Les suivis acoustiques de la migration nocturne des oiseaux permettent-ils de révéler des interactions entre les grandes noctules et les passereaux migrateurs ?

Stage de Master 1
mars - août 2023 · 20 semaines · encadrant : Yves Bas

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24/09/2023

Deux protocoles : Vigie-Chiro et Vol de Nuit

CESCO

Co-encadrants
Louis SALLÉ & Paul COIFFARD

→ tendances de population

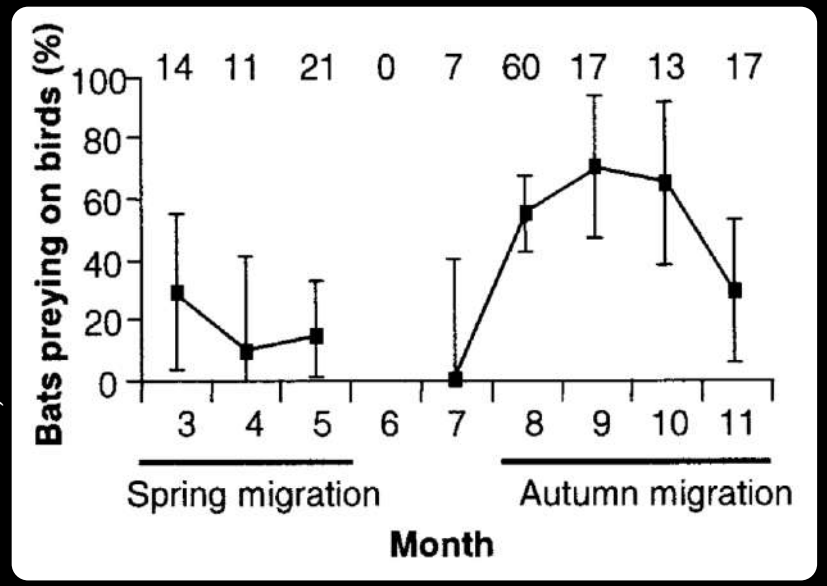
→ stratégies de migration

Introduction | La grande noctule

Menaces

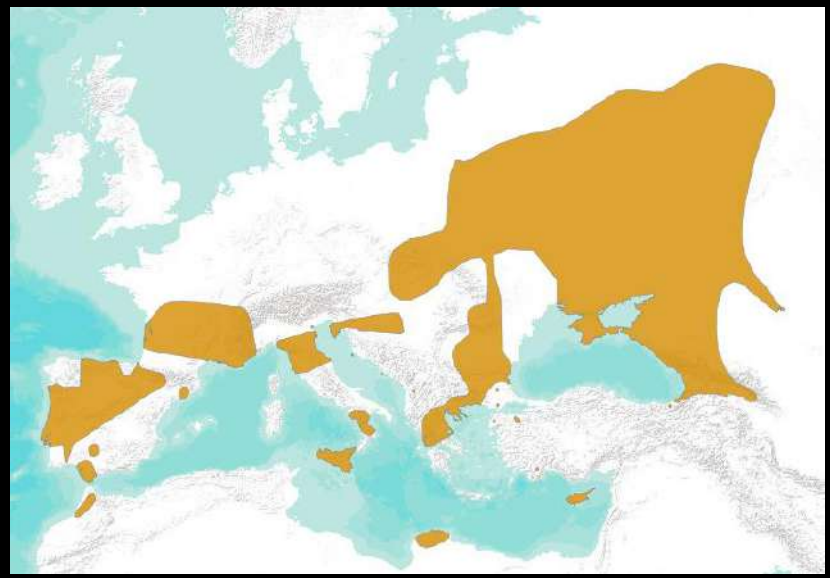
· CR | Italie (2013)

· VU | Monde (2016),
Espagne (2011), France (2017)



Ibáñez et al., 2001

Variation annuelle du pourcentage de grandes noctules capturées en Espagne présentant des plumes dans leur guano.



Distribution de la grande noctule (www.iucnredlist.org)

Introduction | La grande noctule

Menaces

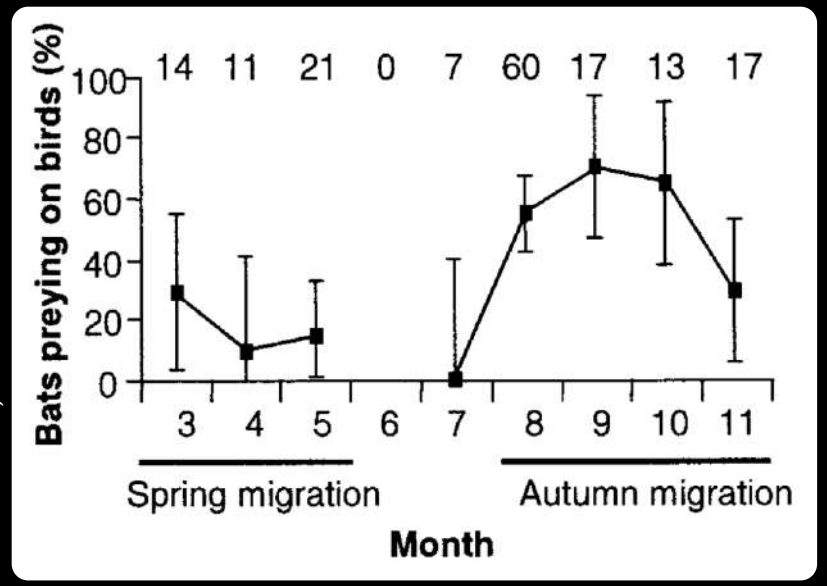
· CR | Italie (2013)

· VU | Monde (2016), Espagne (2011), France (2017)

Hypothèse

· Activité synchronisée avec l'intensité des passages d'oiseaux migrateurs

→ phénomène documenté chez certains chiroptères insectivores stricts (Charbonnier, 2014; Salvarina et al., 2018; Hawkes et al., 2023)



