Linear mixed models: a case study in behavioral ecology

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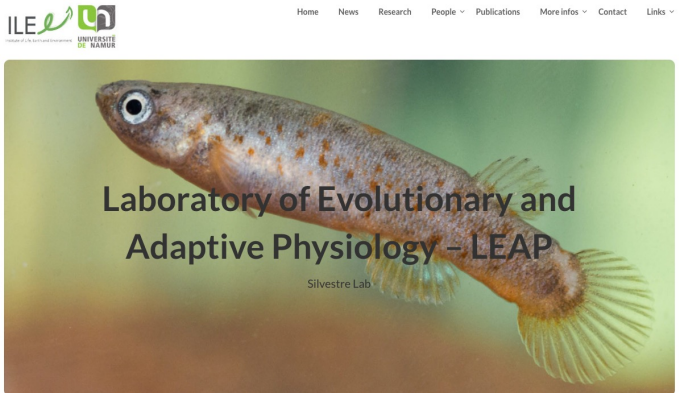


www.evolution-physiology.be

https://github.com/fredsilvestre/LMM-case-study-master-BOE

- R script to be fulfilled « CDIS » (copy/paste in Rstudio)
- Dataset « Dataset CDIS.csv »
- Context: « README.md »

The mangrove rivulus: surviving in the mangroves

Kryptolebias marmoratus

The mangrove rivulus: surviving in the mangroves

Rivulus microhabitat and sampling

https://www.youtube.com/watch?v=DSRT-RPgU48

Must avoid water loss and manage gas exchange, osmotic balance and nitrogenous waste excretion

The mangrove rivulus: surviving in the mangroves

The mangrove rivulus: surviving in the mangroves

Simultaneous Hermaphrodites

Males (1-25%)
(Primary and secondary males)

***K. marmoratus* = Only known self-fertilizing vertebrate**

= androdioecy
(≠ parthenogenesis)

The mangrove rivulus: surviving in the mangroves

Simultaneous Hermaphrodites

Outcrossing

Males (1-25%)
(Primary and secondary males)

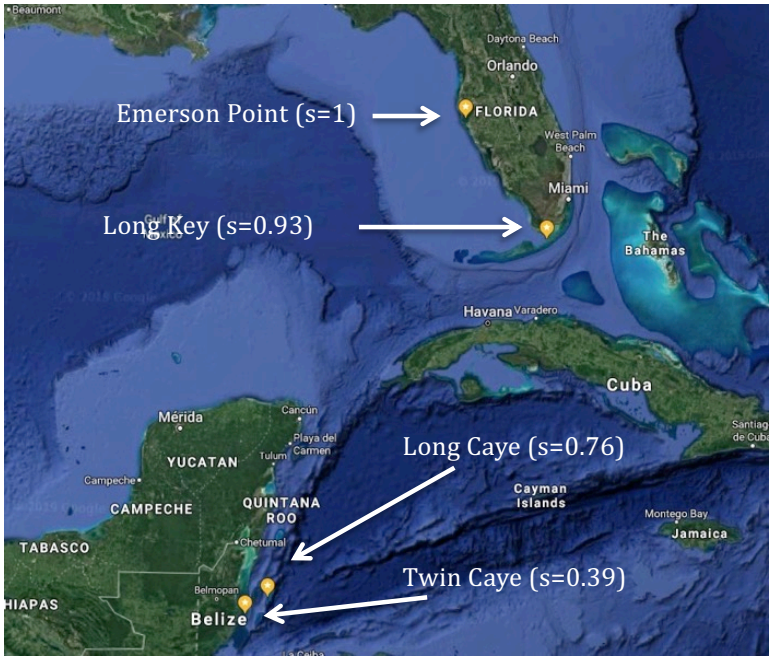
Variable OC (low OC in Florida ; higher in Belize)

Self-fertilization

The mangrove rivulus: surviving in the mangroves

Scientific field missions 2019: Belize and Florida

Valentine Chapelle thesis (FRIA since 10/2018): "*The epigenetic origin of behavioral traits variability in a self-fertilizing fish : the mangrove rivulus*"



