



Drones4Bats

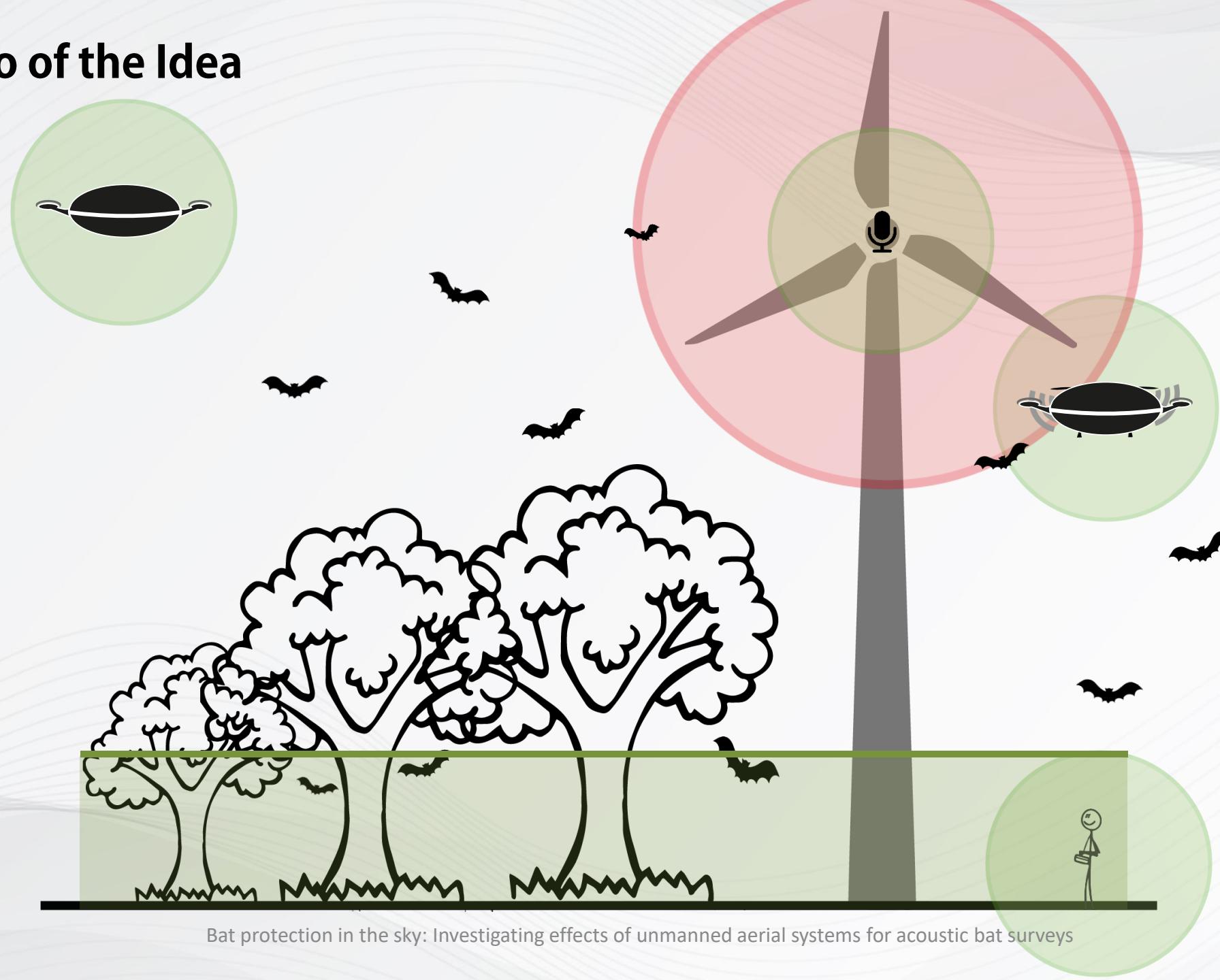
Bat protection in the sky: Investigating effects of
unmanned aerial systems for acoustic bat surveys

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Scenario of the Idea



Introduction

Problem

High bat fatalities at wind turbines [Beh18]

Prevention

Fixed times when the wind turbines must be turned off [Bul15]

Current knowledge

Transect survey: Acoustical detection of bats from the ground by experts [Voi15]

Nacelle monitoring: Acoustical detection of bats by stationary microphones at nacelle [Voi20]

Consequences of missing data

Less bat activity:

Lower wind energy productivity

More bat activity:

Potentially higher bat fatalities

Idea

Validate, if Unmanned Aerial Systems (UAS) can collect additional data of bat activity

Main research question

Are bats changing the behaviour in the vicinity of different UAS?