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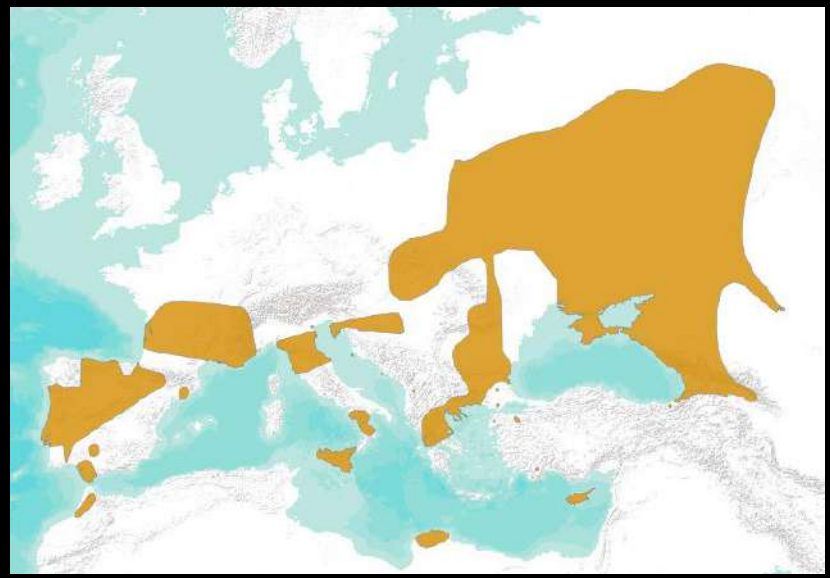
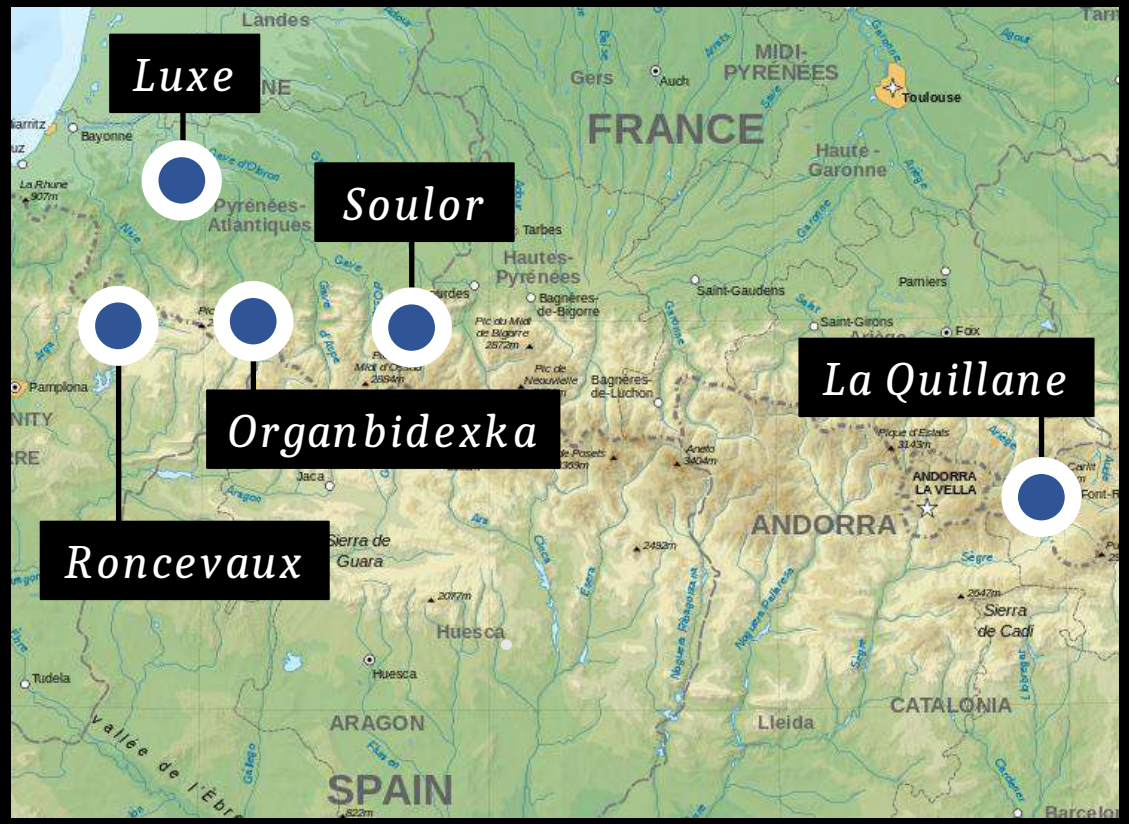
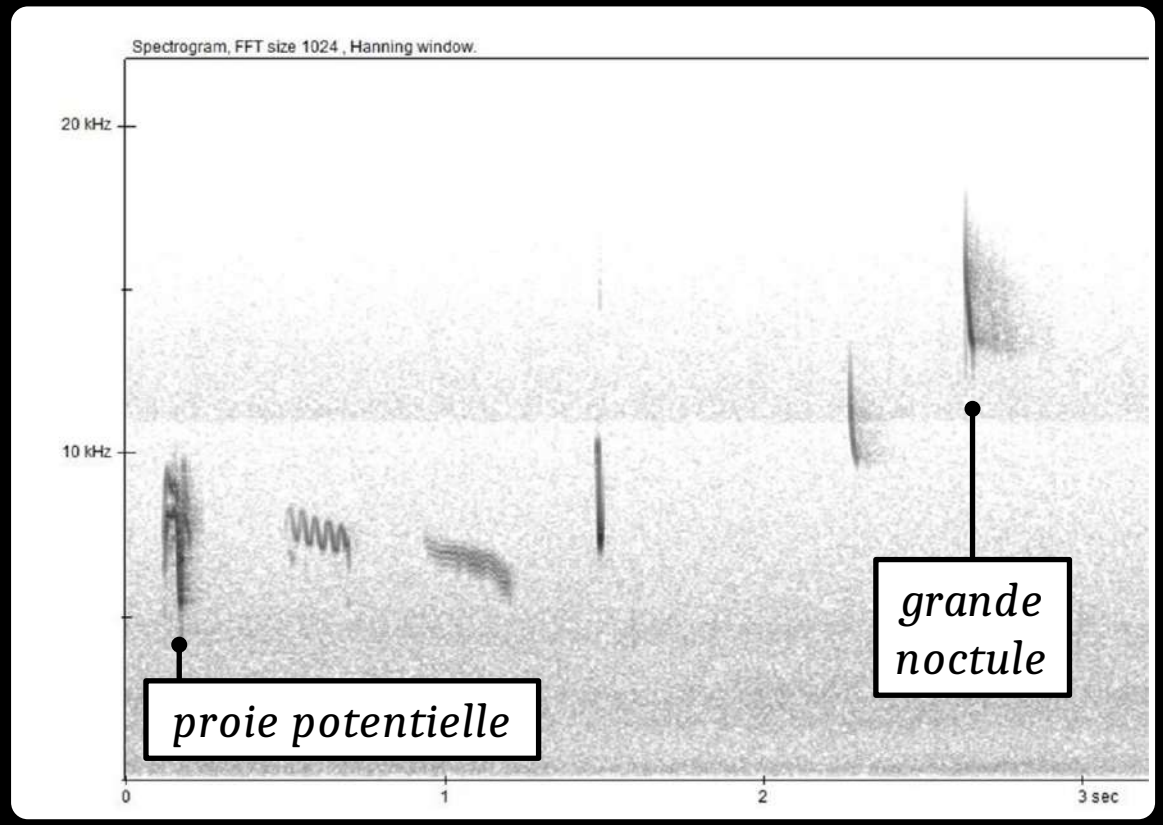


Distribution de la grande noctule (www.iucnredlist.org)

