Accounting for amphibians' behaviour in drift fence optimisation: an exploratory study

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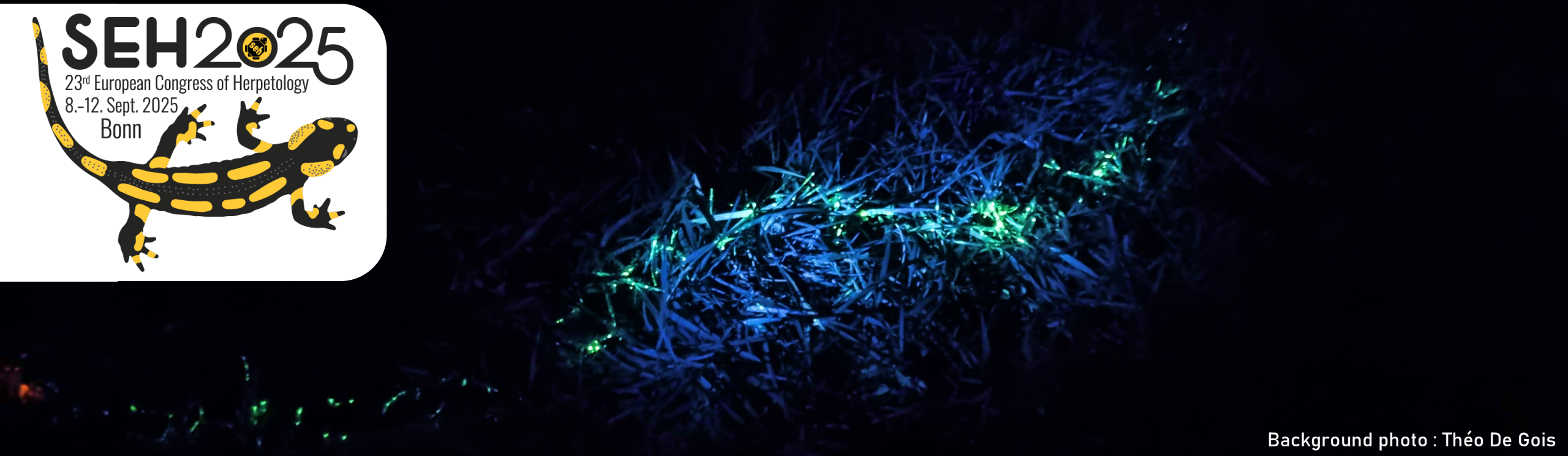
SEH2025
23rd European Congress of Herpetology
8.–12. Sept. 2025
Bonn



Background photo : Théo De Gois

ALSACE Collectivité européenne
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Centre d'Études Biologiques de Chizé
UMR 5175 Centre d'Écologie Fonctionnelle & Evolutive
cnrs
École Pratique des Hautes Études
PSL

What kind of drift fence ?

Seasonal roadkill mitigation device

- Fence

What kind of drift fence ?

Roadkill mitigation device

- Fence
- Captation devices

Collectivité européenne d'Alsace

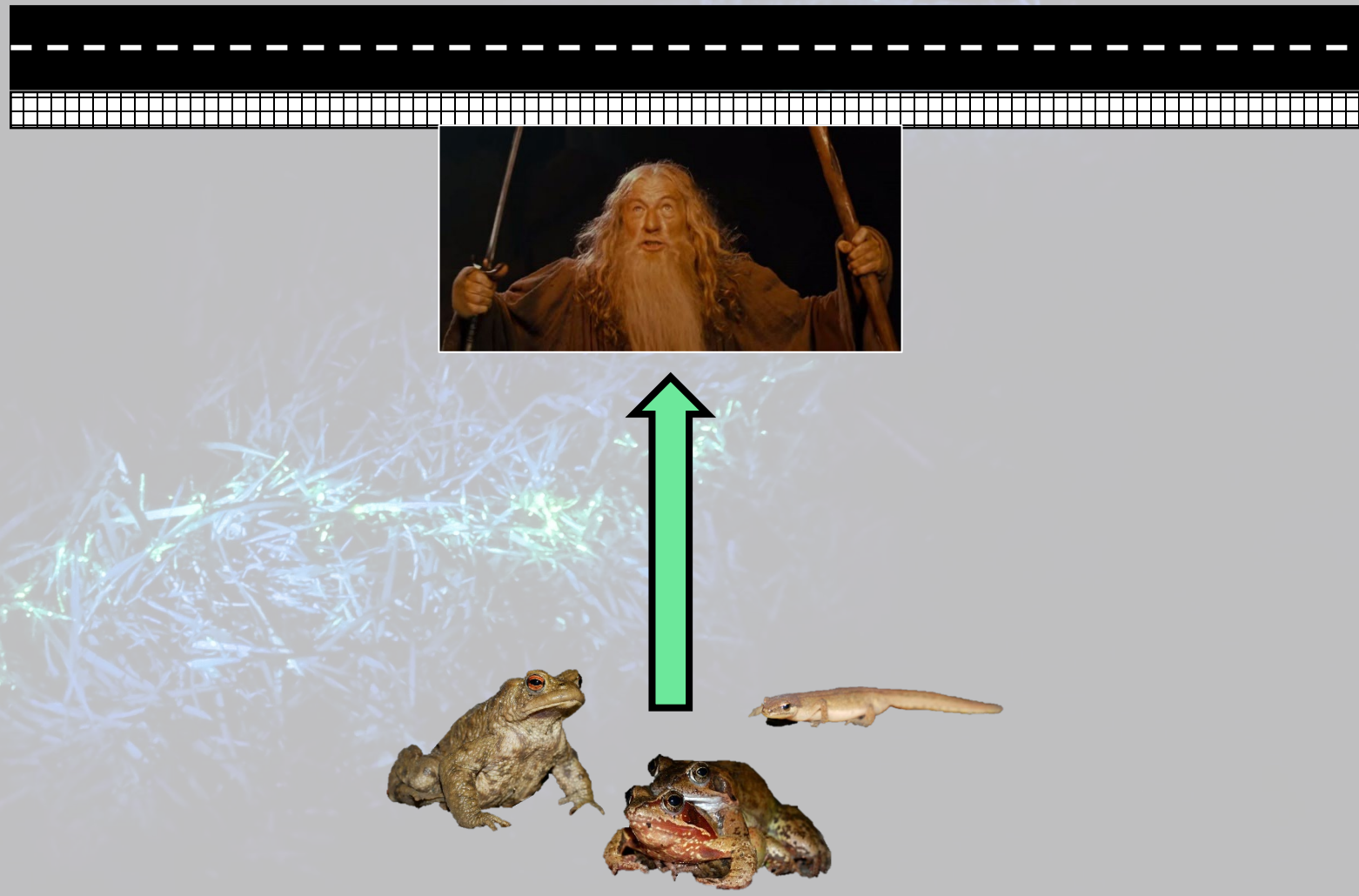
How does it work ?

Exclusion function

How does it work ?

Exclusion function

Prevent roadkills

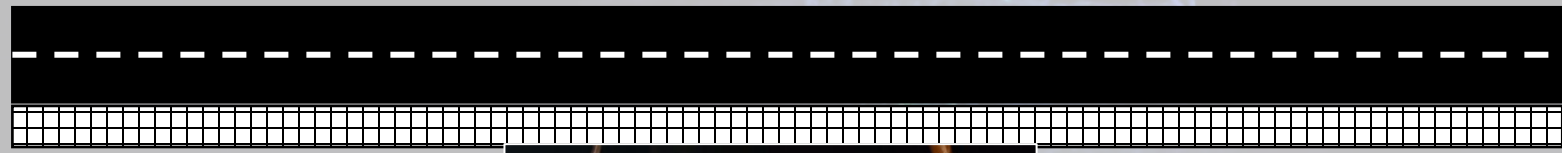


How does it work ?