Is there a deterrent or attracting effect?

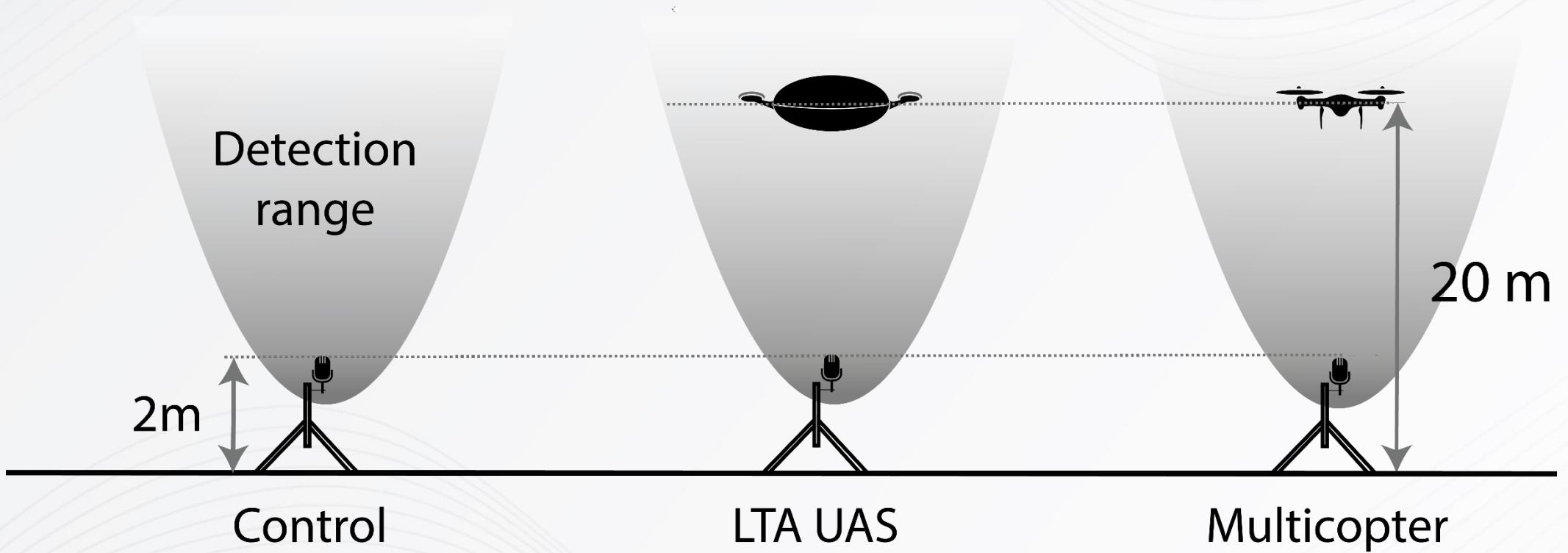
Is there a habituation effect over 15-minutes?

Tested UAS - Technical Data

	Multicopter (ConVecDro) Third Element Aviation	LTA (Zero +) Hybrid Airplane Technology
Take-off weight (incl. batterie)	8 kg	~ 100 g
Dimension (incl. probs)	143 cm x 143 cm x 53 cm	364 cm x 260 cm x 100 cm
Propeller	17 " x 6.5 "	7 " x 4 "
Max. flight duration	30 min	120 min
Wind resistance	15 m/s	2 m/s
Image	 [e]	 [f]