Méthodes | Travaux préliminaires

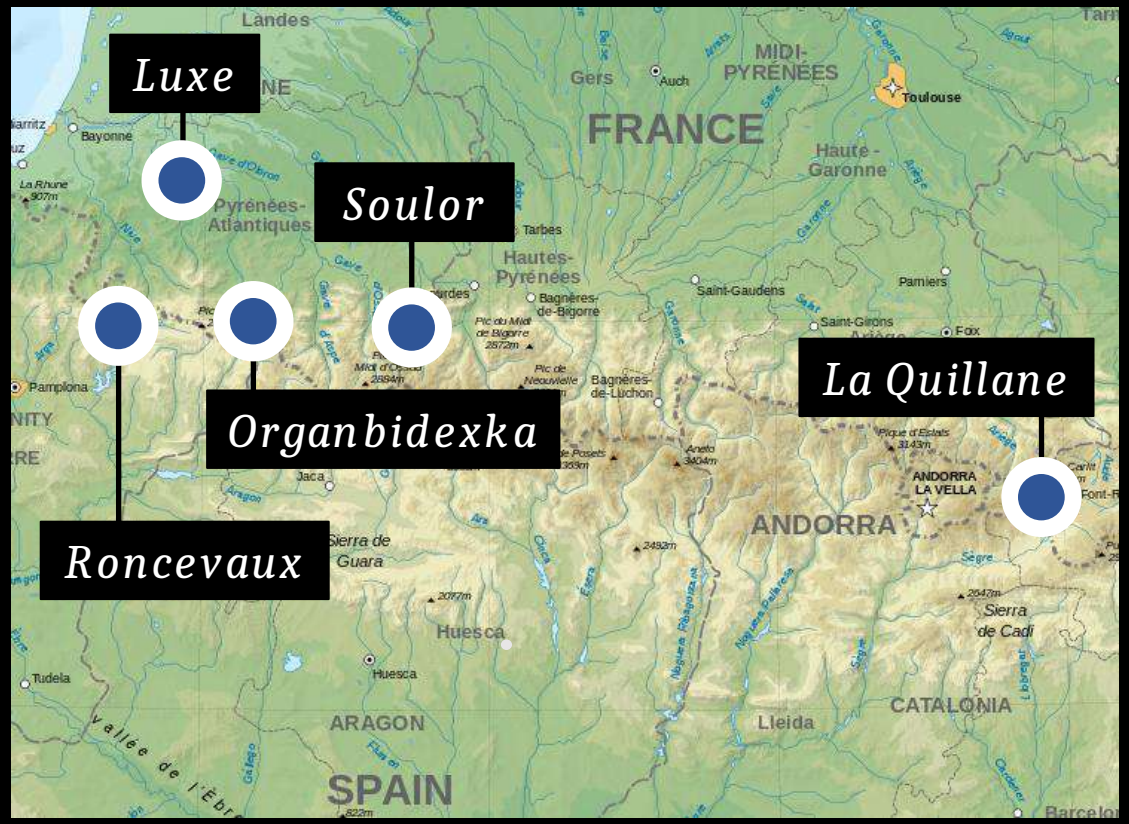


Sites suivis



Groupes fonctionnels enregistrés

Méthodes | Travaux préliminaires



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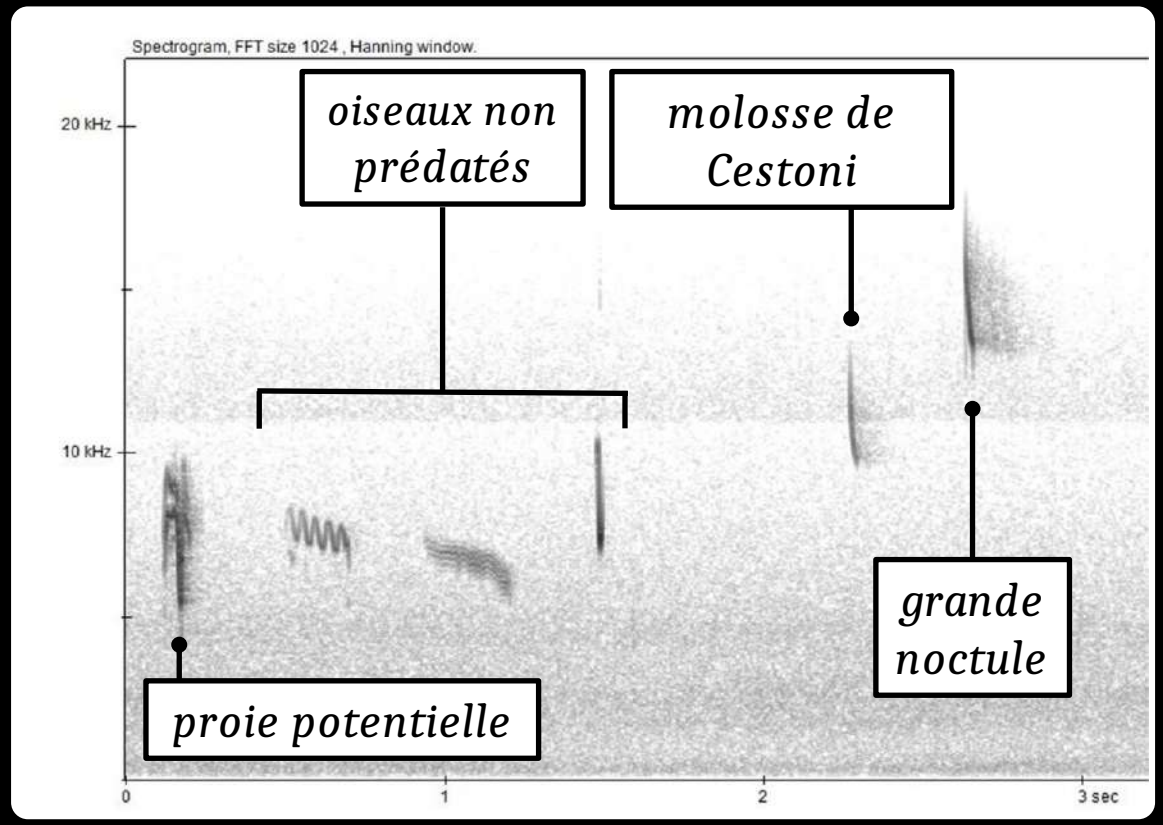
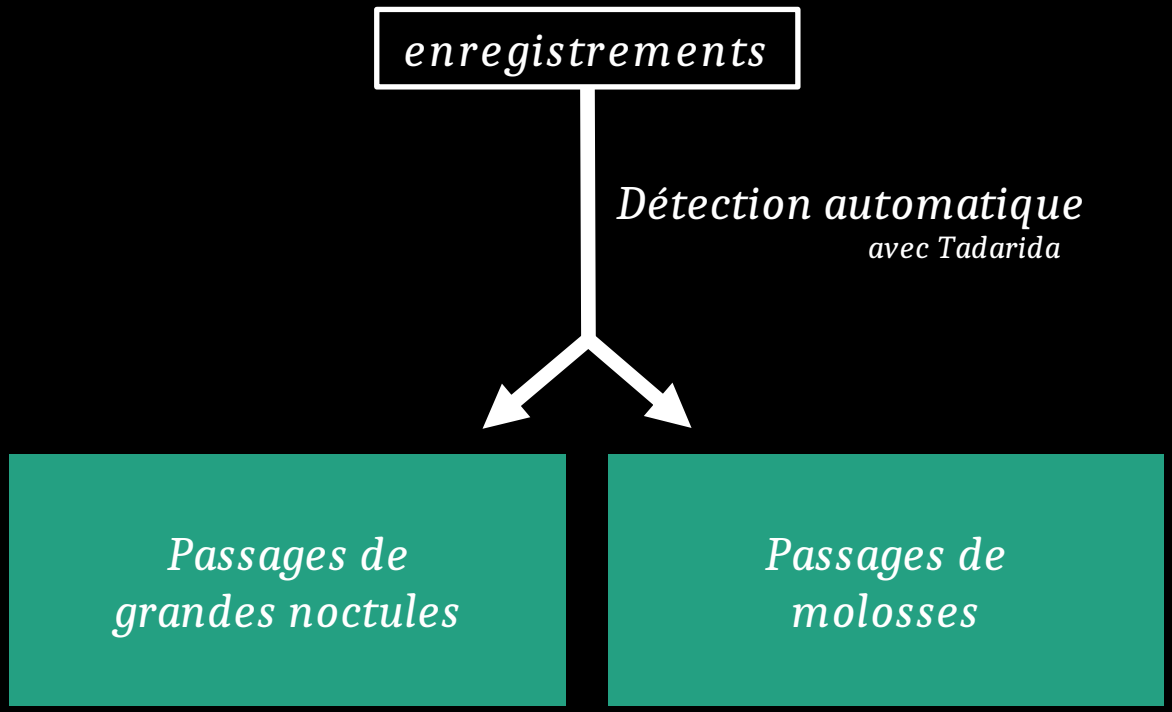