The mangrove rivulus: surviving in the mangroves

The mangrove rivulus: surviving in the mangroves

Population	N total fish	N males	N herma	N juveniles	% of male
Twin Caye (PG)	177	74	103	0	**41.8**
Long Caye (LC)	31	3	26	2	10.3
Emerson Point (EPP)	540	2	538	0	0.4
Long Key (LK)	44	1	35	8	2.8

The mangrove rivulus: surviving in the mangroves

Behavioral tests for boldness and exploration for 140 fish = 163 hours of video to be analyzed
Epigenome to be analyzed in brain, liver and gonads

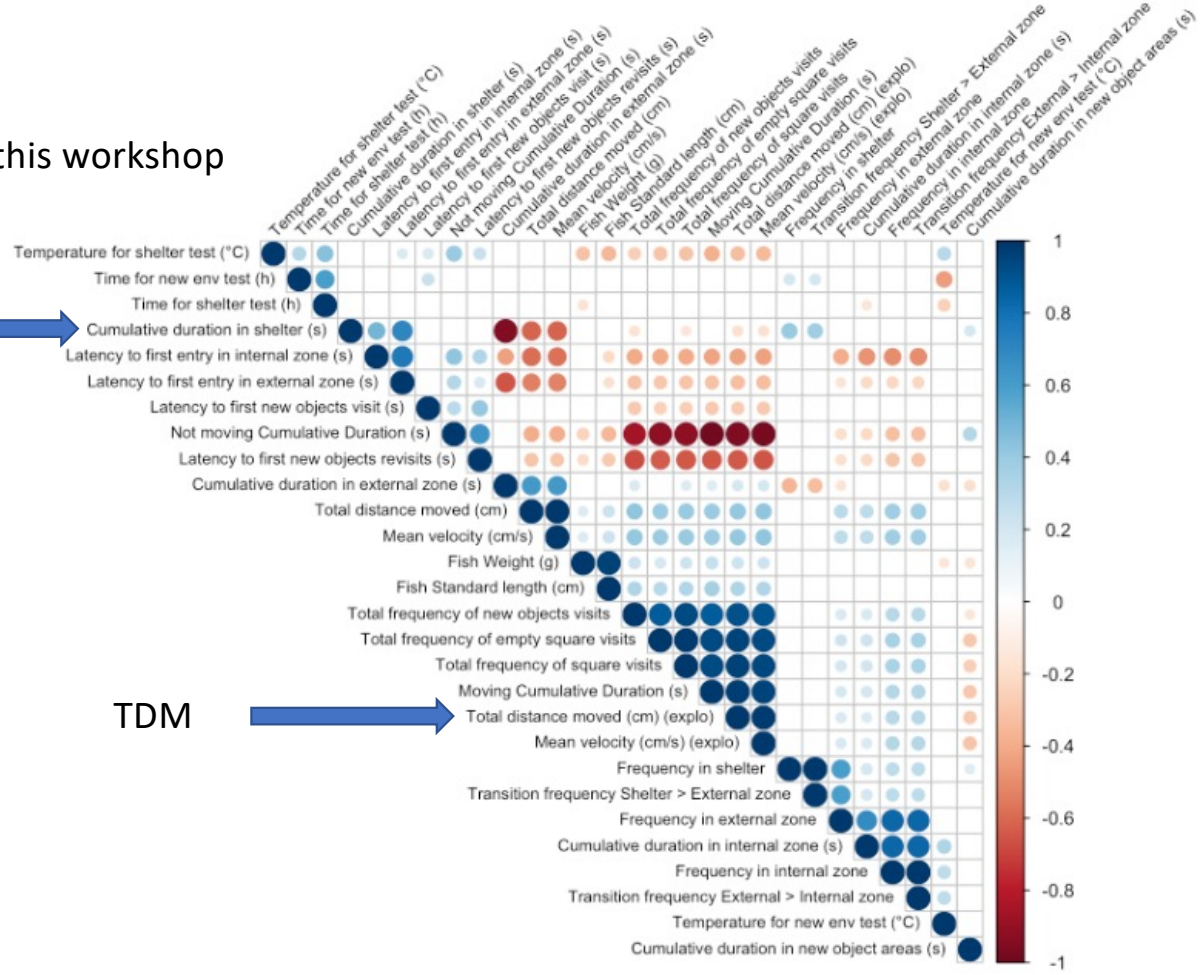
2 tests in duplicate !!:
- Shelter test
- Open Field test