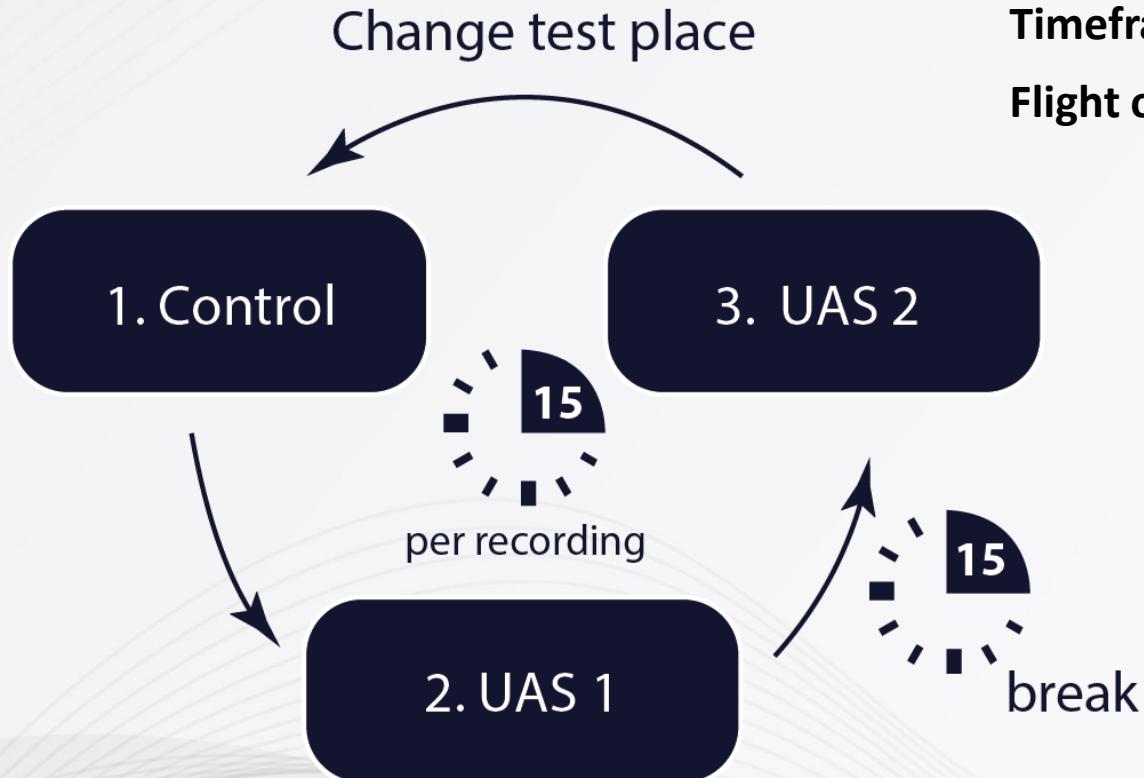
Method: Is there a deterrent or attracting effect?

Test Setup



Method: Is there a deterrent or attracting effect?

Test procedure



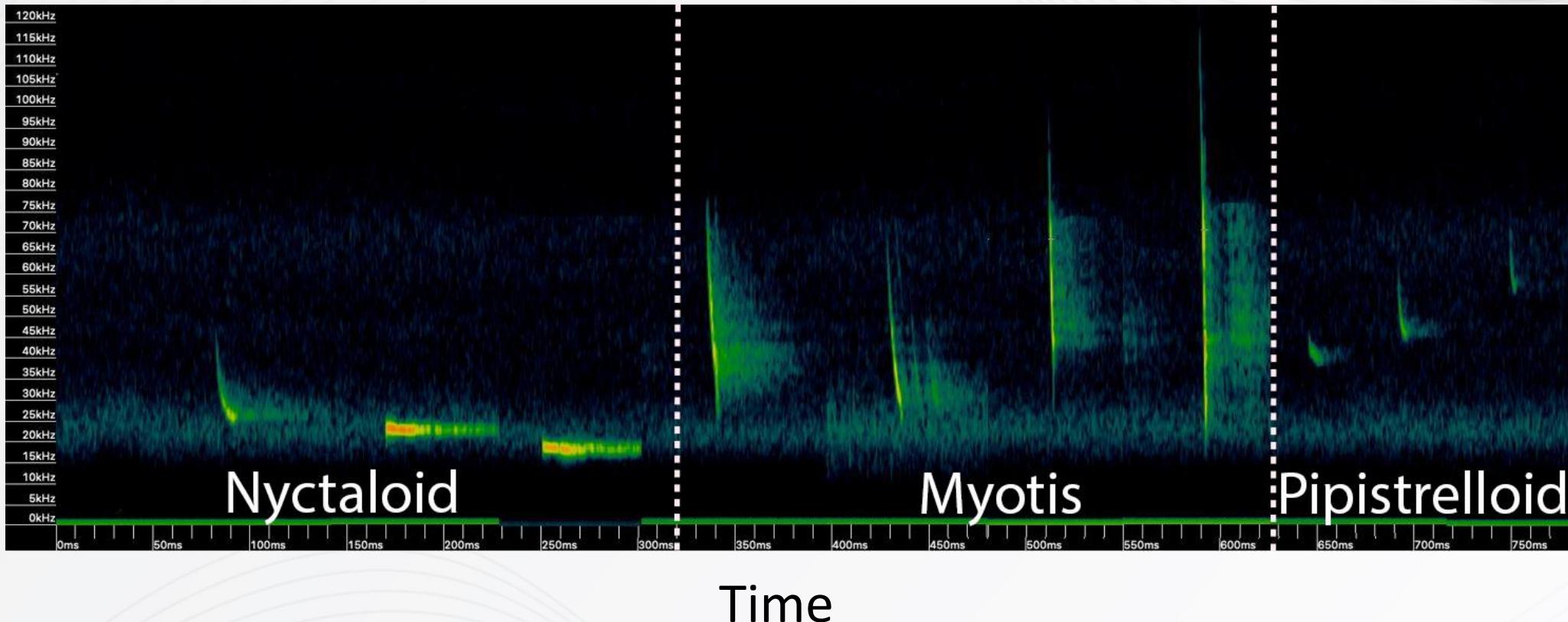
Locations: Per night three study areas at water bodies