Groupes fonctionnels enregistrés

Méthodes | Détection des passages de chiroptères



<u>569 nuits étudiées</u>

- 10 613 passages d'oiseaux non prédatés
- 1 252 passages de proies potentielles
- 7 959 passages de molosse
- 17 962 passages de grande noctule

Méthodes | Modèle linéaire 'GLMM'

Variable réponse	Variable explicative	Pente
grande noctule	proies potentielles	> 0
molosse de Cestoni	proies potentielles	≈ 0
grande noctule	oiseaux non prédatés	≈ 0

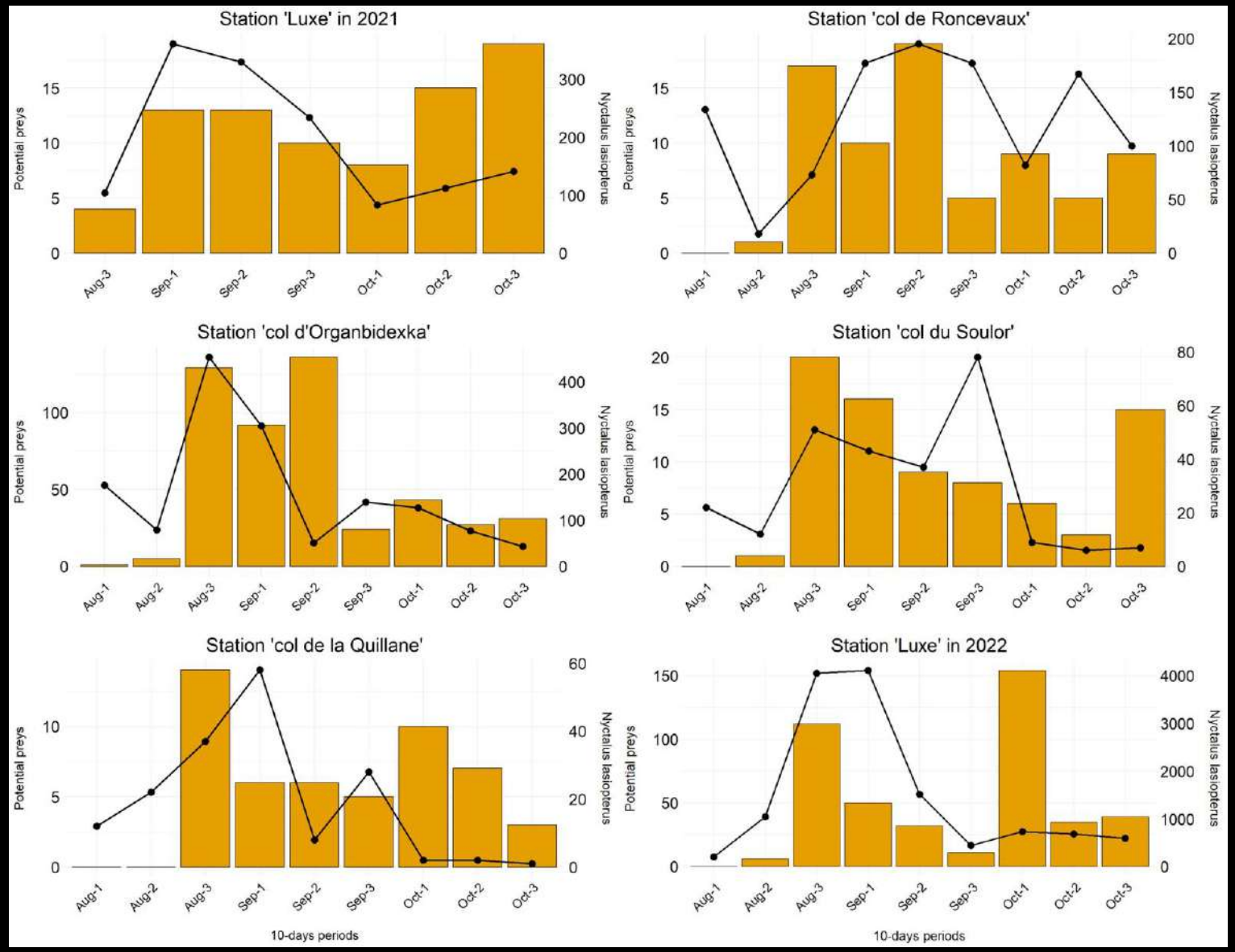
pentes attendues

Résultats | Modèle linéaire 'GLMM'

Variable réponse	Variable explicative	Pente	
grande noctule	proies potentielles	> 0	✓
molosse de Cestoni	proies potentielles	≈ 0	✗
grande noctule	oiseaux non prédatés	≈ 0	✓

pentes calculées

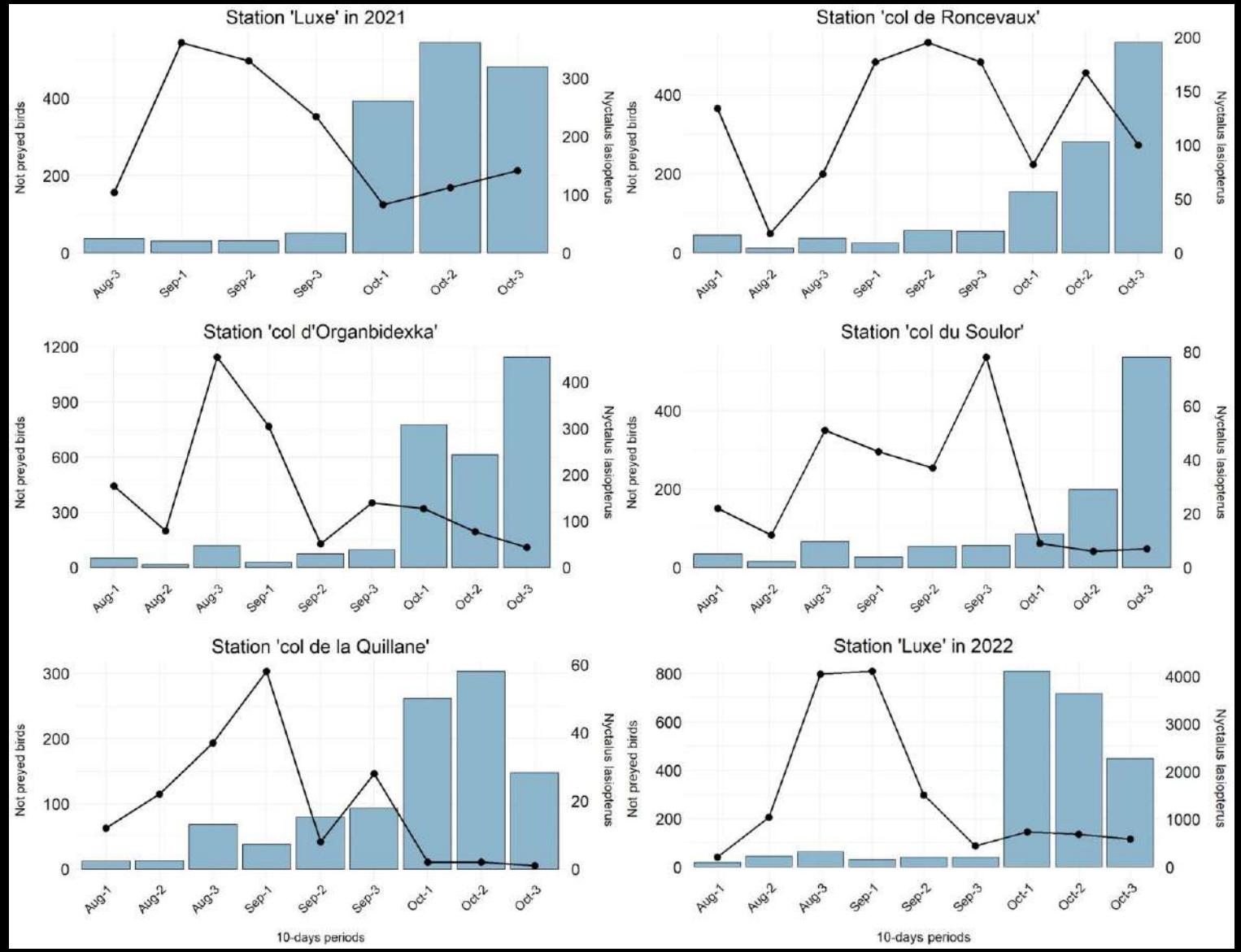
Résultats | Distribution saisonnière des passages



passages de proies potentielles

passages de grandes noctules

Résultats | Distribution saisonnière des passages



passages d'oiseaux non prédatés

passages de grandes noctules

Discussion | Comment expliquer ces résultats ?