Exclusion function

Prevent roadkills

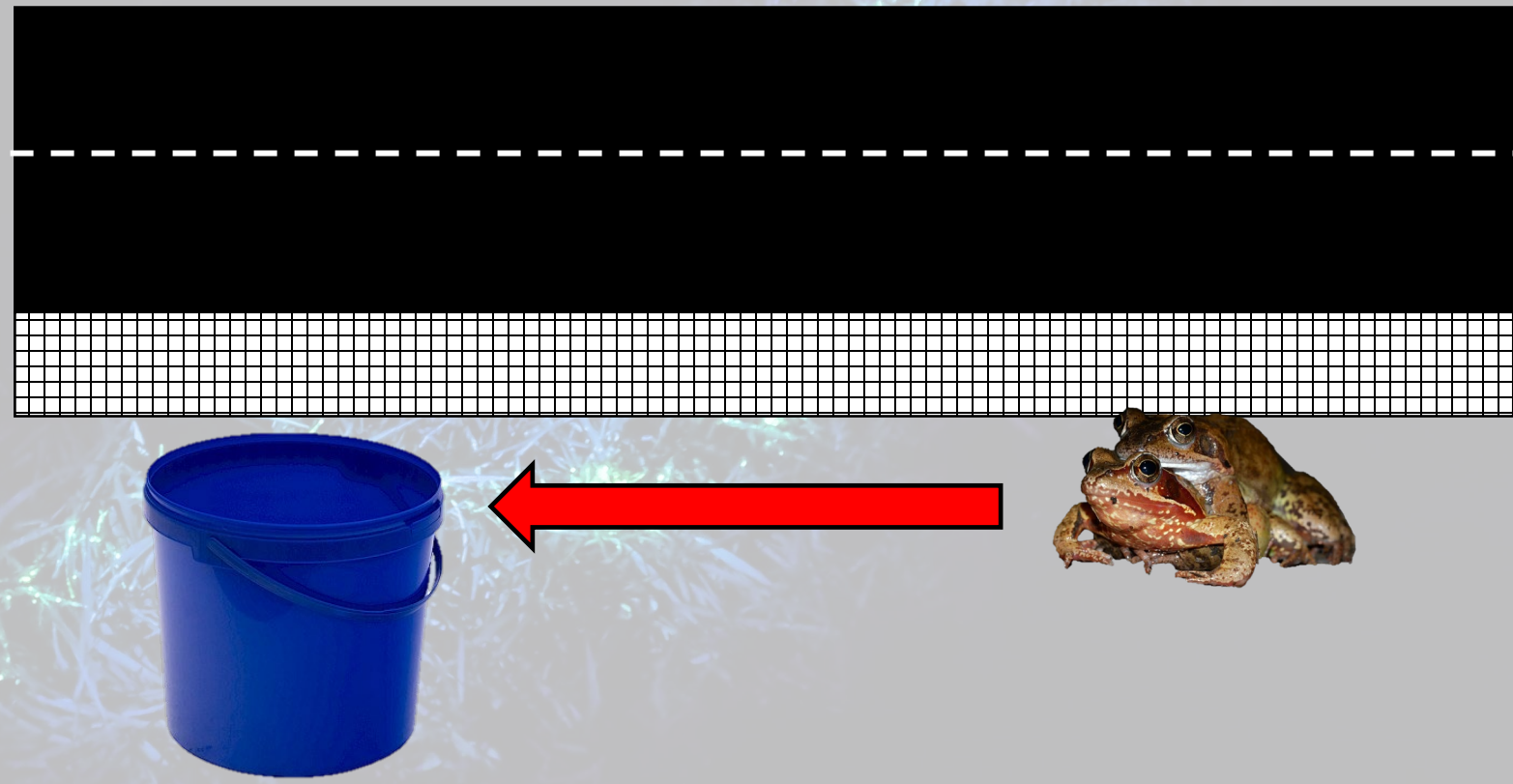
Reduce depletion



How does it work ?

Guiding function

Help amphibians reaching captation devices

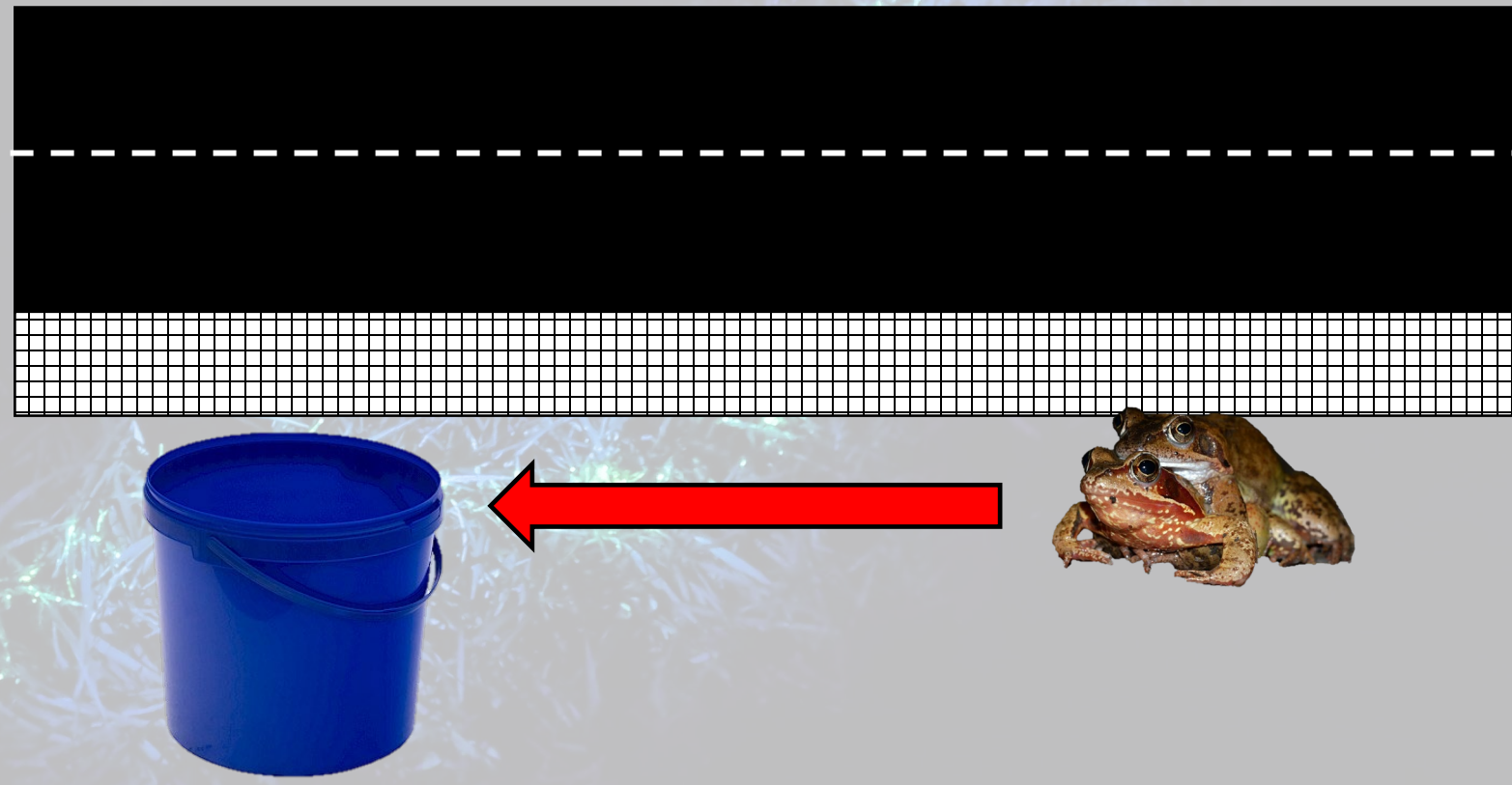


How does it work ?

Guiding function

Help amphibians reaching captation devices

Maintain landscape connectivity



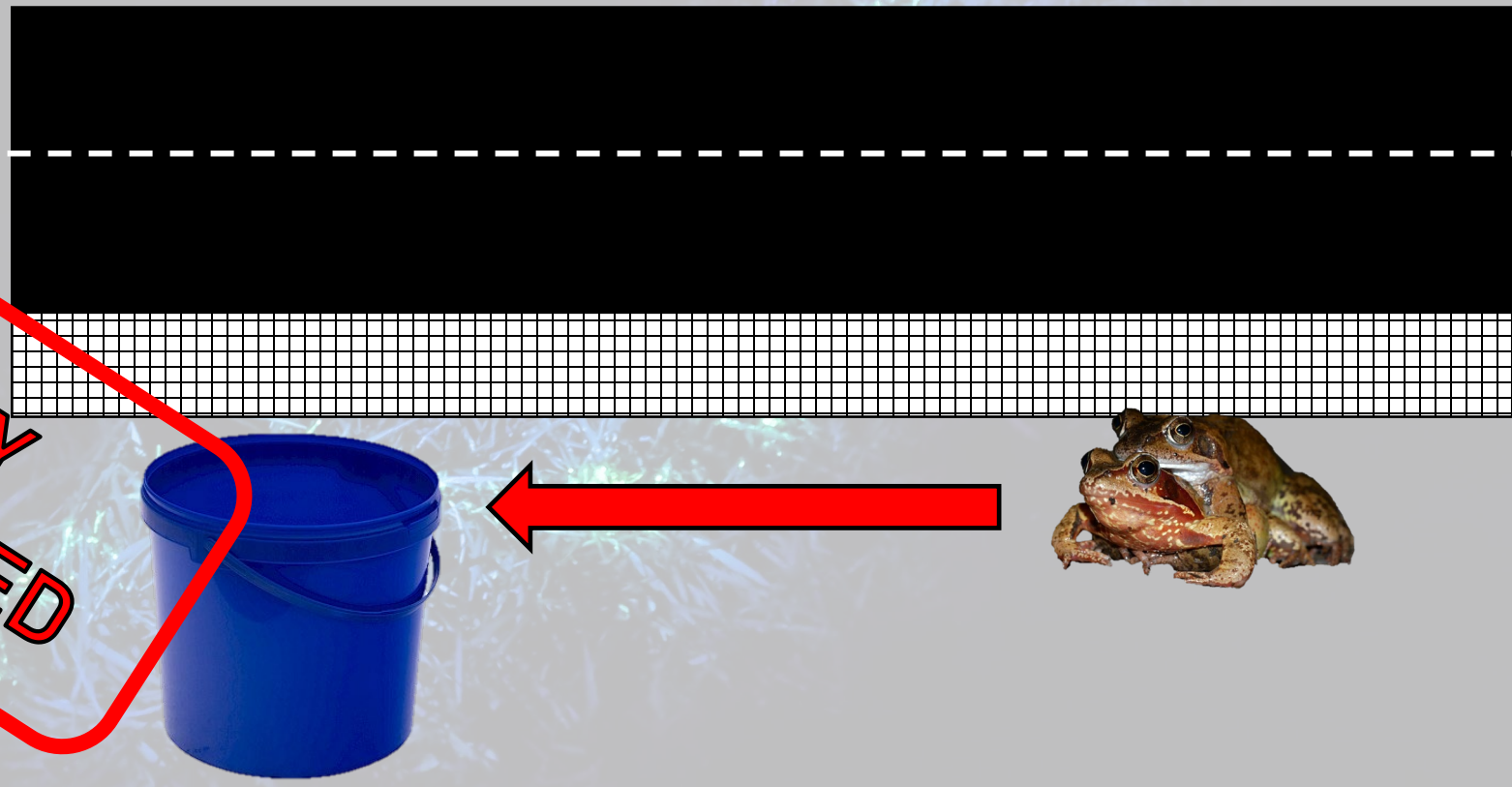
How does it work ?

