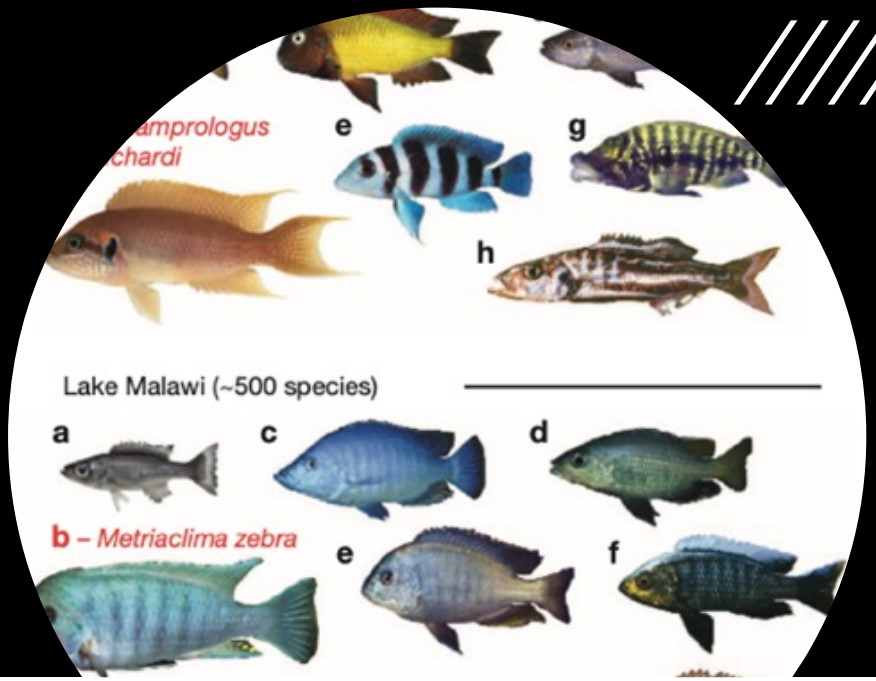
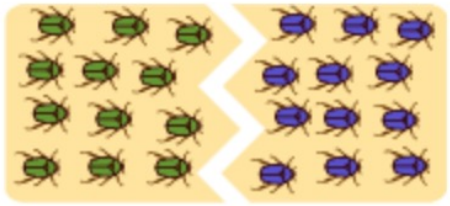
Molecular Methods in Ecology and Evolution 2025



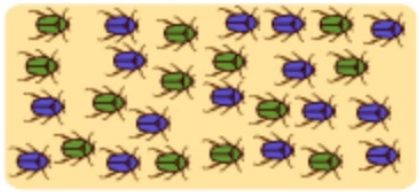
The theme:

Understand the evolutionary and ecological drivers of population divergence and speciation

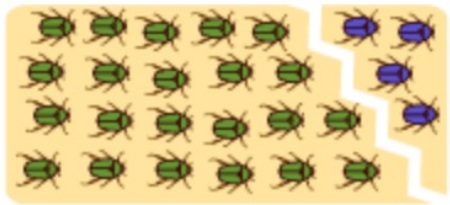
Geographic modes of speciation



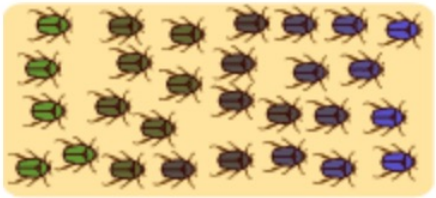
Allopatric: (allo = other) New species formed from geographically isolated populations



Sympatric: (sym = same) New species formed from within the range of the ancestral population



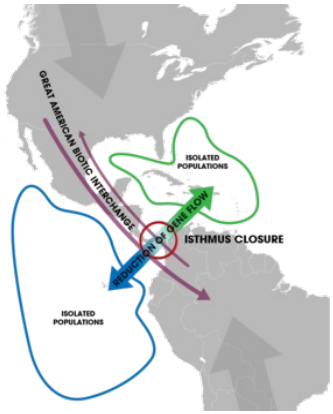
Peripatric: (peri = near) New species formed from a small isolated population at the edge of a larger population