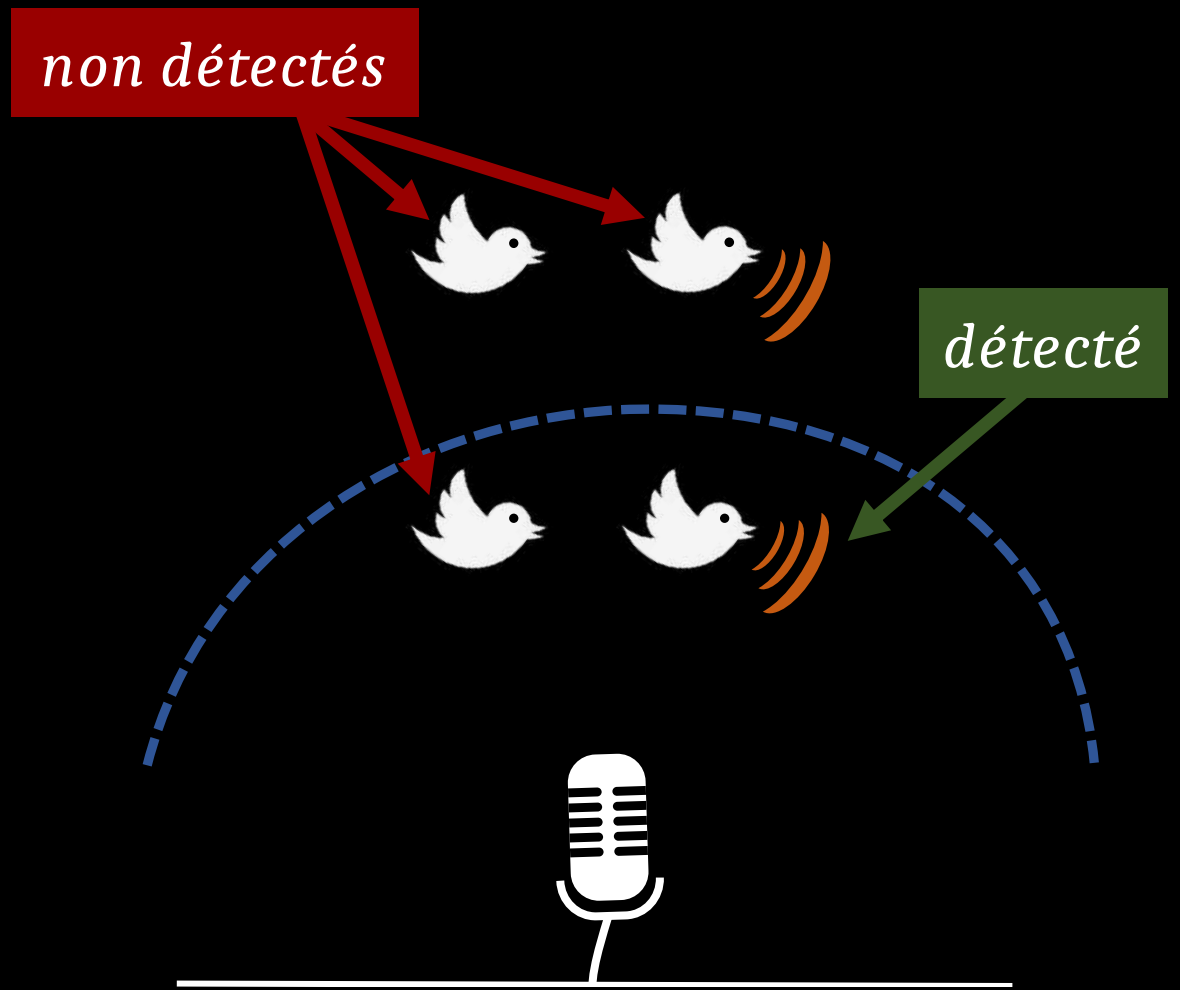
· l'approche acoustique n'est pas exhaustive :

→ portée restreinte des micros

→ les cris de vols des oiseaux sont rares

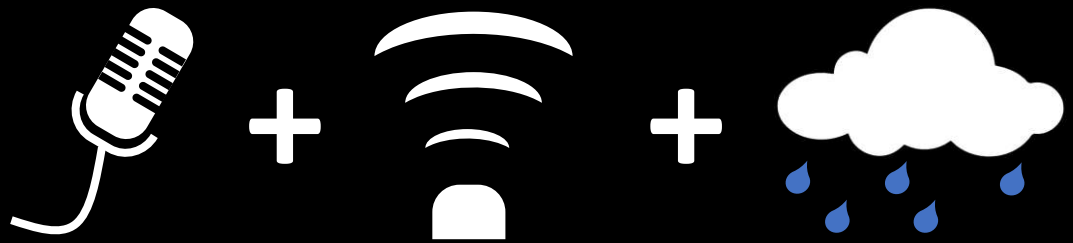
→ beaucoup de proies potentielles sont silencieuses

(Farnsworth, 2005; Ibáñez et al., 2016; Wroza and Rochefort, 2021)



Exploration | Utilisation de données radar et météo

Le flux de passereaux explique-t-il mieux l'activité des grandes noctules que la météo ?



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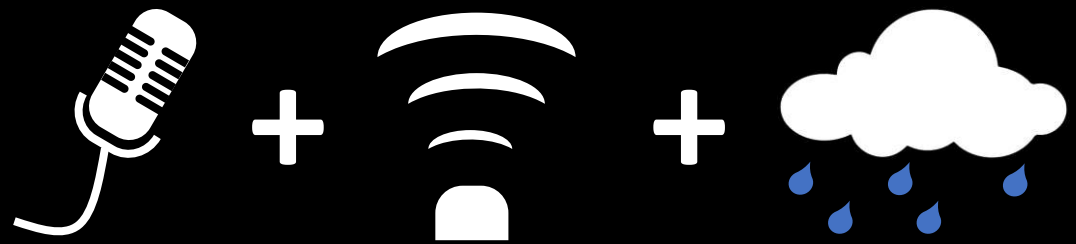

Le flux de passereaux explique-t-il mieux l'activité des grandes noctules que la météo ? Non.

Explication proposée :
Les zones de chasse des grandes noctules dépassent la portée des micros.