Timeframe: Between sunset and maximally four hours thereafter

Flight order: UAS 1 and UAS 2 alternated each night in starting first

Method: Is there a deterrent or attracting effect?

Analysis



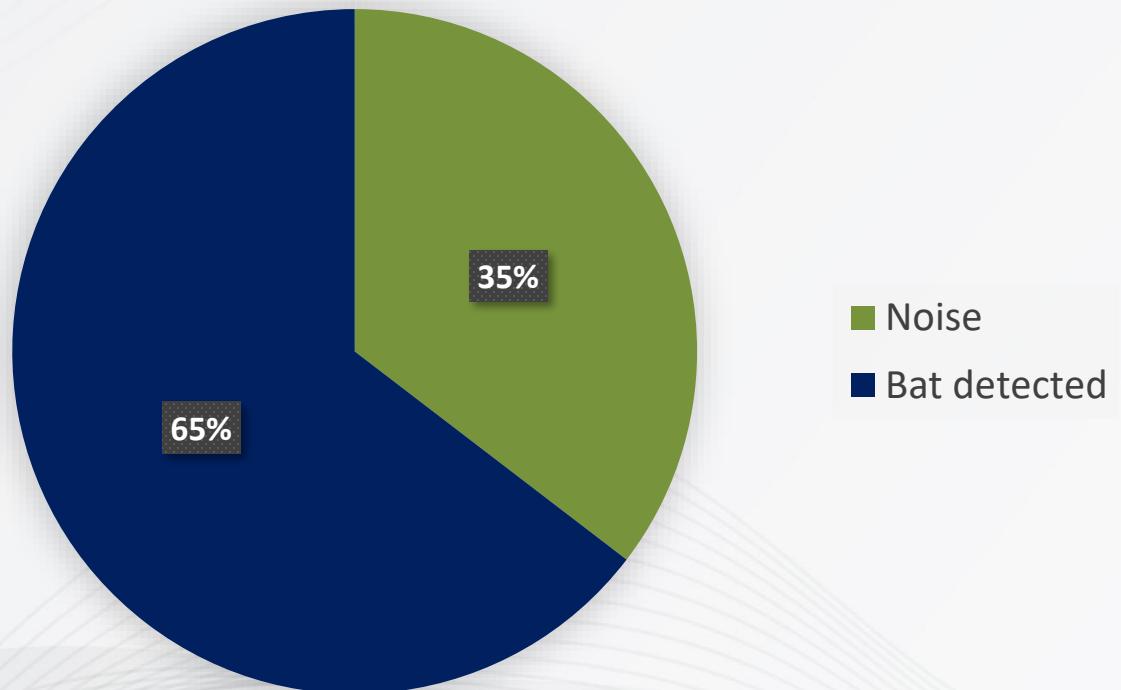
- Split recordings in 1-second-files
- Manually analysed and labelled each 1-second-file (noise/ Pipistrelloid / Myotis / Nyctaloid)

Note: A file can also include and be labelled with more than one species, e.g. Pipistrelloid / Myotis