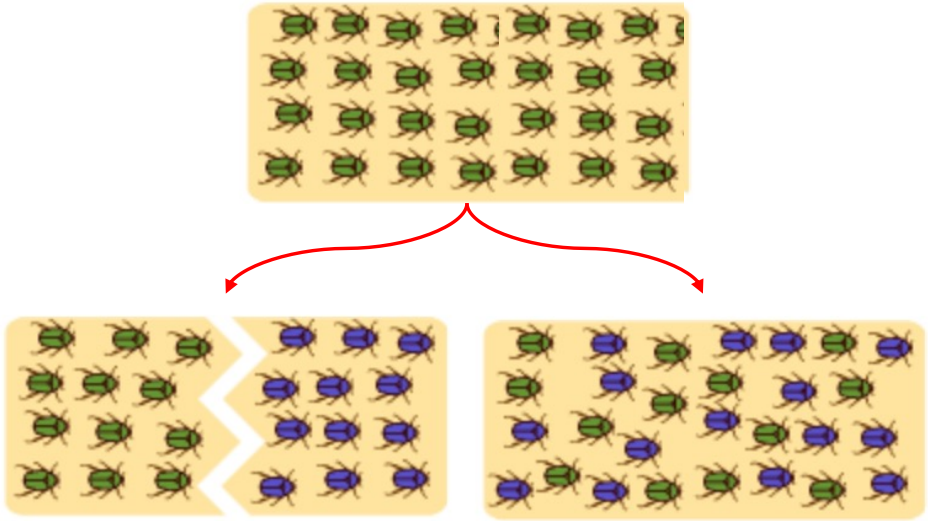
Parapatric: (para = beside) New species formed from a continuously distributed population

The theme:

Understand the evolutionary and ecological drivers of population divergence and speciation



Isthmus of Panama



Geographical / Allopatric divergence

Ecological / sympatric divergence

Scincid lizards

The theme:

Understand the evolutionary and ecological drivers of population divergence and speciation

A special case of parapatric speciation: Greenish warbler (*Phylloscopus trochilloides)*

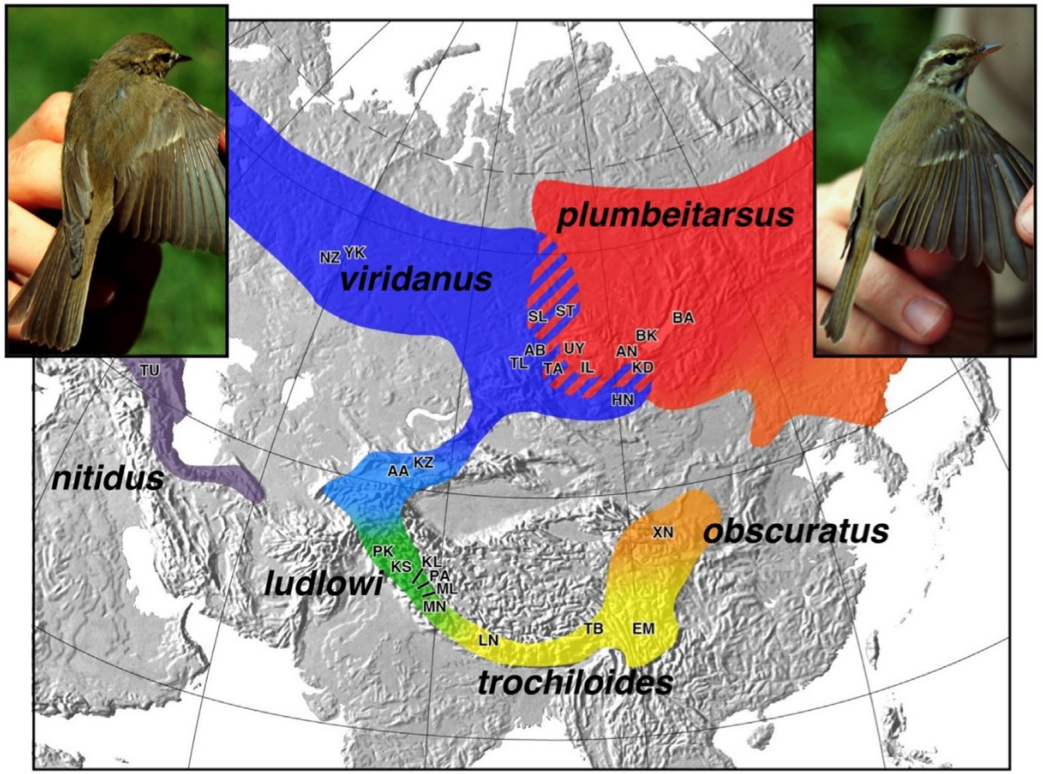
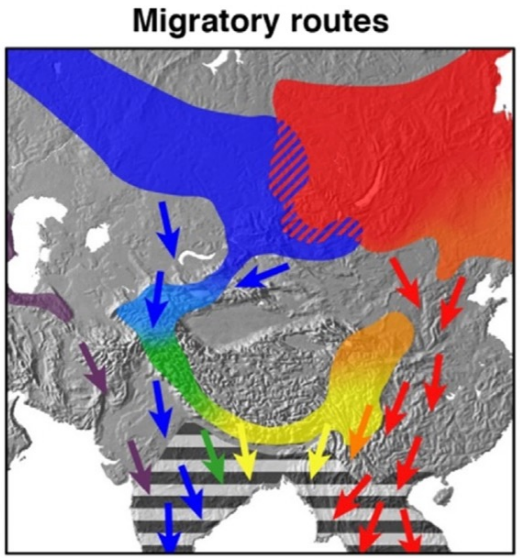


