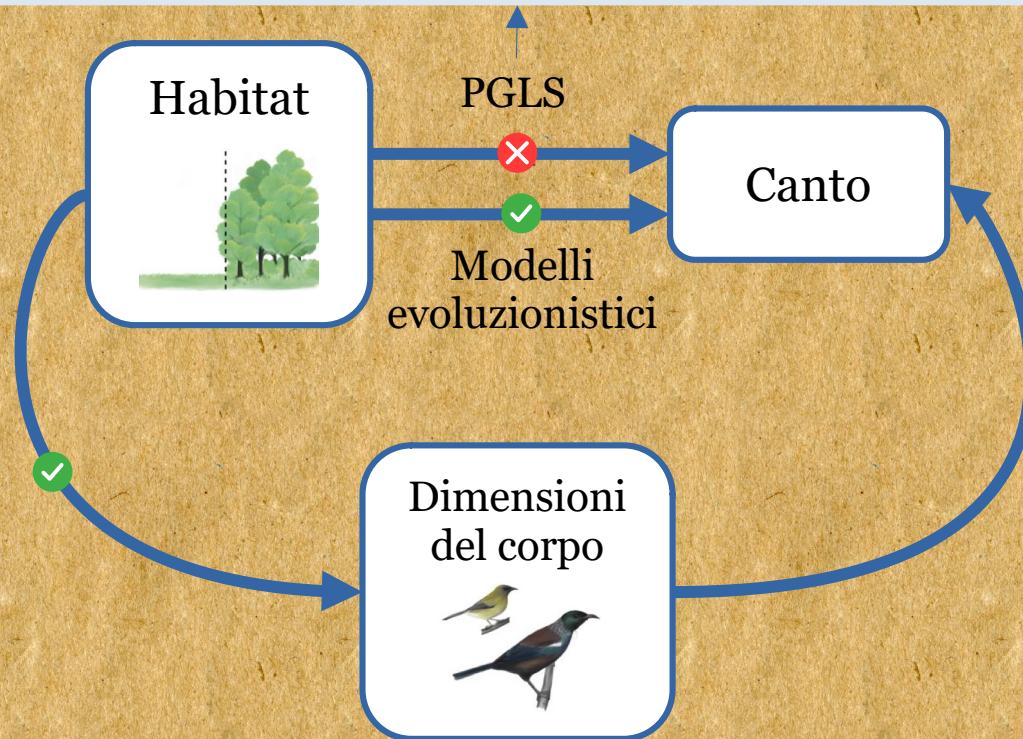


Uccelli più grandi
hanno organi canori
più grandi
→ possibili frequenze
più basse

Uccelli più grandi
hanno organi
respiratori più grandi
→ respiri più grandi e
lenti

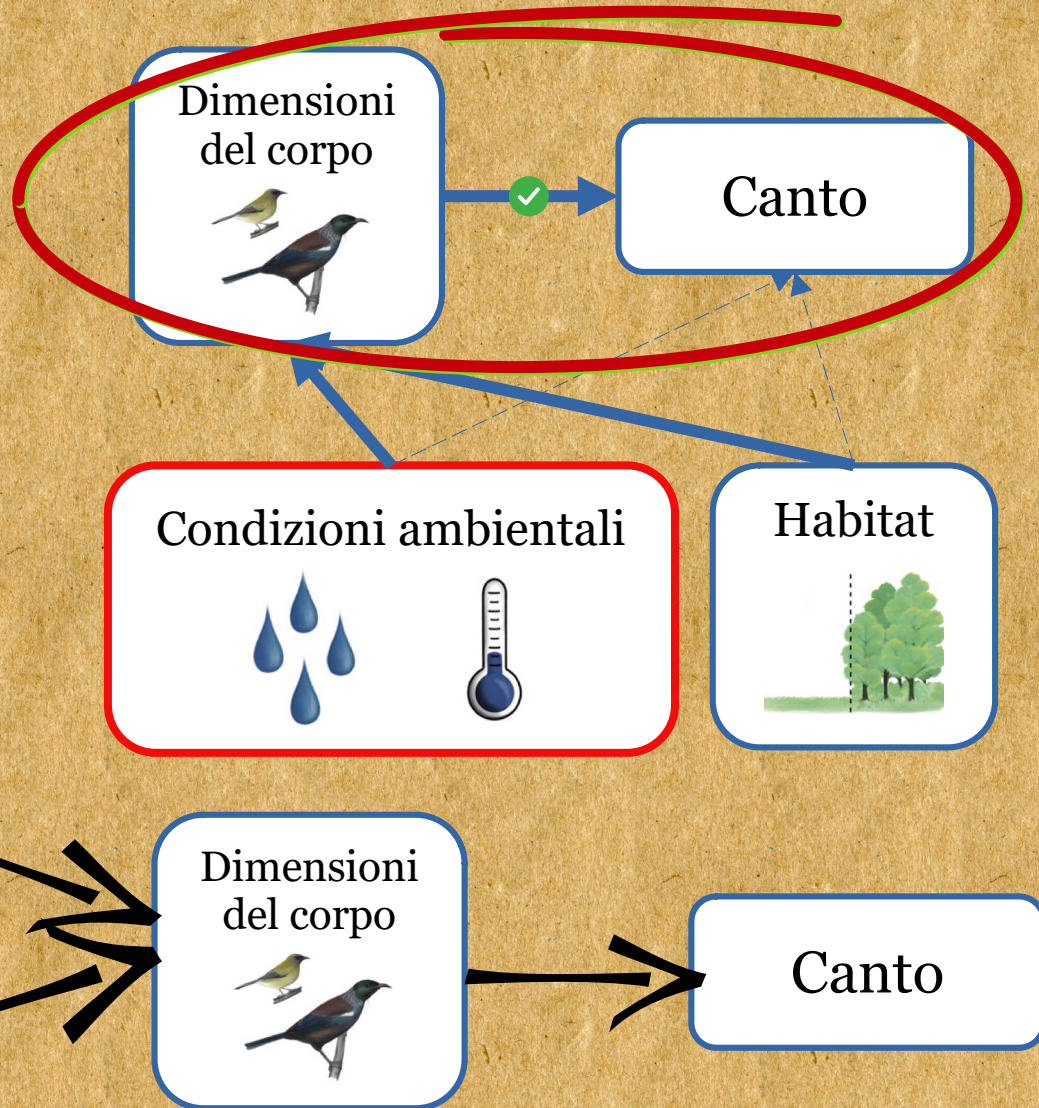
Discussione

Selezione non così forte
Vincoli di trasmissione e ricezione segnali anche in ambienti aperti
Strategie comportamentali



Conclusioni

Supporto all'ipotesi del vincolo morfologico





*Grazie per
l'attenzione!*