Guiding function

Help amphibians reaching captation devices

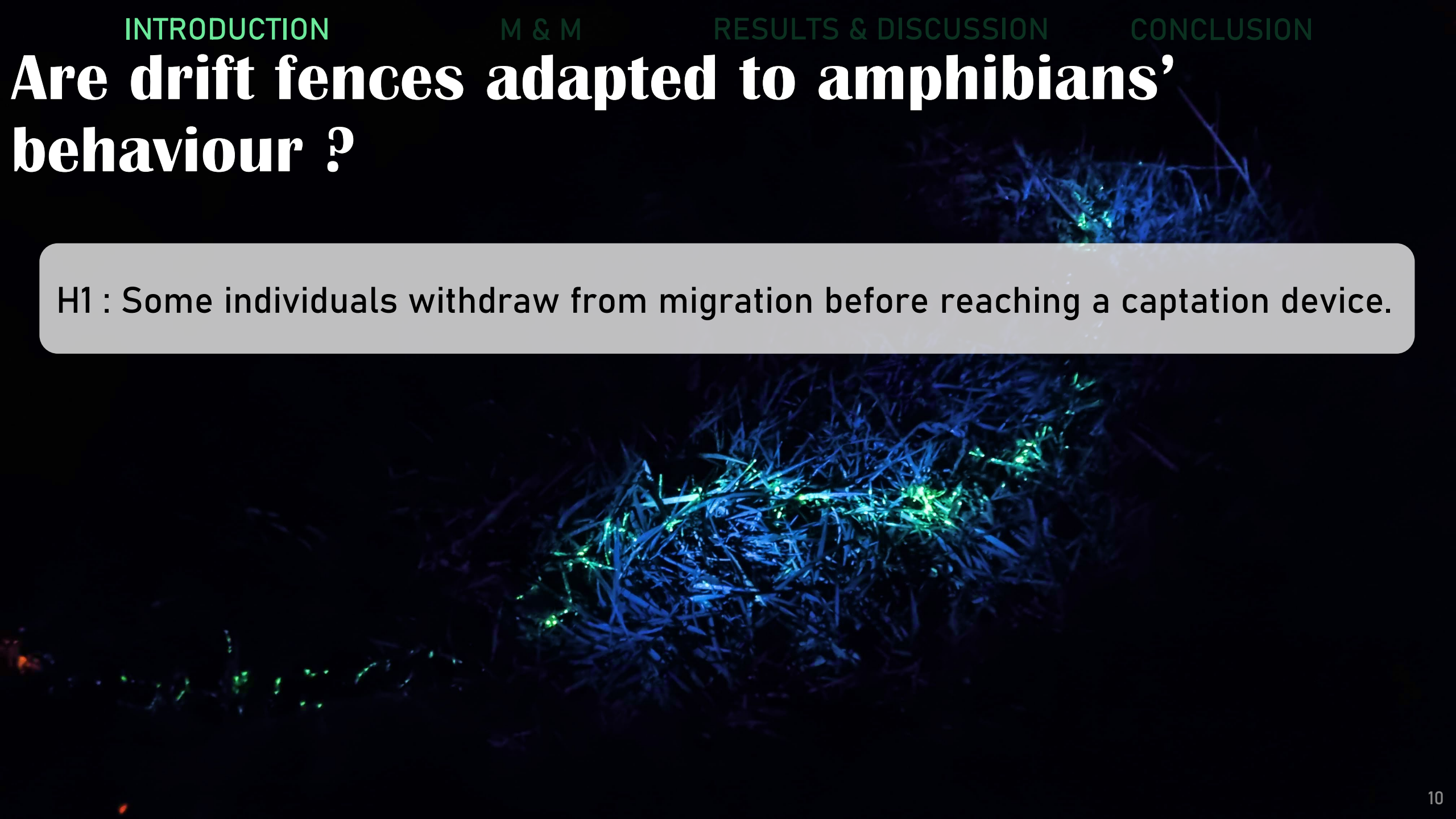
POORLY DOCUMENTED

Maintain landscape connectivity



Are drift fences adapted to amphibians' behaviour ?

H1 : Some individuals withdraw from migration before reaching a captation device.



Are drift fences adapted to amphibians' behaviour ?

H1 : Some individuals withdraw from migration before reaching a captation device.

H2 : Some individuals avoid captation devices.

Are drift fences adapted to amphibians' behaviour ?

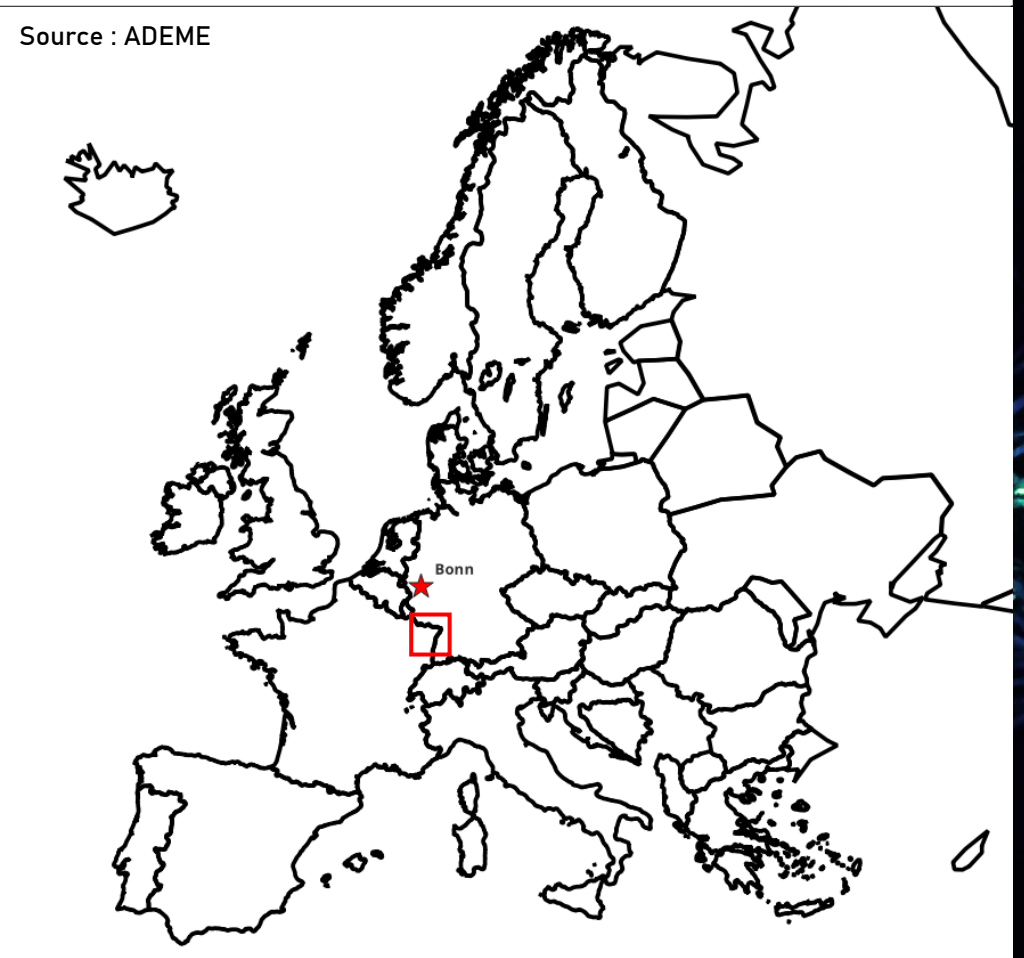
H1 : Some individuals withdraw from migration before reaching a captation device.

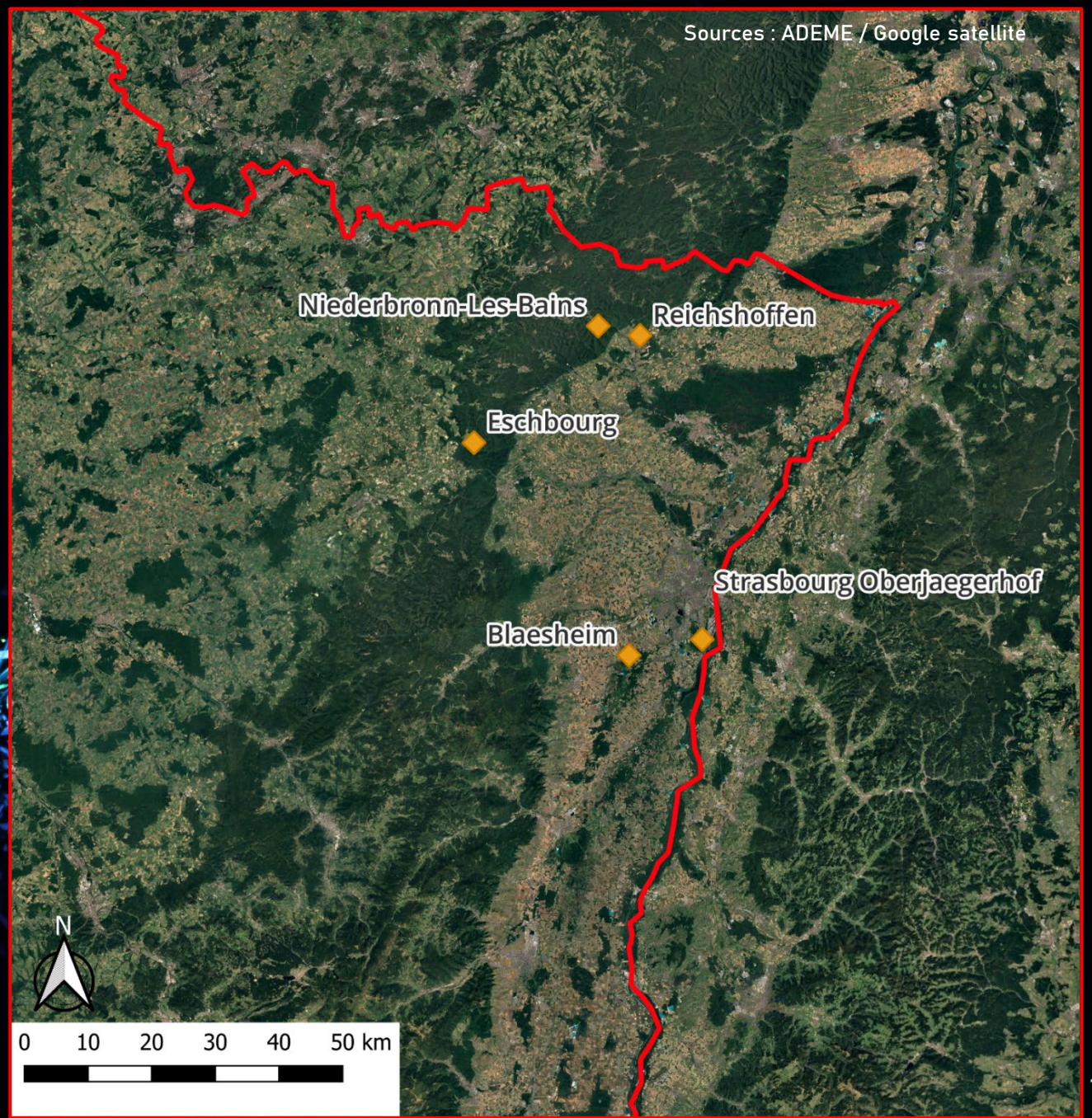
H2 : Some individuals avoid captation devices.