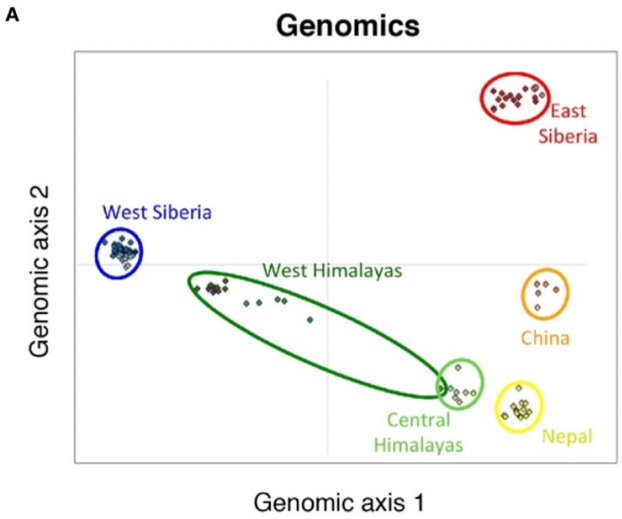
Fig. 4 The breeding range of greenish warblers (*Phylloscopus trochiloides*) in Asia. Subspecies designations according to Ticehurst (1938) are shown with different colors: *viridanus* in blue, *ludlowi* in green, *trochiloides* in yellow, *obscuratus* in orange, *plumbeitarsus* in red, and *nitidus* (outside of the main ring) in purple. Photos show the difference in wing bars between *viridanus* (upper left, with a single wing bar), and *plumbeitarsus* (upper right, with two wing bars).

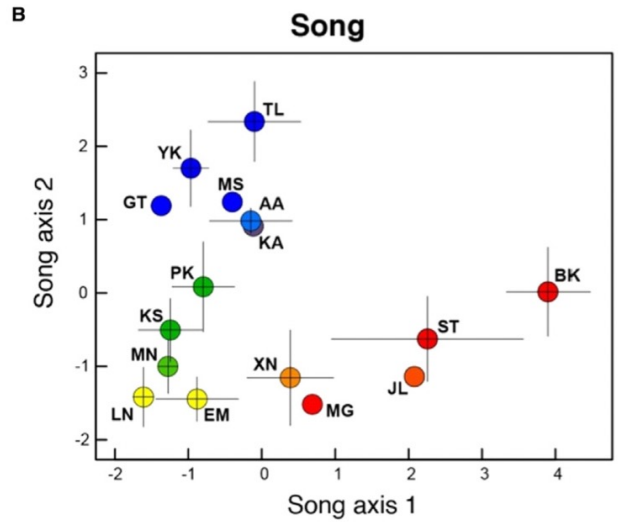
The theme:

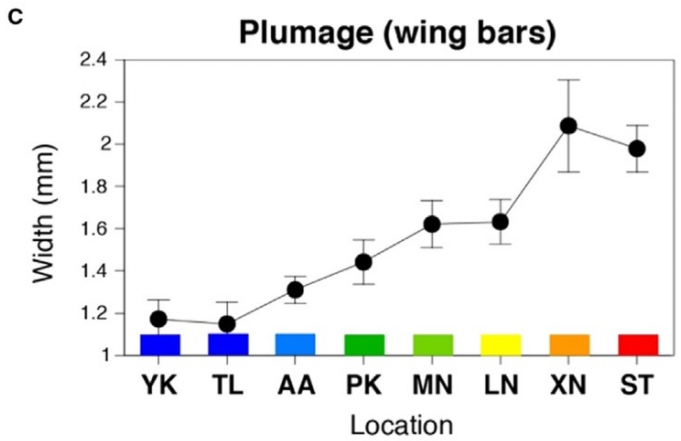
Understand the evolutionary and ecological drivers of population divergence and speciation

Patterns of genomic and phenotypic variation show strong differentiation between the mayor two forms, but gradual / stepwise variation through the chain of populations to the south.



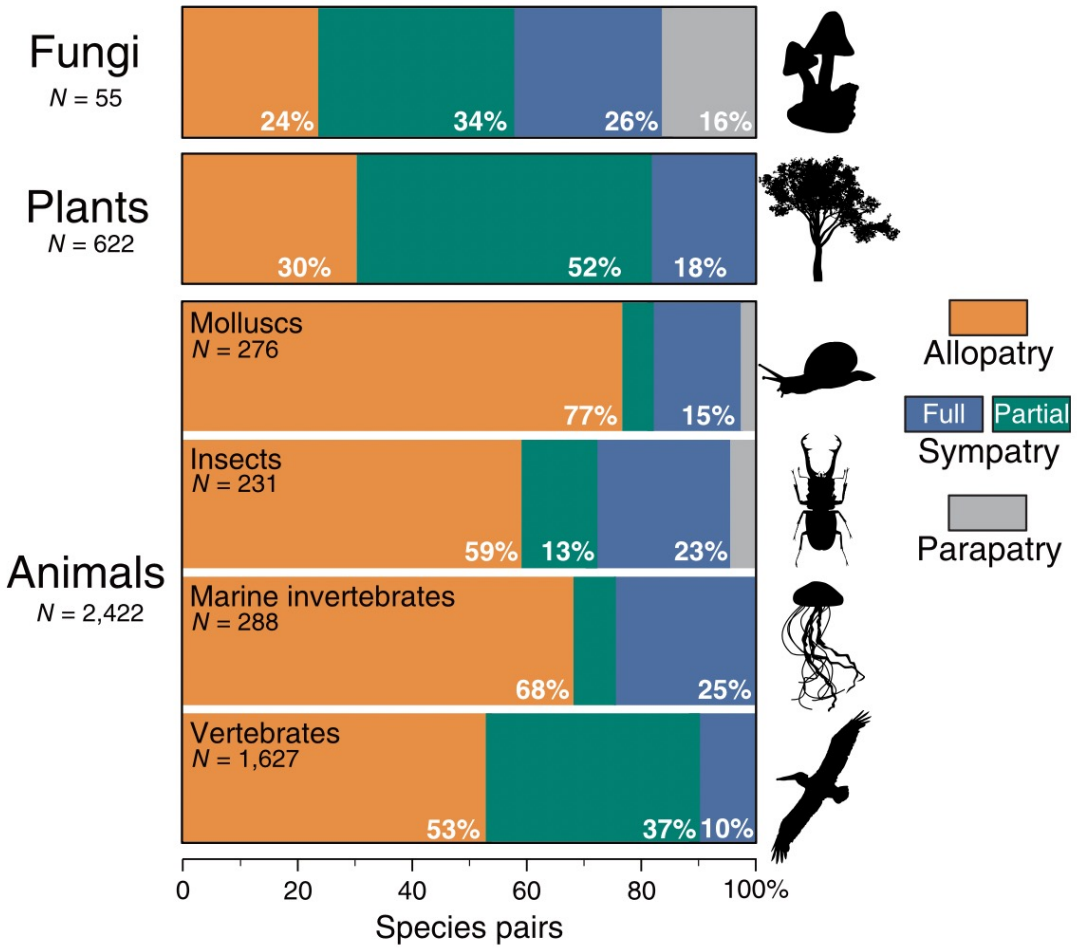




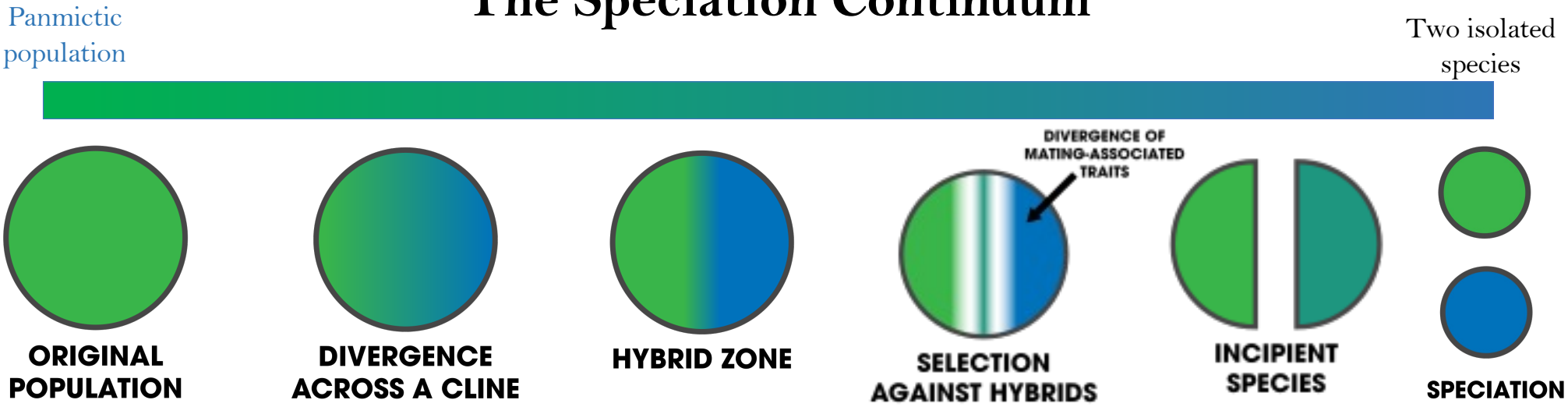


The theme:

Understand the evolutionary and ecological drivers of population divergence and speciation



The Speciation Continuum



Strength of Reproductive Isolation (RI)