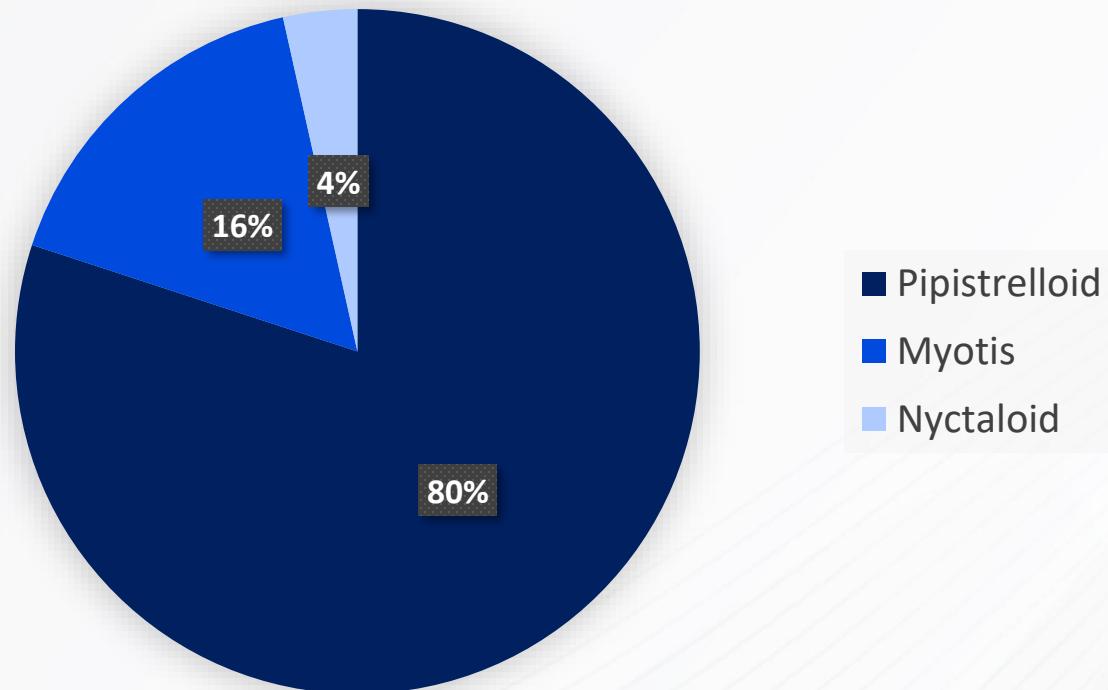
Results - Deterrent or Attraction Effect