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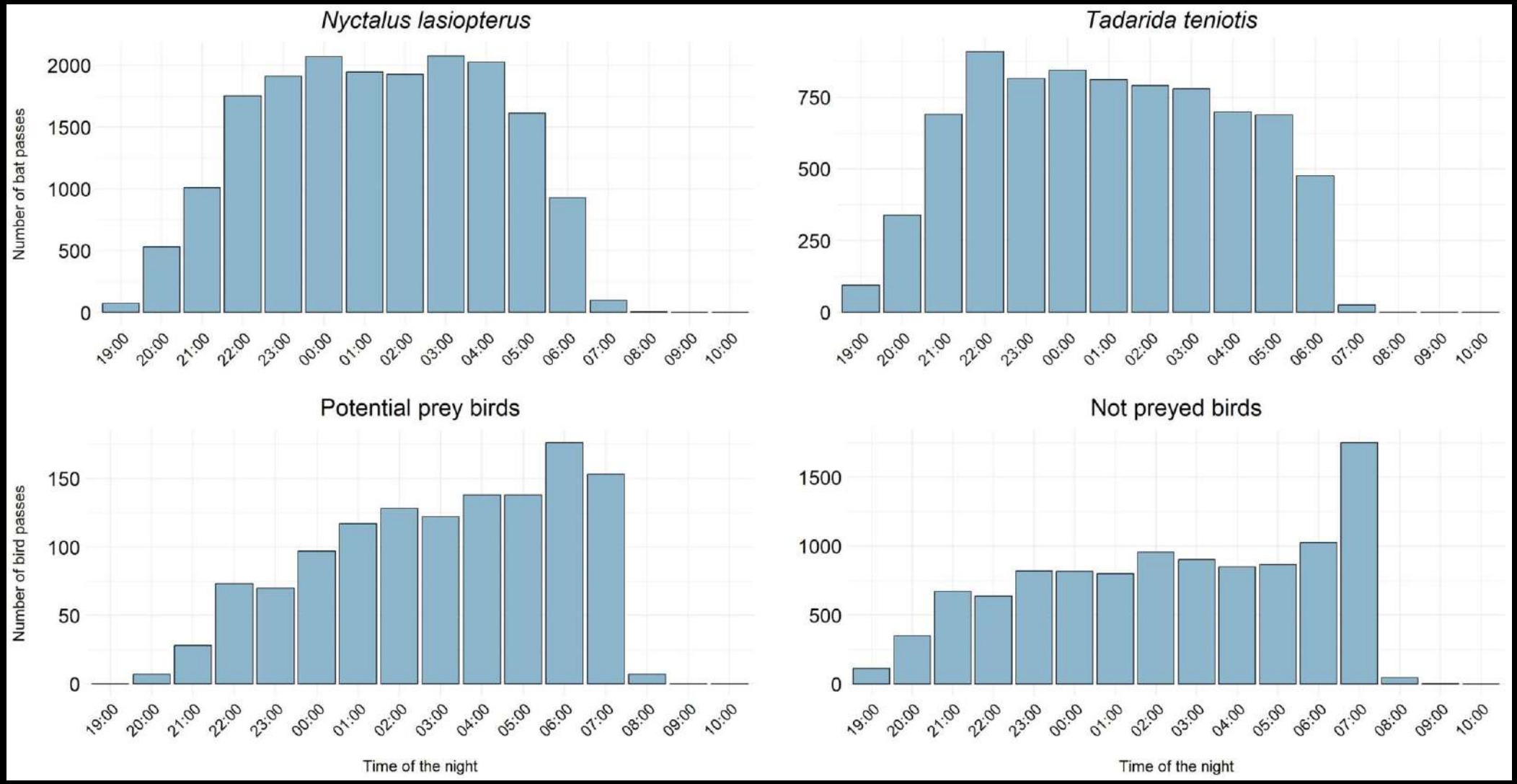


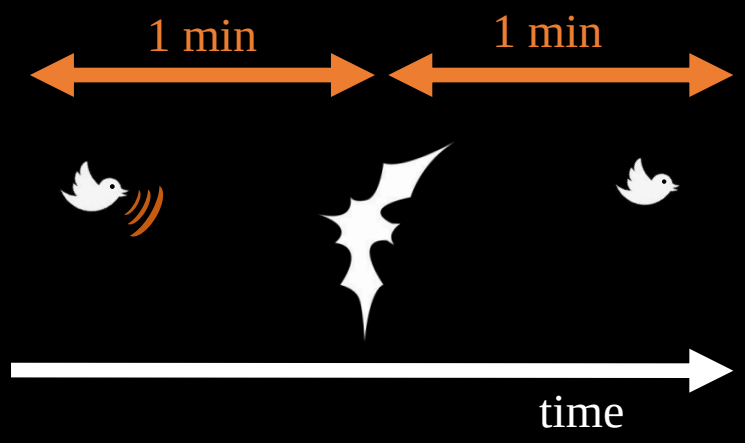
Hourly distribution of detected calls emitted by the four functional groups

Distribution of calls detected by the different recording stations

Year	2021					2022
Station	'Luxe'	'col de Roncevaux'	'col d'Organbidexka'	'col du Soulor'	'col de la Quillane'	'Luxe'
Altitude	110 m	1,000 m	1,260 m	1,455 m	1,720 m	110 m
Recording period	20/08 – 01/11	22/07 – 01/11	23/07 – 01/11	24/07 – 01/11	28/07 – 02/11	27/07 - 07/11
Number of nights	73	102	100	99	97	104
Call number						
Potential prey birds (< 25 g)	82	76	499	77	51	467
Not preyed birds (> 25 g)	1,588	1,249	3,131	1,077	1,029	2,539
Nyctalus lasioperus	1,366	1,126	1,459	281	171	13,559
Tadarida teniotis	0	311	1,582	2,956	3,110	0
Total	3,036	2,762	6,671	4,391	4,361	16,565

Avoidance hypothesis | *Methods*

Co-occurrence probability



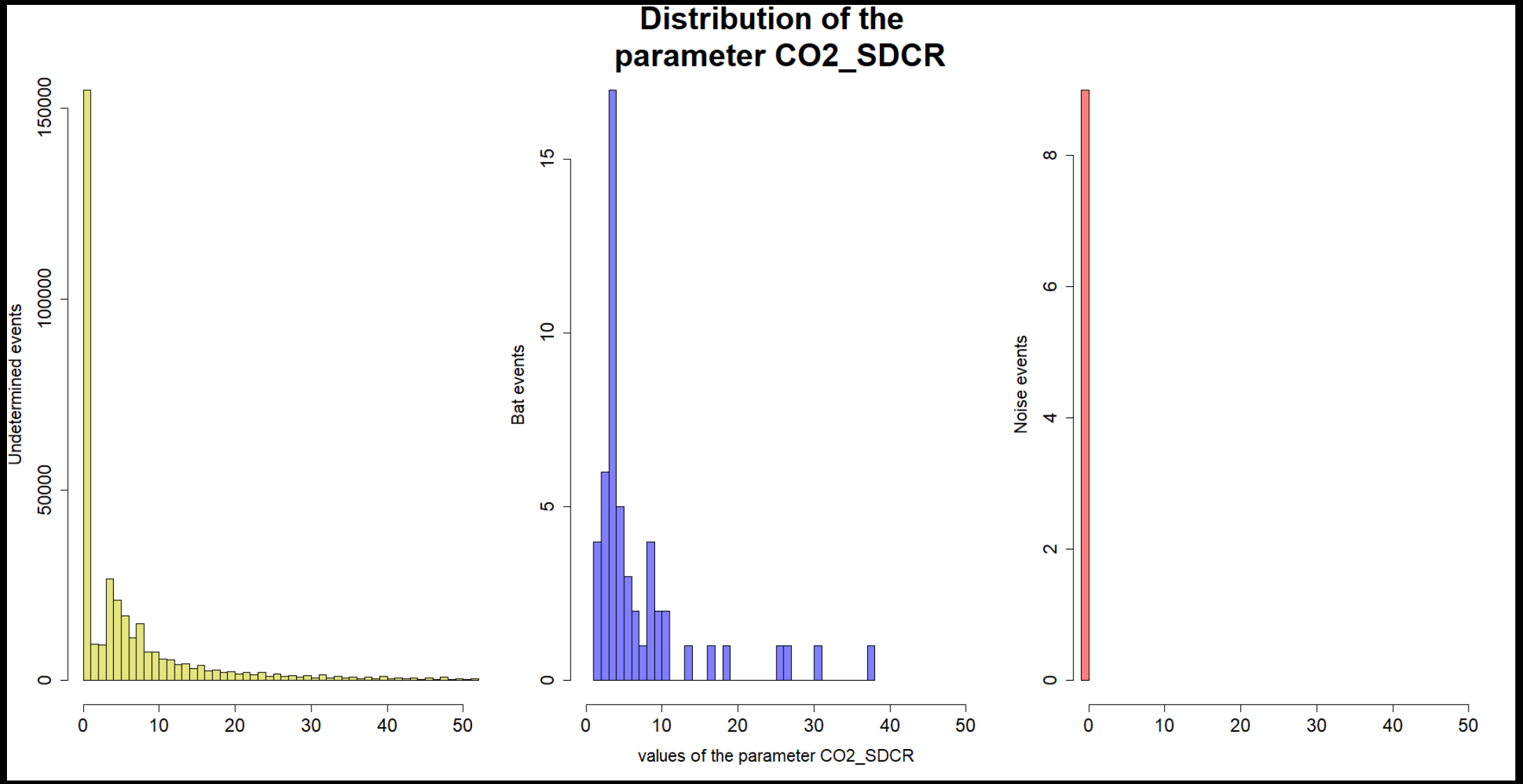
Expected probability of detecting a potential prey