Time

Speciation

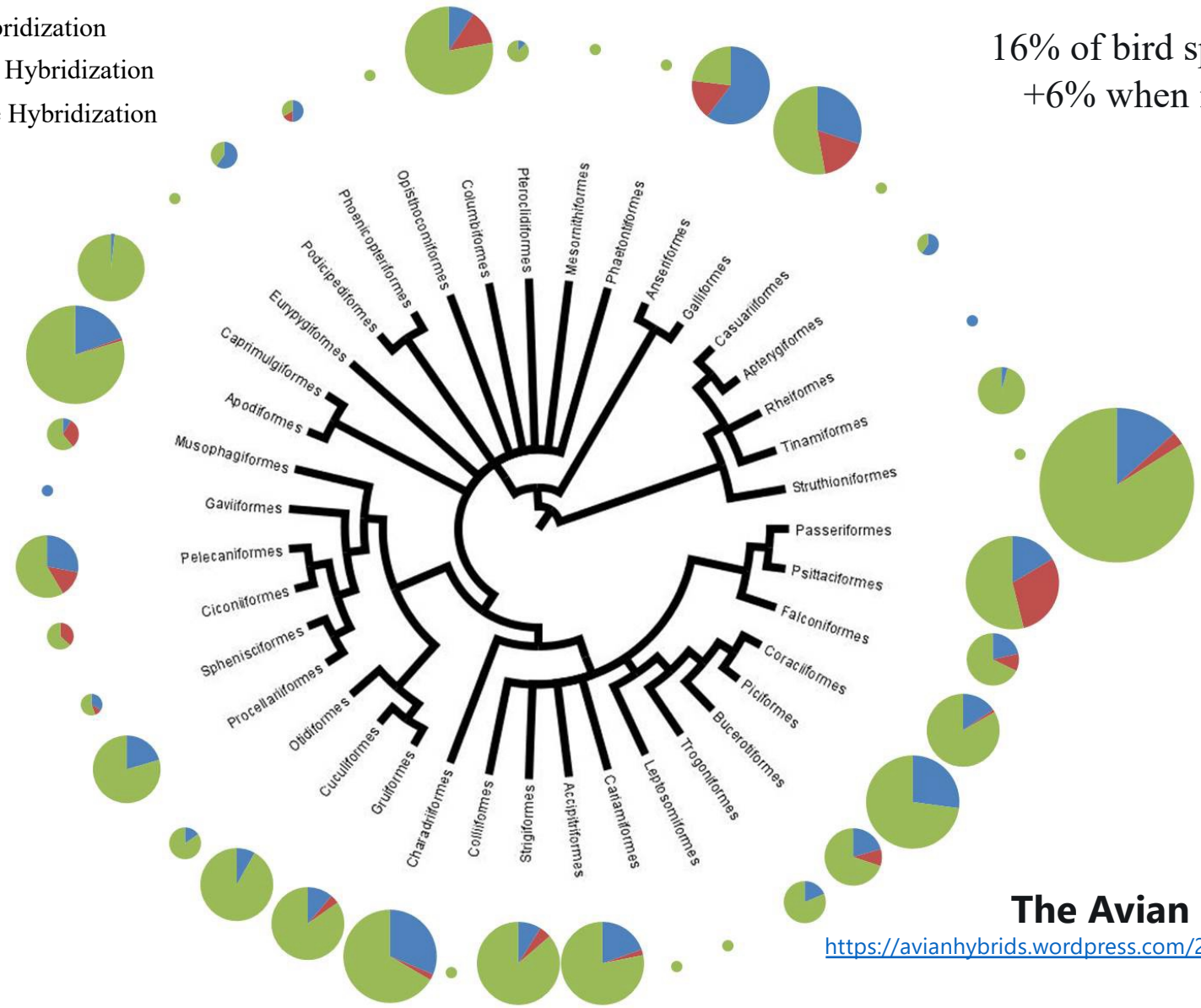
collapse

completion

The speciation process is dynamic, bidirectional and continuous.

No Hybridization
Natural Hybridization
Captive Hybridization

16% of bird species hybridize in the wild
+6% when including captive hybrids



The Avian Hybrids Project

https://avianhybrids.wordpress.com/2017/12/01/hybridization-in-birds-the-trilogy/

Ottenburghs et al. (2015) Ibis

The goal:

To give you an insight to how biologists use specific techniques and tools to tackle ecological and evolutionary questions

To gain experience on some of these approaches, and the application of the scientific method to real-world systems.

- Marker gene amplification and sequencing
- Restriction site Associated DNA sequencing (RADseq)

- Phylogenetic reconstruction
- Population genetics
- Population structure analyses
- Genomic-scale analyses of natural selection
- ….

Project 1.

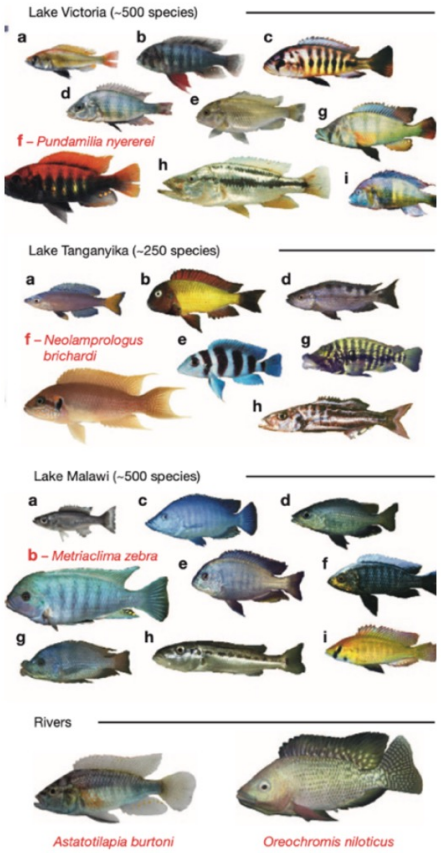
A mysterious frog

Project 2.

Hylid frogs

Project 3.

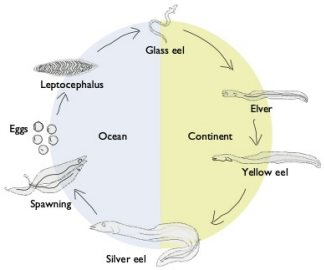
Cichlids

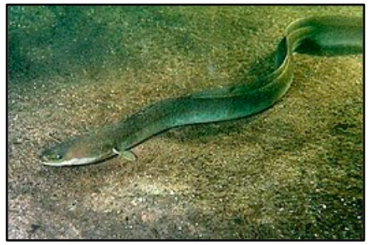


Brawand et al., 2014

Project 4.