H3 : There is a species-dependent distance between captation devices that optimises capture probability.

Trajectometry survey

5 sites in Eastern France





Trajectometry survey

Toads :

- *Bufo bufo*

Trajectometry survey

Toads :

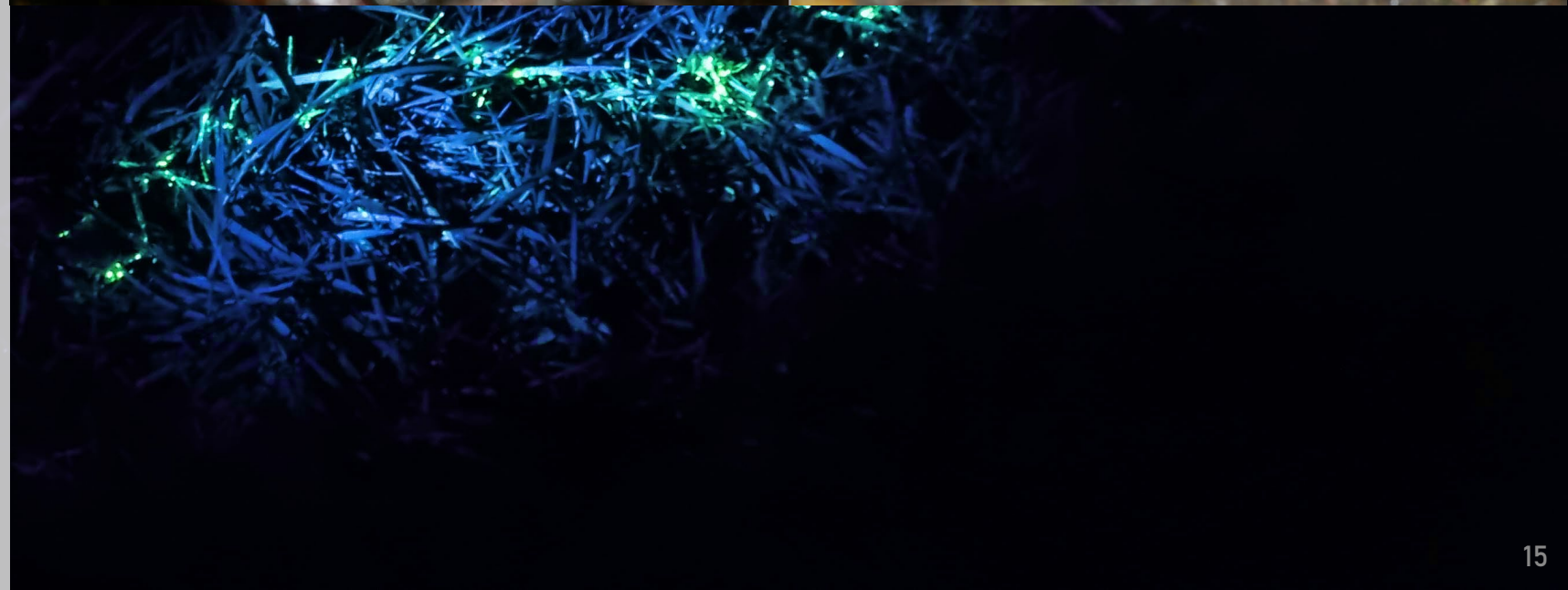
- *Bufo bufo*

Frogs :

- *Rana temporaria*


Meven Le Brishoual


Meven Le Brishoual



Trajectometry survey

Toads :

- *Bufo bufo*

Frogs :

- *Rana temporaria*

Newts :

- *Ichthyosaura alpestris*
- *Lissotriton sp.*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Meven Le Brishoual


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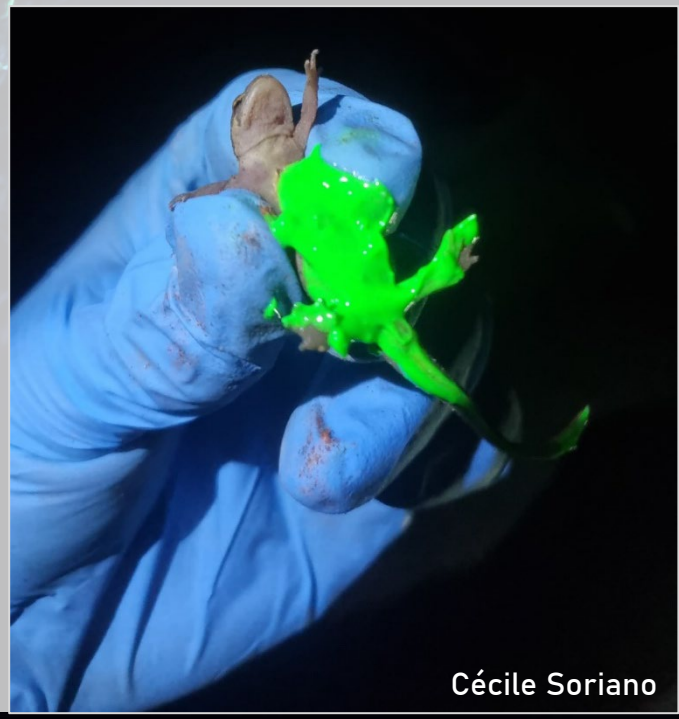
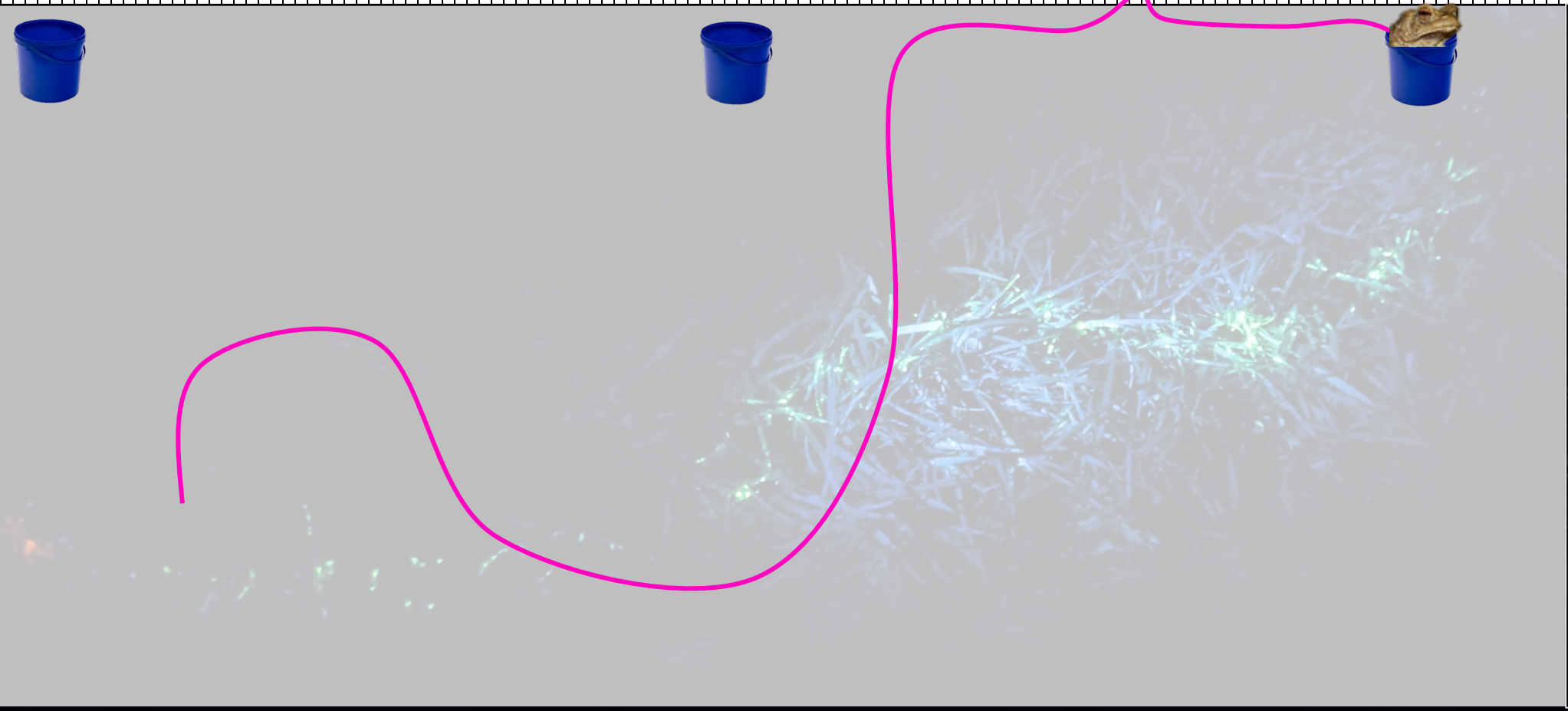
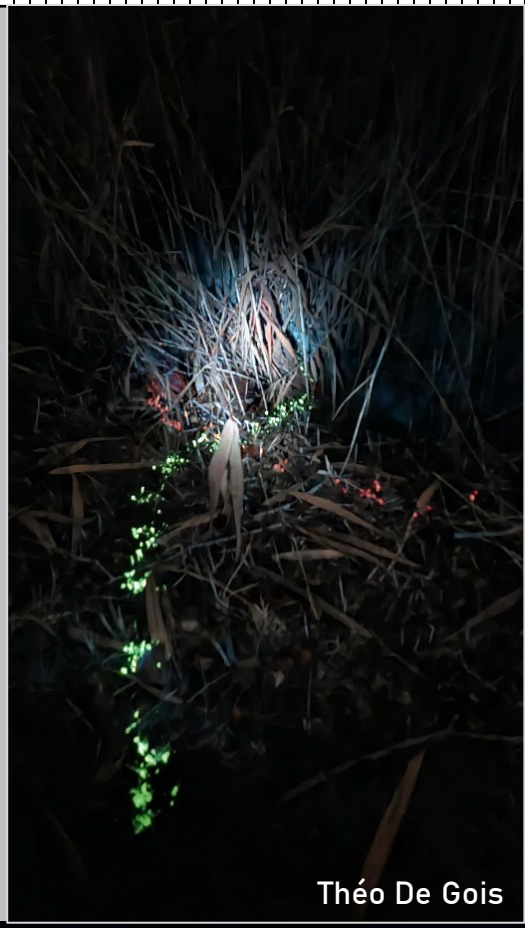
Trajectometry survey