- 63 tests
- 107,356 1-second-files

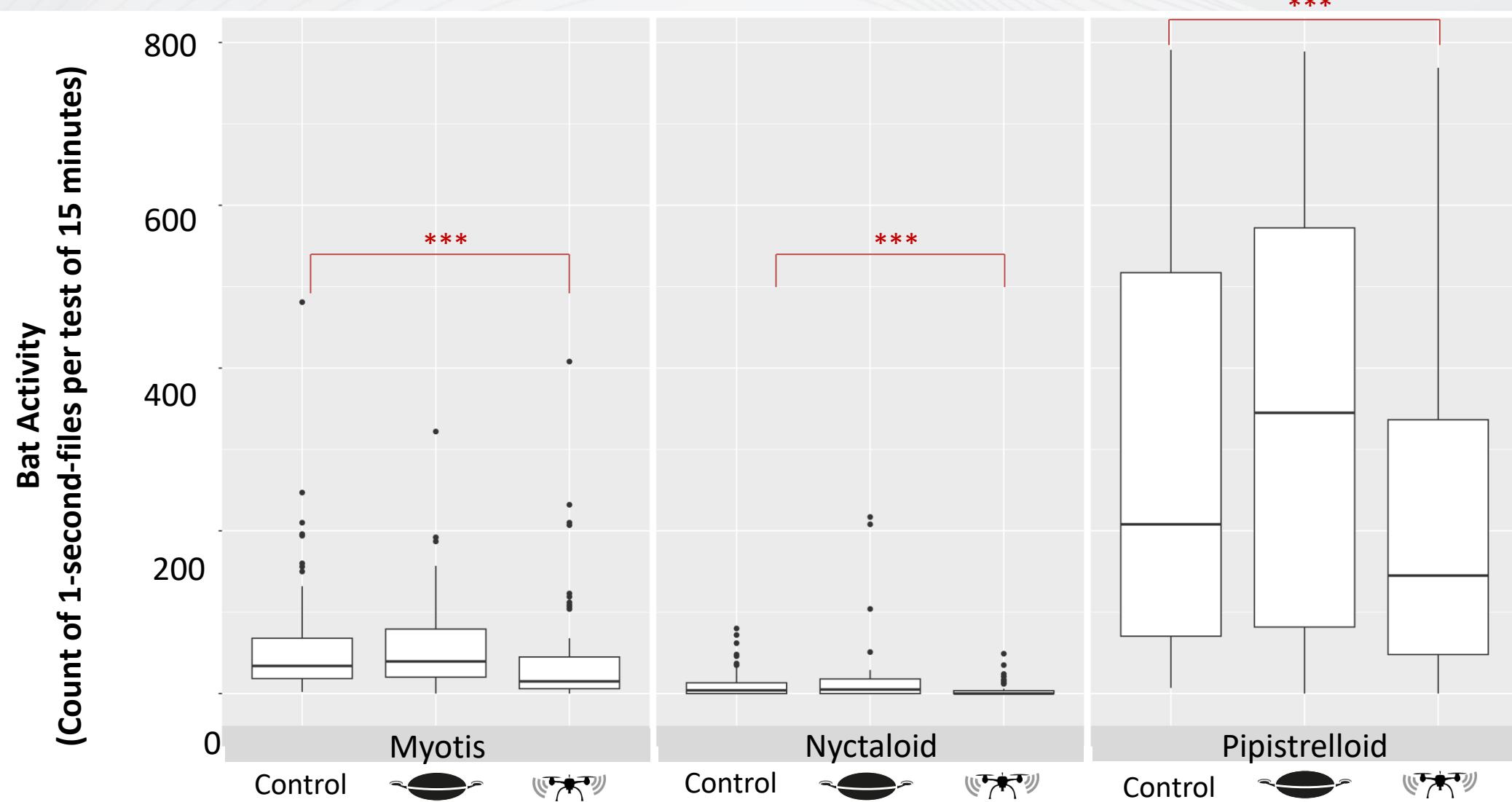
Noise Contribution



Bat Species



Results - Deterring or attraction effect

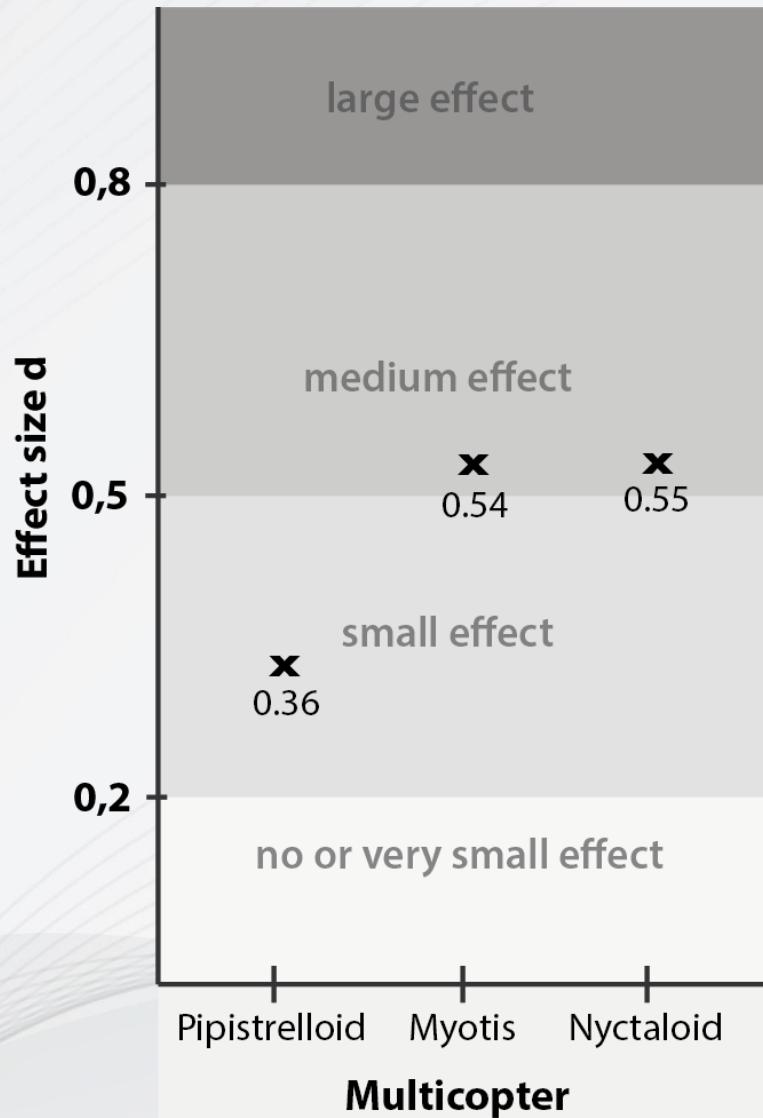




*** = p < 0.001

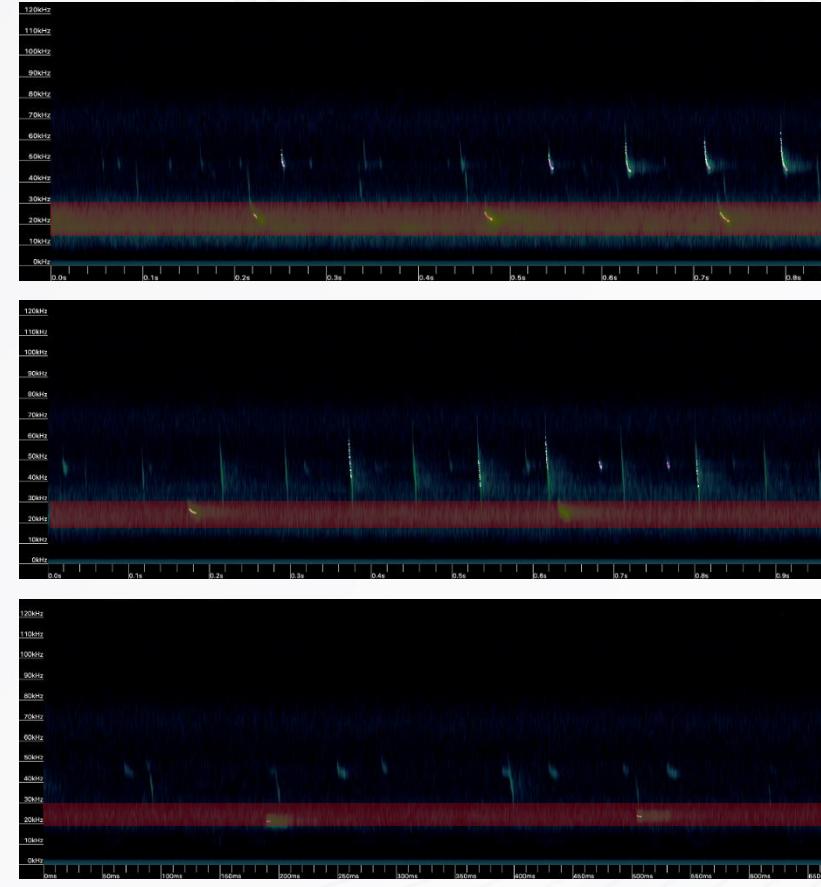
Results - Deterring or Attraction Effect

Effect Size of Multicopter



Control

Possible reason for different effect sizes



Results - Habituation Effect during Multicopter Flight

- No habituation effect across 15 flight minutes
- Estimated slope < 0.01 per minute for all species



Conclusion

Main research question

Are bats changing the behaviour in the vicinity of different UAS?

There is a deterrent or attraction effect?

There is a habituation effect over 15-minute?



- Multicopter
 - Species-specific deterrent
 - Small and medium effect
 - LTA UAS
 - No deterrent or attraction effect
 - Inappropriate for usage in acoustic bat monitoring
 - Susceptibility to winds
-
- Kuhlmann's 2022 suggests: **smaller** UAS have a lower impact on bat activity [Kuh22]
 - This study suggests: **quieter** UAS have lower impact on bat activity

Topics for Future Works

- What is the range for deterrent effect?
- Unknown about habituation effect over a longer time
- Comparison with traditional survey methods