		1-minute window
mean value →	Among every windows	≈
variation expected	Before *N. lasiopterus*	≈
	After *N. lasiopterus*	<
no variation expected	Before *T. teniotis*	≈
	After *T. teniotis*	≈

Avoidance hypothesis | *Results and discussion*

	Probability of detecting a potential prey	
	1-minute window	5-minutes window
Among every windows	0.004	0.021
Before *N. lasiopterus*	0.017	0.083
After *N. lasiopterus*	0.018	0.087
Before *T. teniotis*	0.021	0.084
After *T. teniotis*	0.017	0.079

← *no avoidance into the detection volume of microphones*

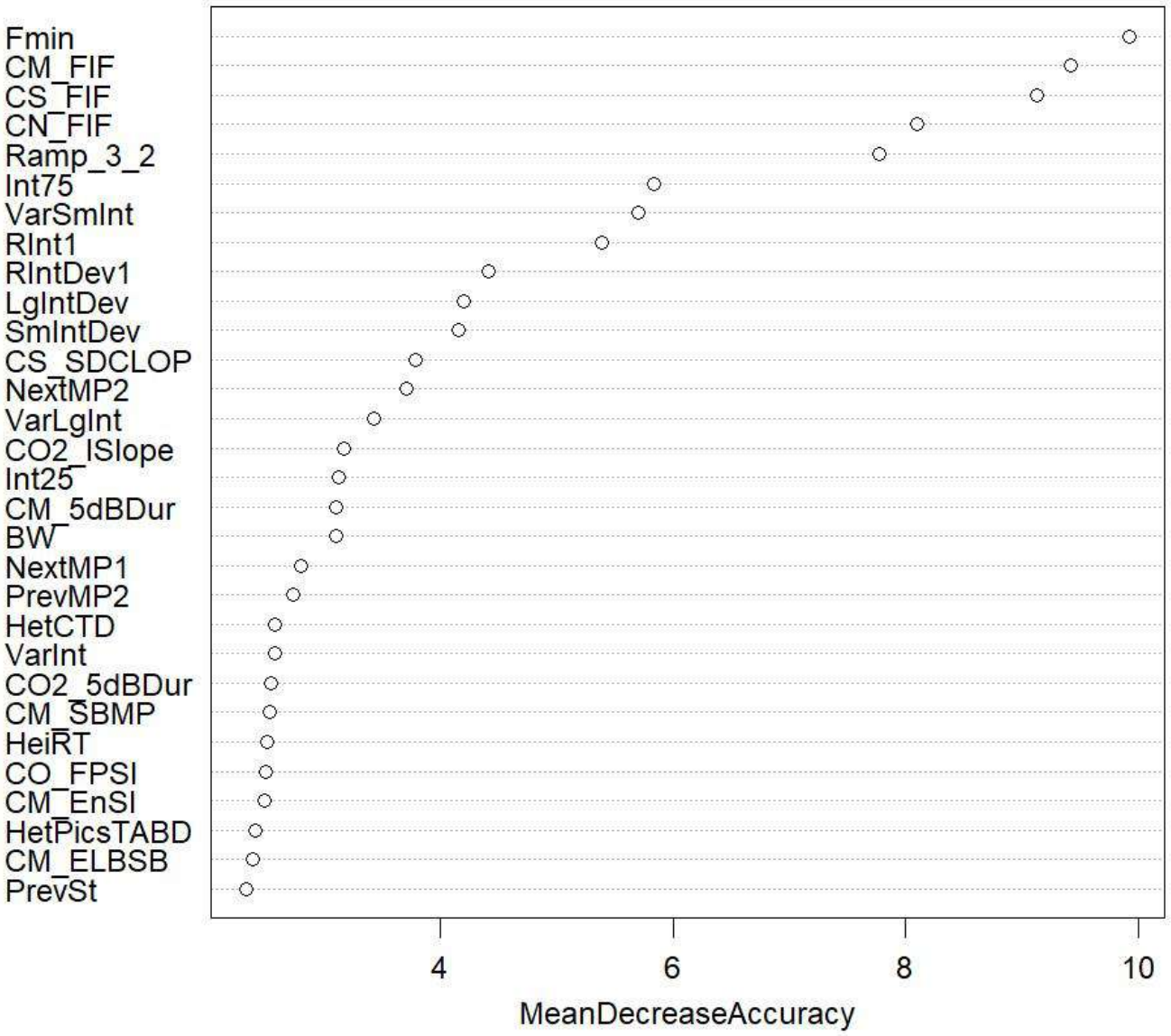


Example of parameter allowing to discriminate bat calls and noises during manual selection