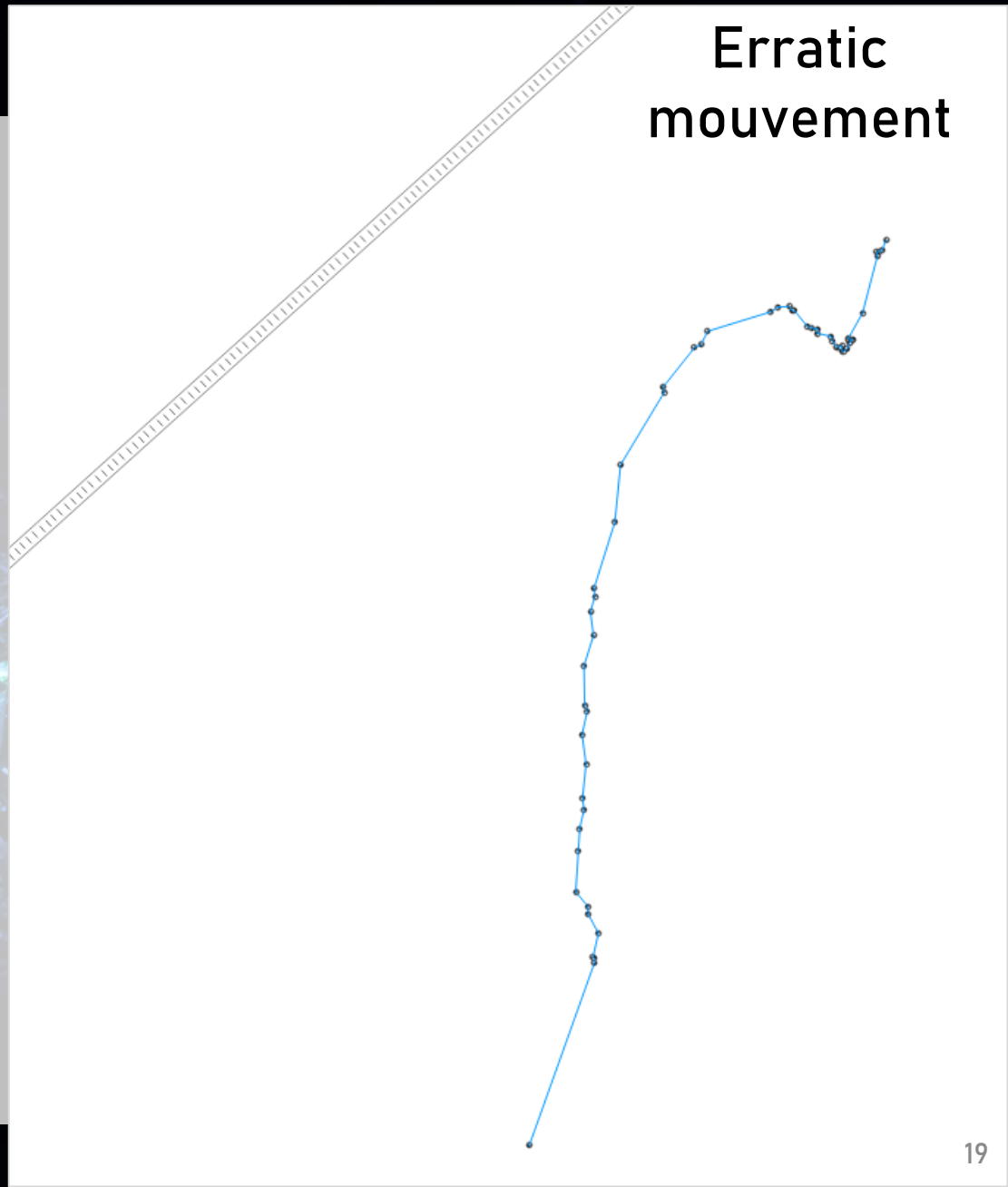
Trajectometry survey





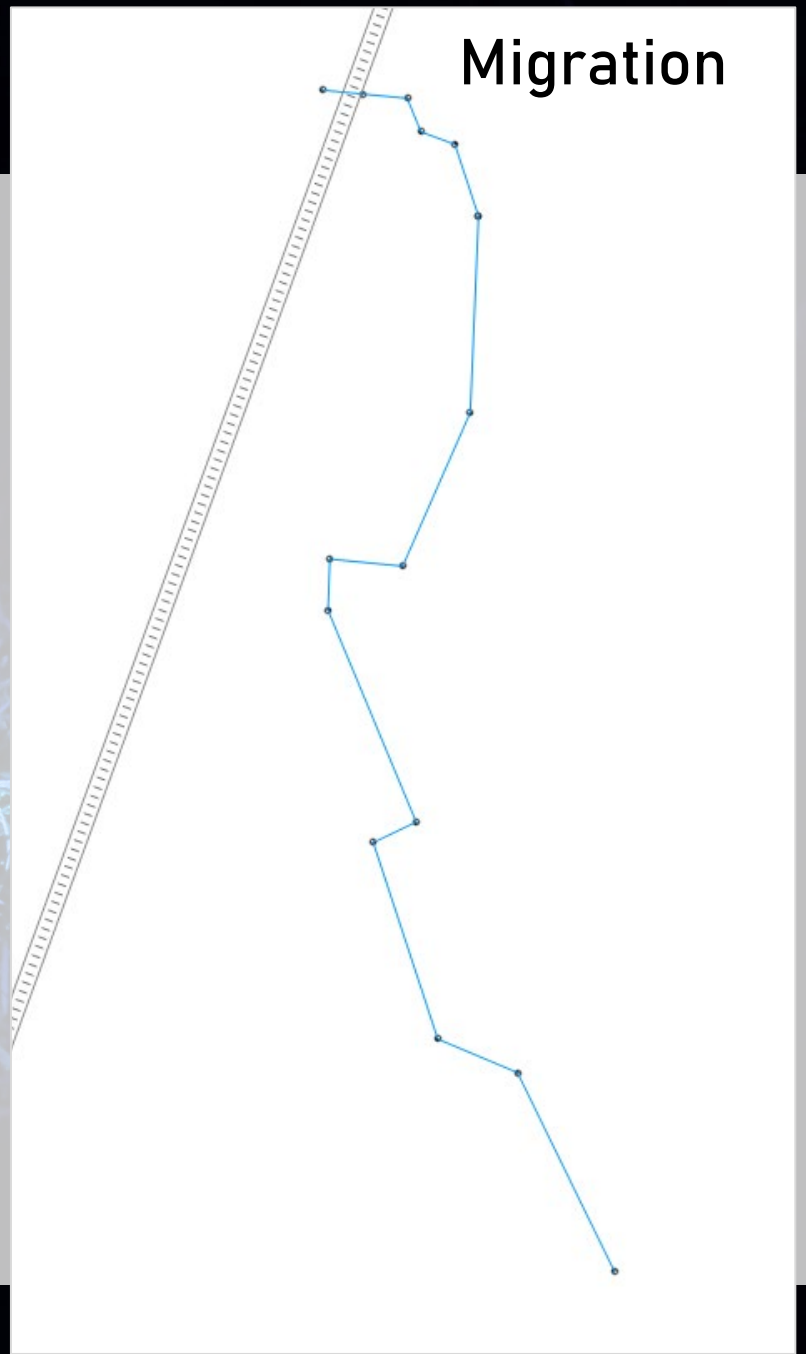
Stereotypical behaviours

- Interaction with the fence : NO



Stereotypical behaviours

- Interaction with the fence : YES
- Ends at the fence : YES



Stereotypical behaviours

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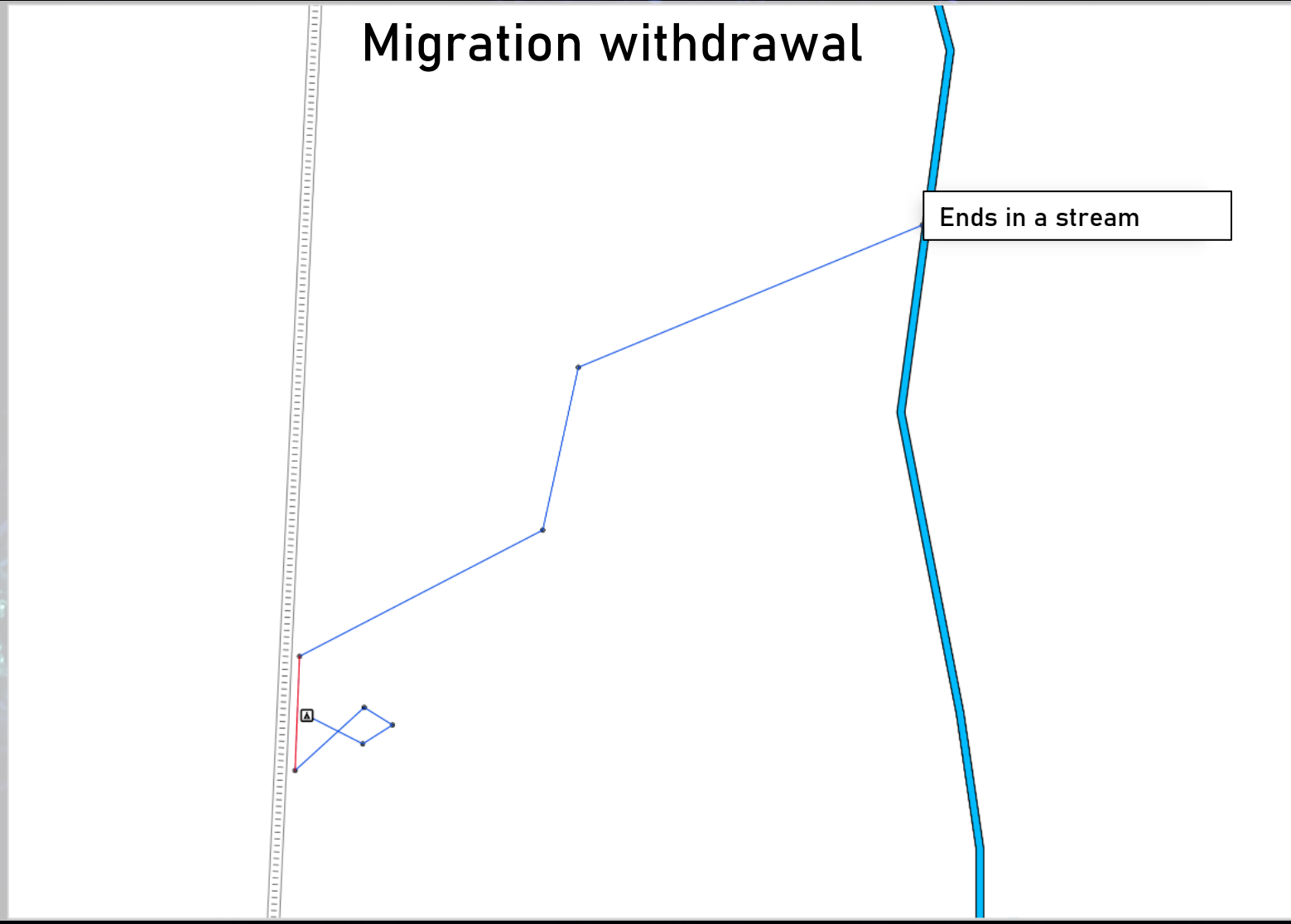


Statistical analyses