Sources

- [Beh18] Behr O, Brinkmann R, Hochradel K, Mages J, Korner-Nievergelt F, Reinhard H, Simon R, Stiller F, Weber N, Nagy M (2018). Bestimmung des Kollisionsrisikos von Fledermäusen an Onshore-Windenergieanlagen in der Planungspraxis – Endbericht des Forschungsvorhabens gefördert durch das Bundesministerium für Wirtschaft und Energie (Förderkennzeichen 0327638E). In: Behr O. et al., Erlangen, Freiburg, Ettiswil
- [Bri11] Brinkmann R, Behr O, Ivo N, Michael R, editors. Entwicklung von Methoden zur Untersuchung und Reduktion des Kollisionsrisikos von Fledermäusen an Onshore-Windenergieanlagen. Göttingen: Umwelt und Raum Bd. 4, Cuvillier Verlag; 2011
- [Bul15] Bulling L, Sudhaus D, Schnittker D, Schuster E, Biehl J, Tucci F. Vermeidungsmaßnahmen bei der Planung und Genehmigung von Windenergieanlagen Bundesweiter Katalog von Maßnahmen zur Verhinderung des Eintritts von artenschutzrechtlichen Verbotstatbeständen nach §44 BNatSchG.; 2015
- [Kuh22] Kuhlmann, K., Fontaine, A., Brisson-Curadeau, É., Bird, D.M. & Elliott, K.H. (2022). Miniaturization eliminates detectable impacts of drones on bat activity. *Methods Ecol Evol* 13 (4): 842–851
- [Voi15] Voigt CC, Lehnert LS, Petersons G, Adorf F, Bach, Wildlife and renewable energy: German politics cross migratory bats, European Journal of Wildlife Research, 2015
- [Voi20] Voigt, Christian C. (2020): Evidenzbasierter Fledermausschutz in Windkraftvorhaben. Berlin, Heidelberg: Springer. Online available: https://library.oapen.org/bitstream/handle/20.500.12657/41713/2020_Book_EvidenzbasierterFledermausschu.pdf?sequence=1#page=113, valid at 04.01.2022

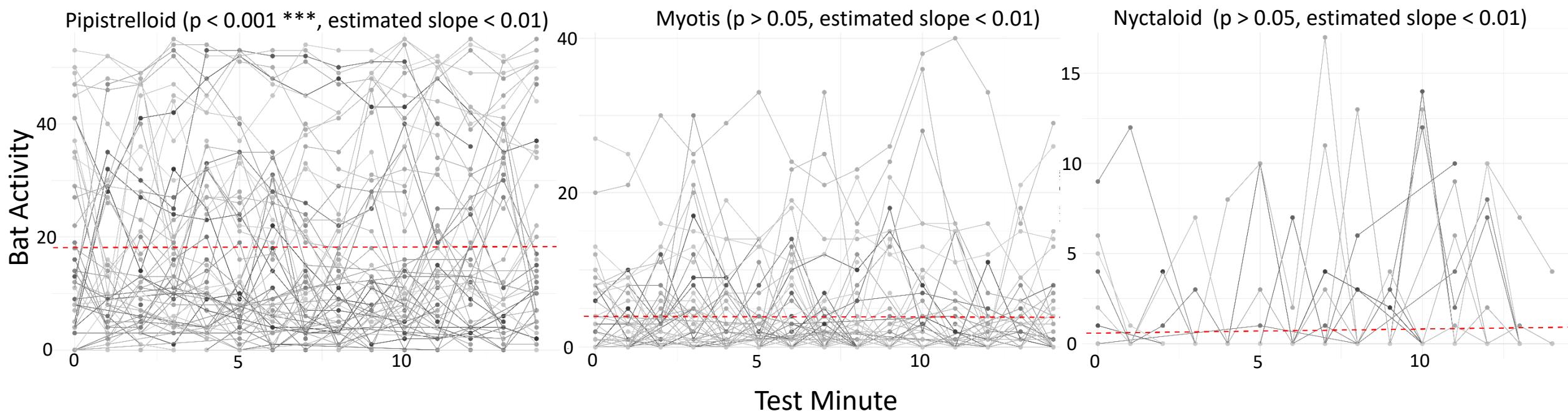
Images

- [a] Third Element Aviation GmbH
[b] Hybrid Airplane Technology GmbH
[c] Third Element Aviation GmbH
[d] Own photo
- [e] Third Element Aviation GmbH
[f] Hybrid Airplane Technology GmbH
[g] royalty-free image: <https://unsplash.com/de/fotos/NljTy5Y15JM>

Any Questions?



Results - Habituation effect during multicopter flight



- Show the activity per Test minute
- Lines connect points per test procedure
- Dashed line show estimated slope of GLMM Regression
- Dashed line starts at average activity level at minute 0