European eel





Schedule

Time	Monday Sept 29	Tuesday Sept 30	Wednesday Oct 1st	Thursday Oct 2nd	Friday Oct 3rd
08:00 - 08:45	DNA extraction	PCR Gel preparation	Sequencing prep	Lecture IS	
09:00 - 09:45					
10:15 - 11:00	Lecture IS	Lecture IS	Lecture IS	Lecture NS	
11:15 - 12:00					
12:15 - 13:00				DEE Seminar	
13:15 - 14:00	TP Introduction	Electrophoresis		Lecture LF	
14:15 - 15:00	DNA extraction Quantification Dilution				Lecture NS
15:15 - 16:00		Lecture IS		Introduction & Installation	
16:15 - 17:00					
17:15 - 18:00		PCR purification			

Time	Monday Oct 6th	Tuesday Oct 7th	Wednesday Oct 8th	Thursday Oct 9th	Friday Oct 10th
08:00 - 08:45	Project 1 Phylogeny- Sanger	last comments project 2 & start Project 3	last comments project 3. & start Project 4	Project 4. & Final questions	
09:00 - 09:45					
10:15 - 11:00	Lecture LF				
11:15 - 12:00					
12:15 - 13:00				DEE Seminar	
13:15 - 14:00	Project 2 Cryptic speciation in hylid frogs.	Project 3. Genomic analyses of divergence between Lake Malawi cichlids			
14:15 - 15:00			Project 4. The curious case of the European Eel	Personal Research Work	
15:15 - 16:00					
16:15 - 17:00					
17:15 - 18:00					

Project 1. →

Wet-Lab Experiment	POL 203 and 205
Lecture	POL 334
Computer Analyses	POL 204.2

Project 2. Project 3. Project 4.

The report

General introduction

Wet lab / Project 1
- methods
- results & Discuss

Computer lab:
Project 1 & 2.
- Intro
- methods
- results
- discussion
- conclusion
- references

Project 3.
- Intro
- methods
- results
- discussion
- conclusion
- references

Project 4.
- Intro
- methods
- results
- discussion
- conclusion
- references

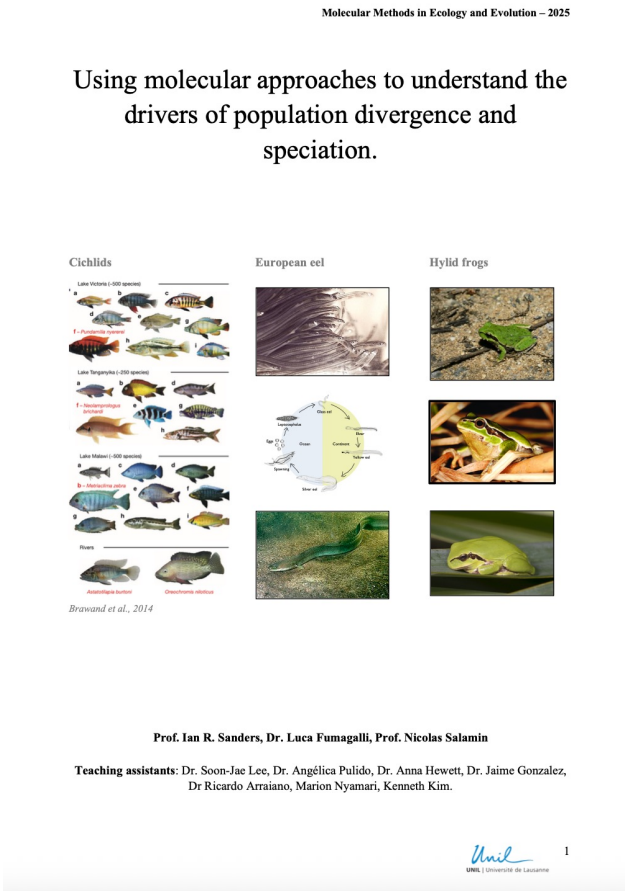
General Discussion

max **5 pages** per project
(including text and figures)

max **25 pages** in total
(including text, figures and references)

DEADLINE: 27 / 10 / 25

Report grading



Molecular Methods in Ecology and Evolution – 2025

Using molecular approaches to understand the drivers of population divergence and speciation.