- Species focused

- Behaviour focused

Statistical analyses

- Species focused →

- Behaviour focused

Statistical analyses

- Species focused →

- Behaviour focused → let's talk about it !

Number of tracks

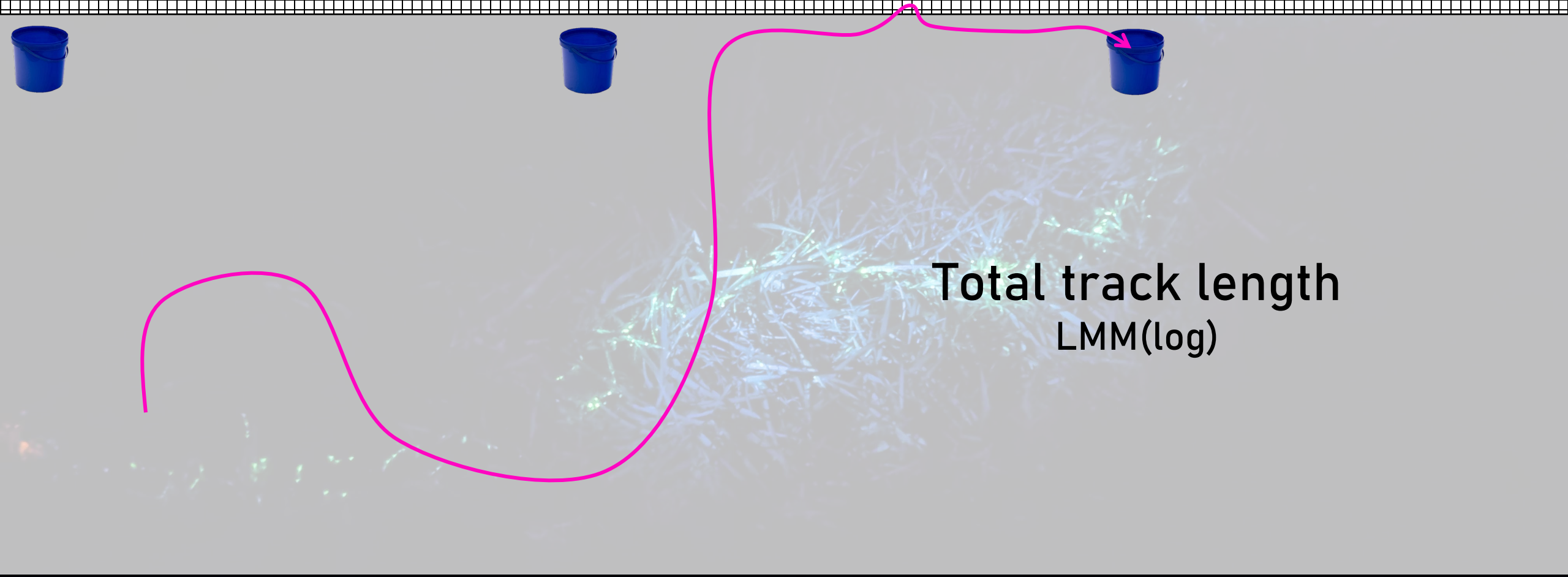
Total : 103 tracks

29

17

57

Total track length

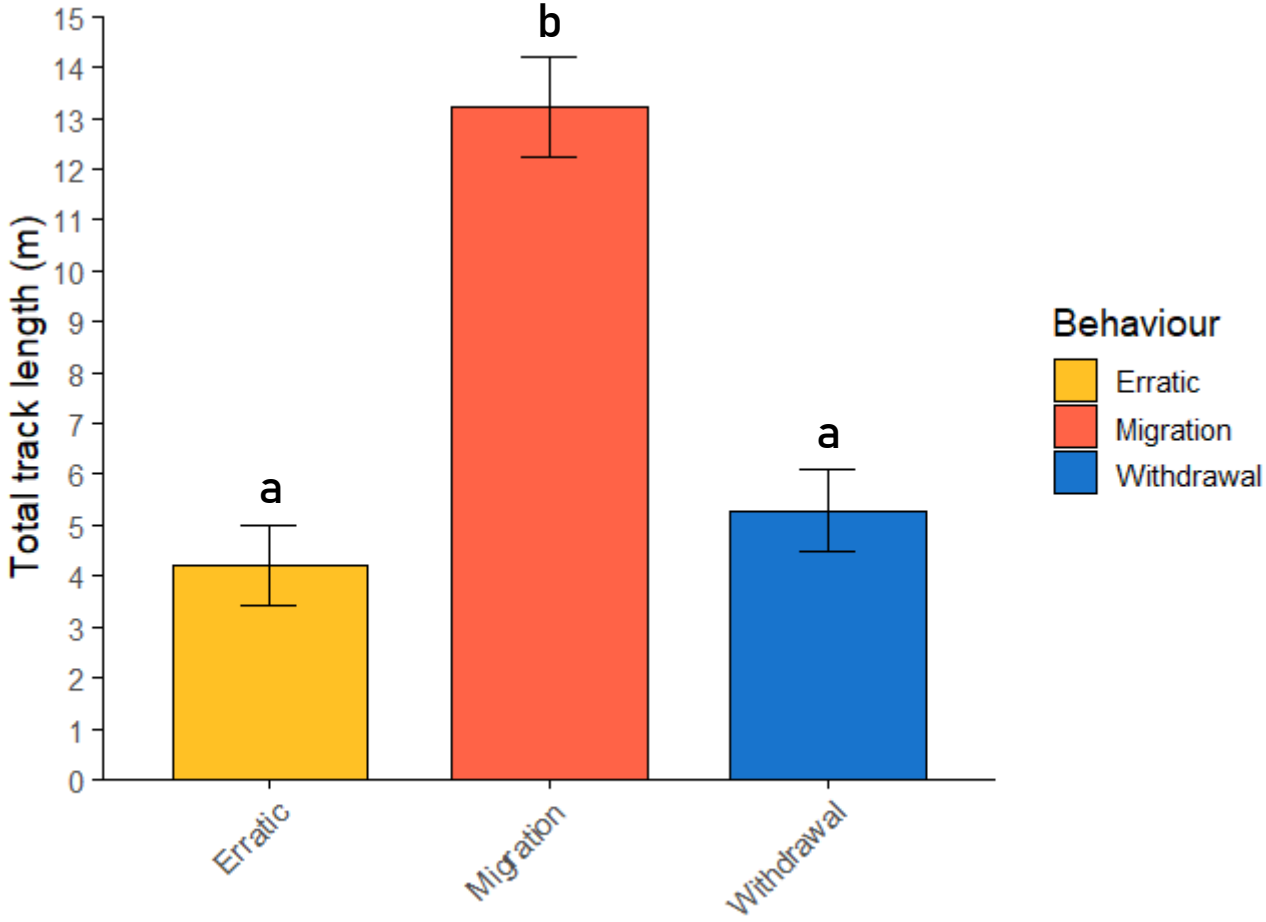


Total track length

Migration :
12.57 m (± 0.76)