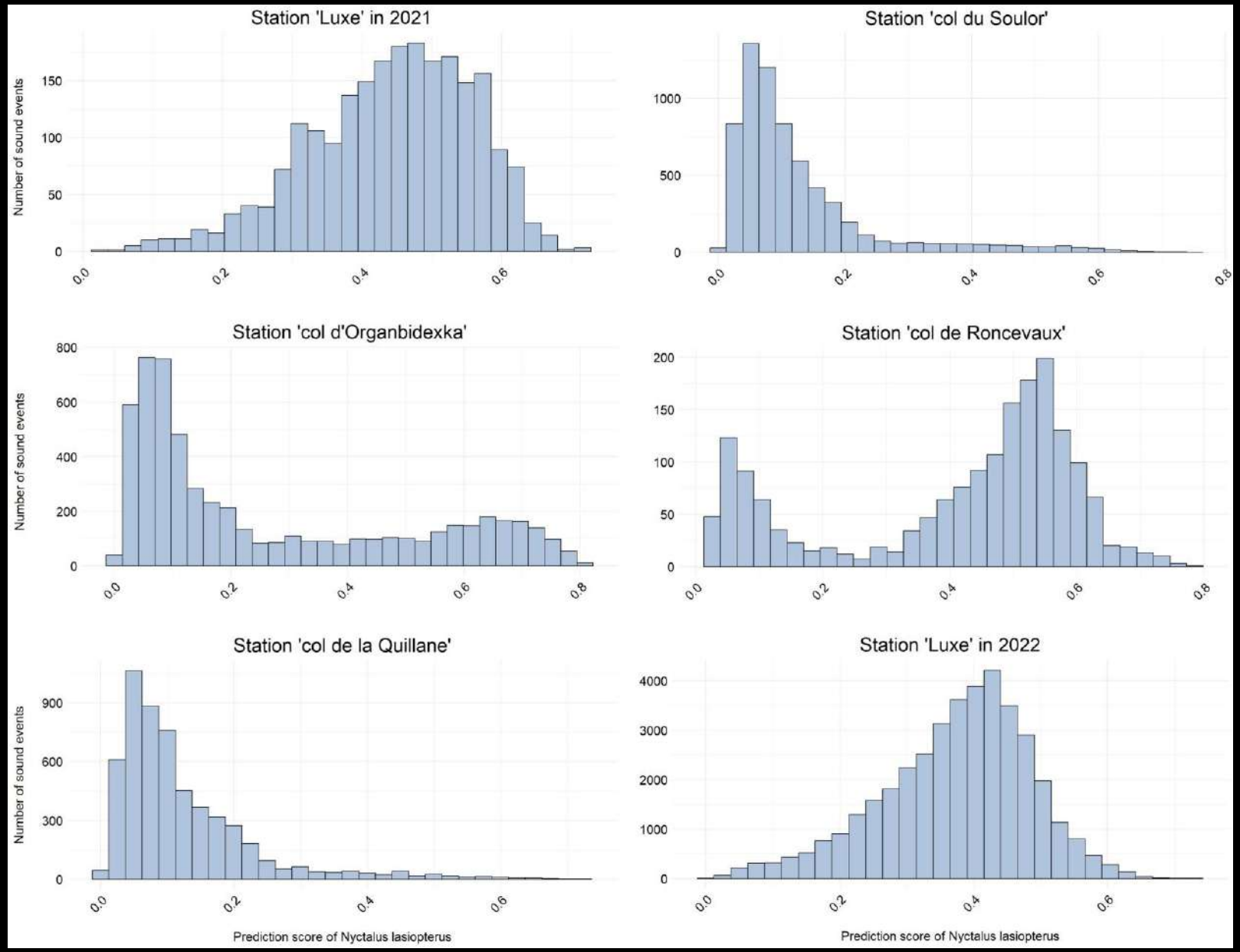
Manual selection of parameters

parameter	selection	parameter signification
Dur	> 10 & < 40	DSE duration
Fmin	> 9 & < 16	Minimum frequency
NoiseUp	> -10 & < -5	Average energy among the elements neighbouring the DSE on the bottom on a 3-element width
CM_5dBDur	> 1	Time difference between 5dBBF point and 5dBAF point
CO2_SDCR	≥ 1	SDC / Dur
CO2_FPkD	≥ -1 & < 4	Difference of frequency of maximum amplitude with previous DSE
CM_SDCLROP	≤ 1	SDCLOP / Dur
CS_SDCLOP	≥ 3	Cumulated changes in frequency slope of the “main slope” of the line
CN_SDCR	≤1	SDC / Dur
Dbl8	≥ 5	Amplitude difference between the DSE and low-frequency noise (=everything below 8kHz)

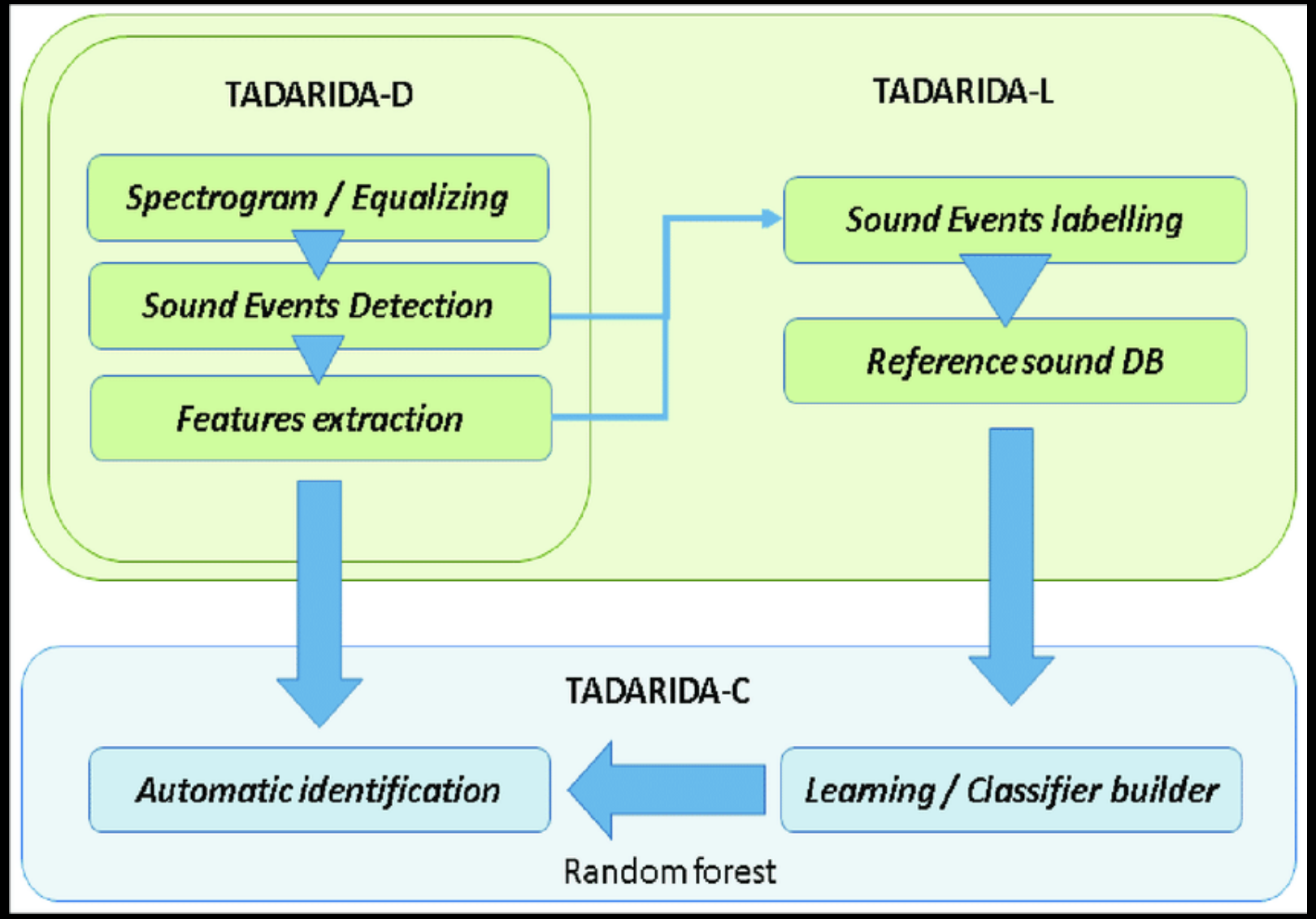
CM is the line of elements which have the maximum amplitude on each time window.
CN is the upper frequency edge of the DSE.
CS is the lower frequency edge of the DSE.
CO2 is formed by the first elements forming a local amplitude maximum on each frequency band (matrix line).



Mean decrease accuracy of parameters determined with random forest computation



Distribution of prediction scores obtained by all detected sound events for each recording station thanks to the random forest classification method.



Simplified diagram showing how the software Tadarida works. Diagram from Bas *et al.* (2017).