Cichlids | European eel | Hylid frogs

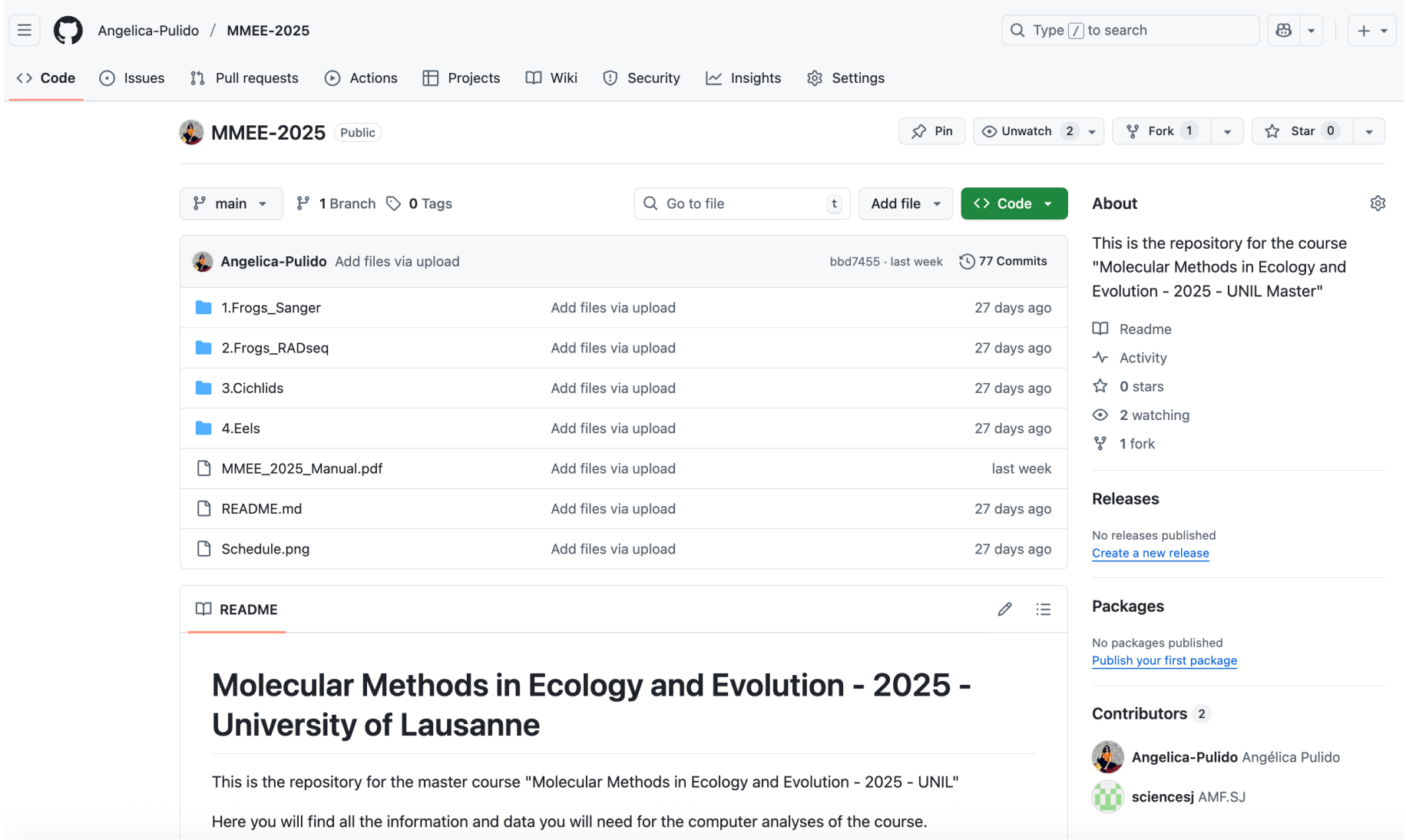
Brawand et al., 2014

Prof. Ian R. Sanders, Dr. Luca Fumagalli, Prof. Nicolas Salamin

Teaching assistants: Dr. Soon-Jae Lee, Dr. Angélica Pulido, Dr. Anna Hewett, Dr. Jaime Gonzalez, Dr Ricardo Arraiano, Marion Nyamari, Kenneth Kim.

See "**Advice on preparing your report**" section in your manual, these guidelines are there to help you write your report, but they will also be the basis of the marking scheme used to grade your reports.

https://github.com/Angelica-Pulido/MMEE-2025/



https://github.com/Angelica-Pulido/MMEE-2025/