The measured variables and their correlations

2 Response variables to be analysed in this workshop

CDIS

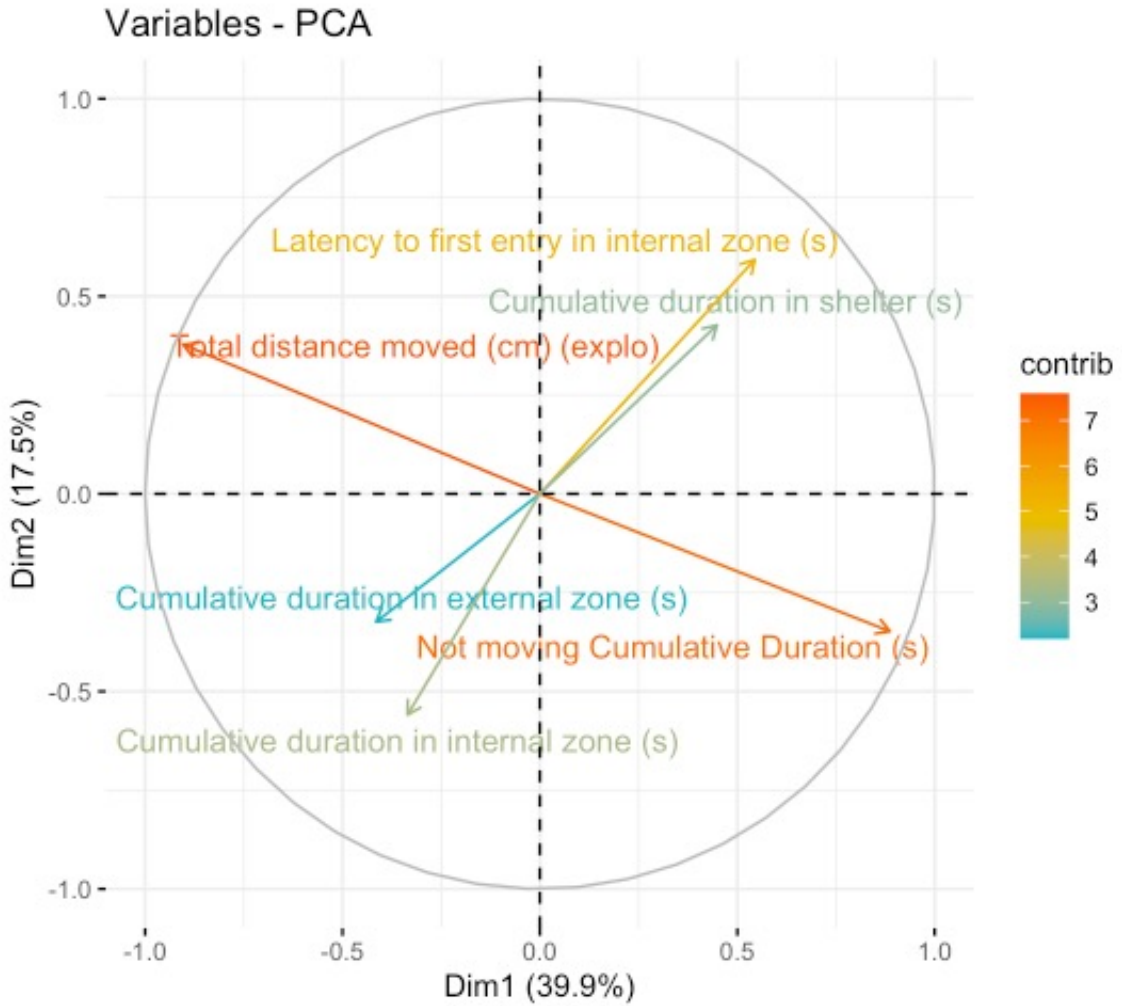
TDM



Explanatory variables:

- Population
- Replicate
- Fish length
- Fish weight
- Fish ID
- Temperature (for each test)
- Time (for each test)

PCA of the 6 selected response variables



Rstudio

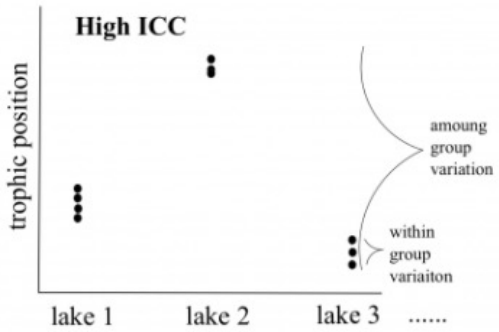
- Prepare the working environment
- Install and load the packages
- Load the data

1° Preparation of the data
2° Exploration of the data
3° Search for colinearity
4° Search for extreme values
5° Variables transformation
6° Model building
7° Model validation
8° Model visualization
9° Repeatability calculation

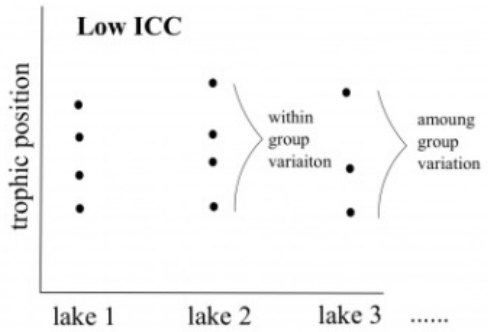
Questions scientifiques ?

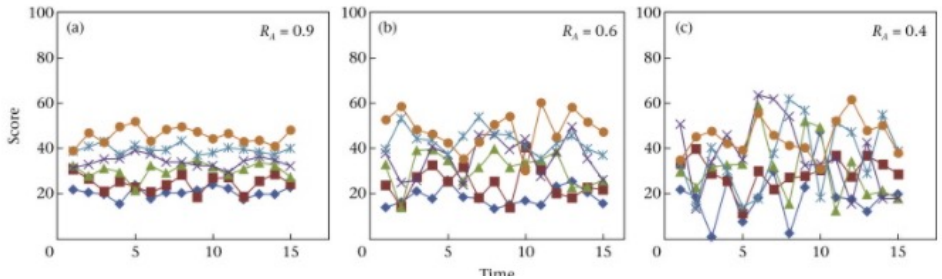
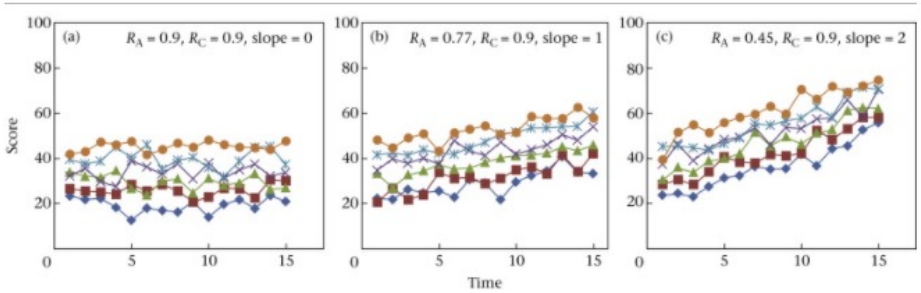
ICC (Intraclass correlation coefficient)

High ICC



Low ICC



Conditional repeatability

$$R = \frac{\mathrm{VAR}_{across}}{\mathrm{VAR}_{across} + \mathrm{VAR}_{resid}}$$