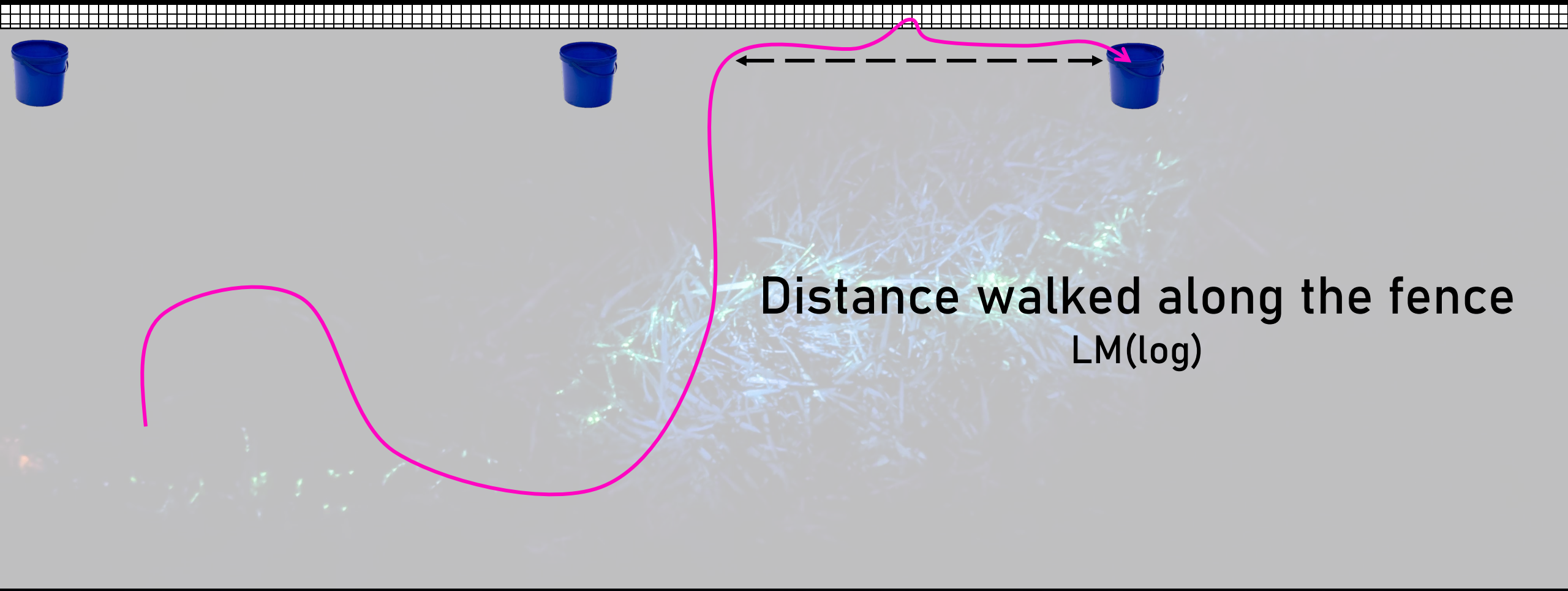
Erratic :
4.21 m (± 0.80)

Withdrawal :
5.29 m (± 0.80)



LMM(log), Anova : $p < 0.001$ (Tukey post hoc)

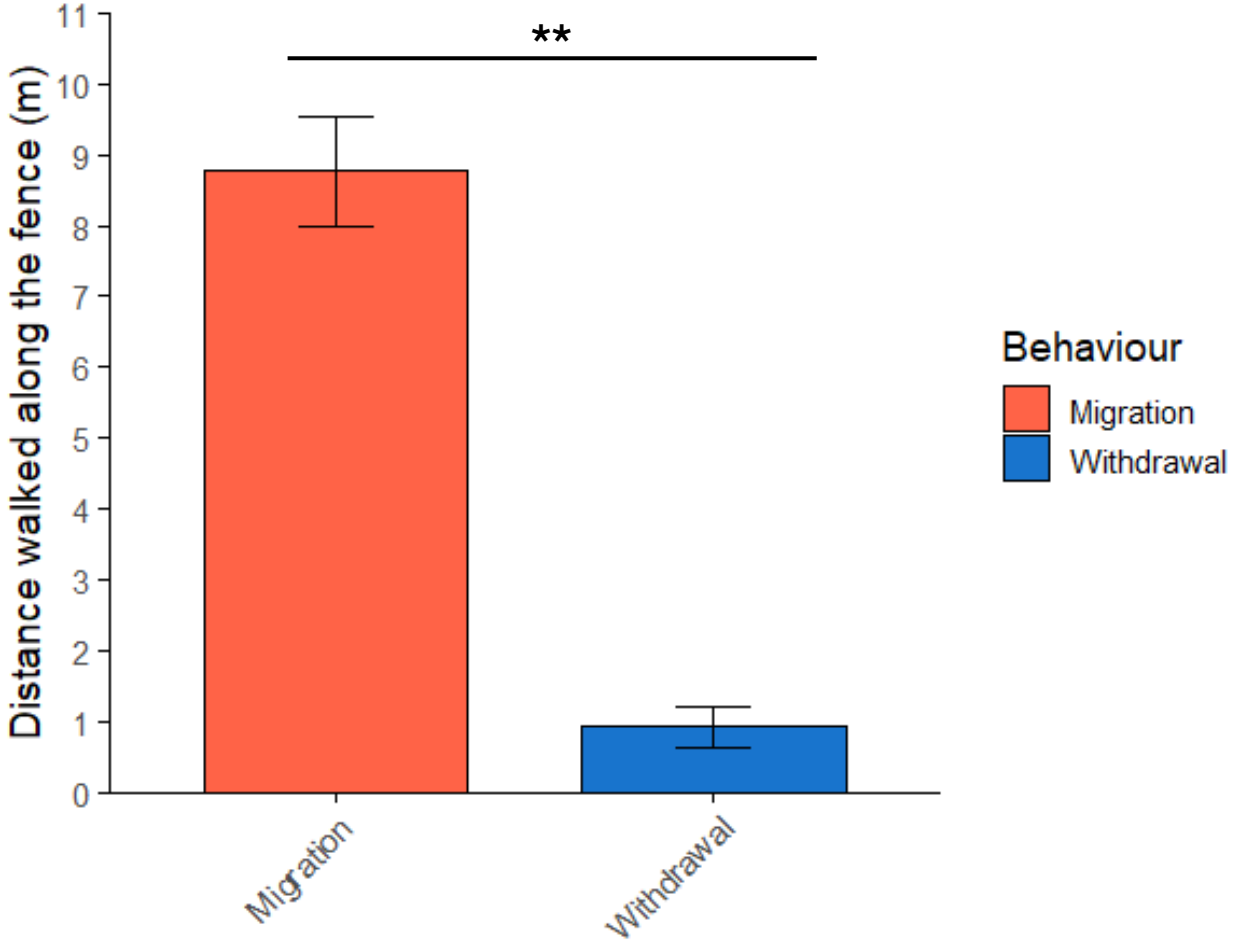
Distance walked along the fence



Distance walked along the fence

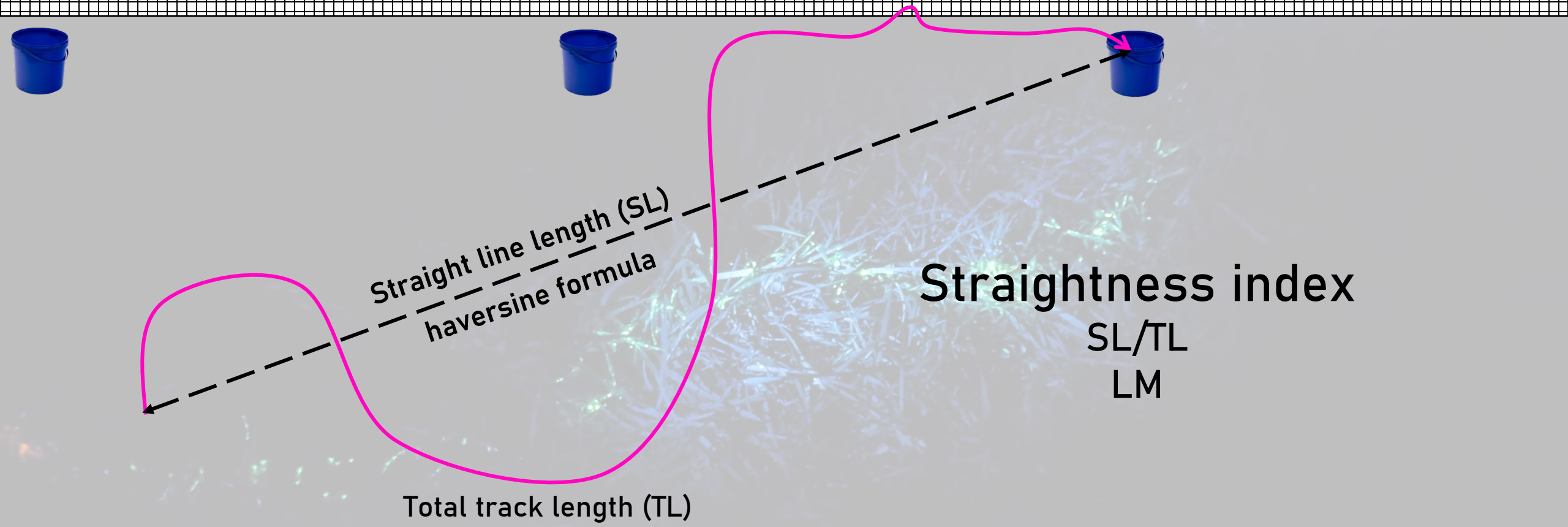
Migration :
8.76 m (± 0.77)

Migration withdrawal :
0.93 m (± 0.29)



LM(log), Anova : $p < 0.01$

Straightness



Straightness index

SL/TL

LM

Straightness

Erratic mouvement :

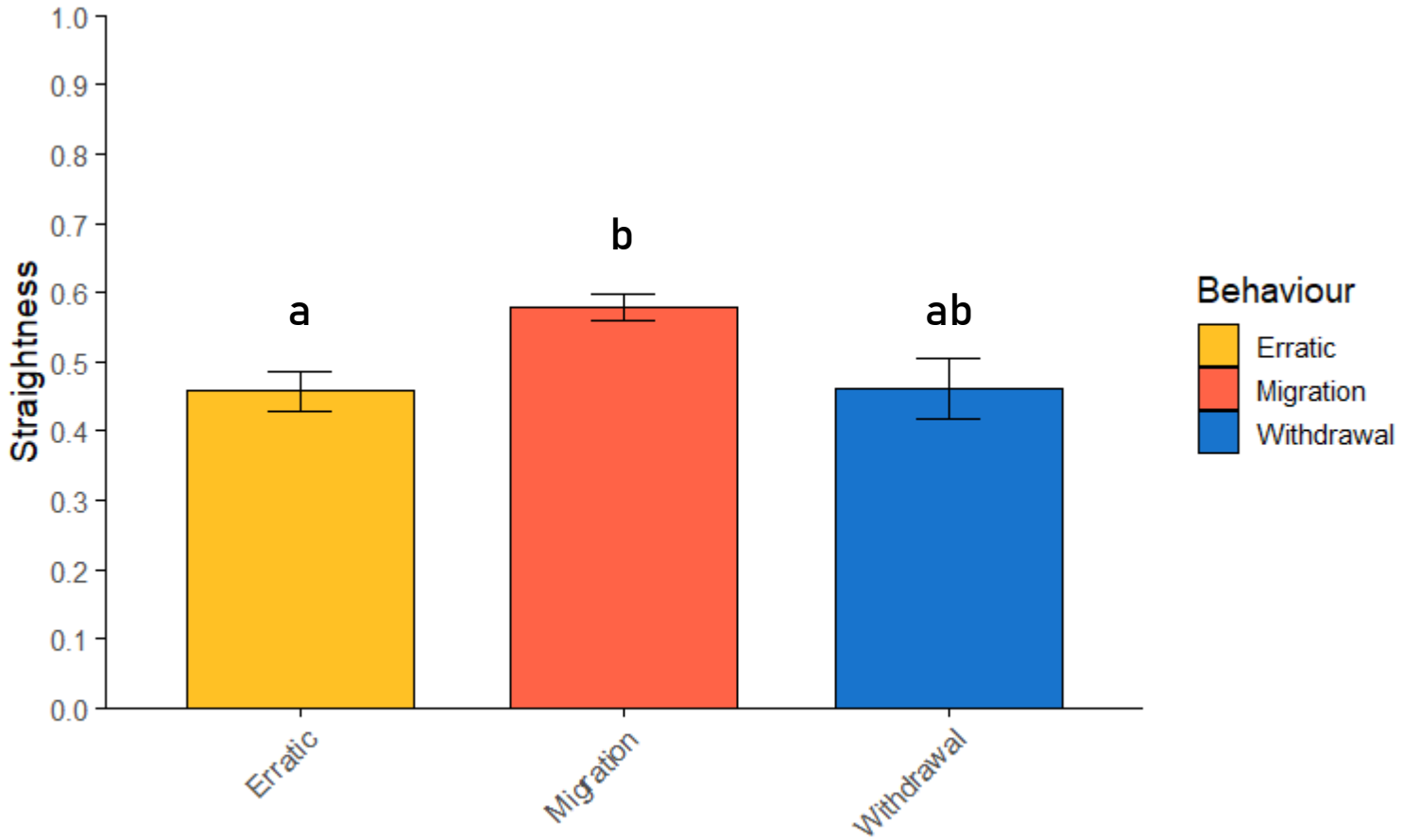
0.45 (± 0.03)

Migration :

0.58 (± 0.02)

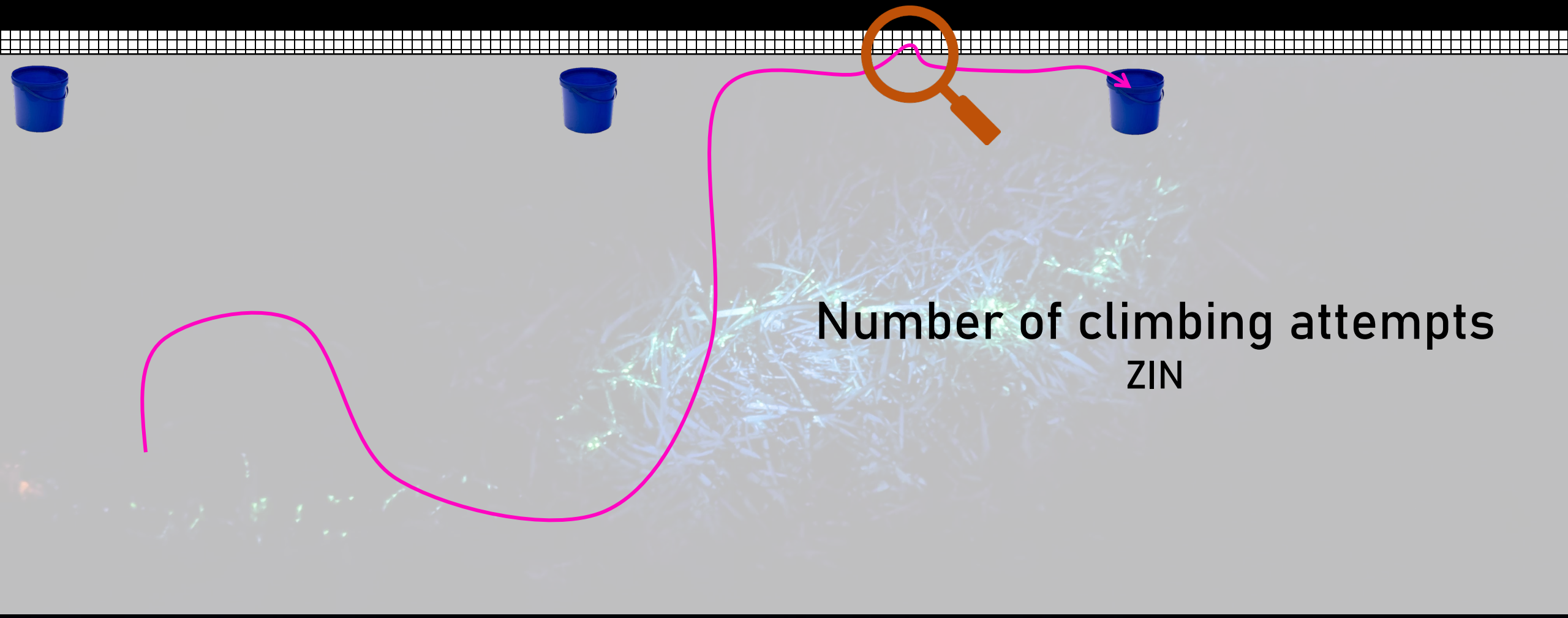
Migration withdrawal :

0.46 (± 0.04)



LM, anova : $p < 0.01$ (Tukey post hoc)

Climbing attempts

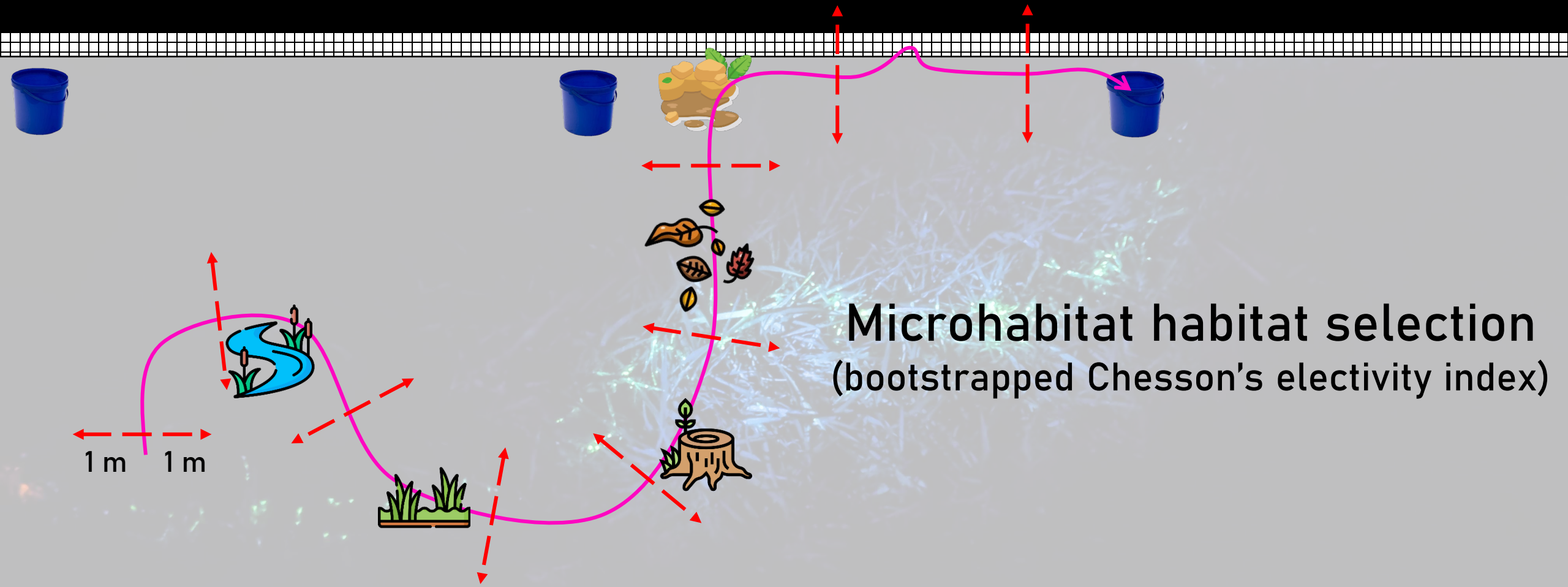


Climbing attempts

ZIN, anova p = 0.42

Mean climbing attempts : 2.68 (± 0.54)

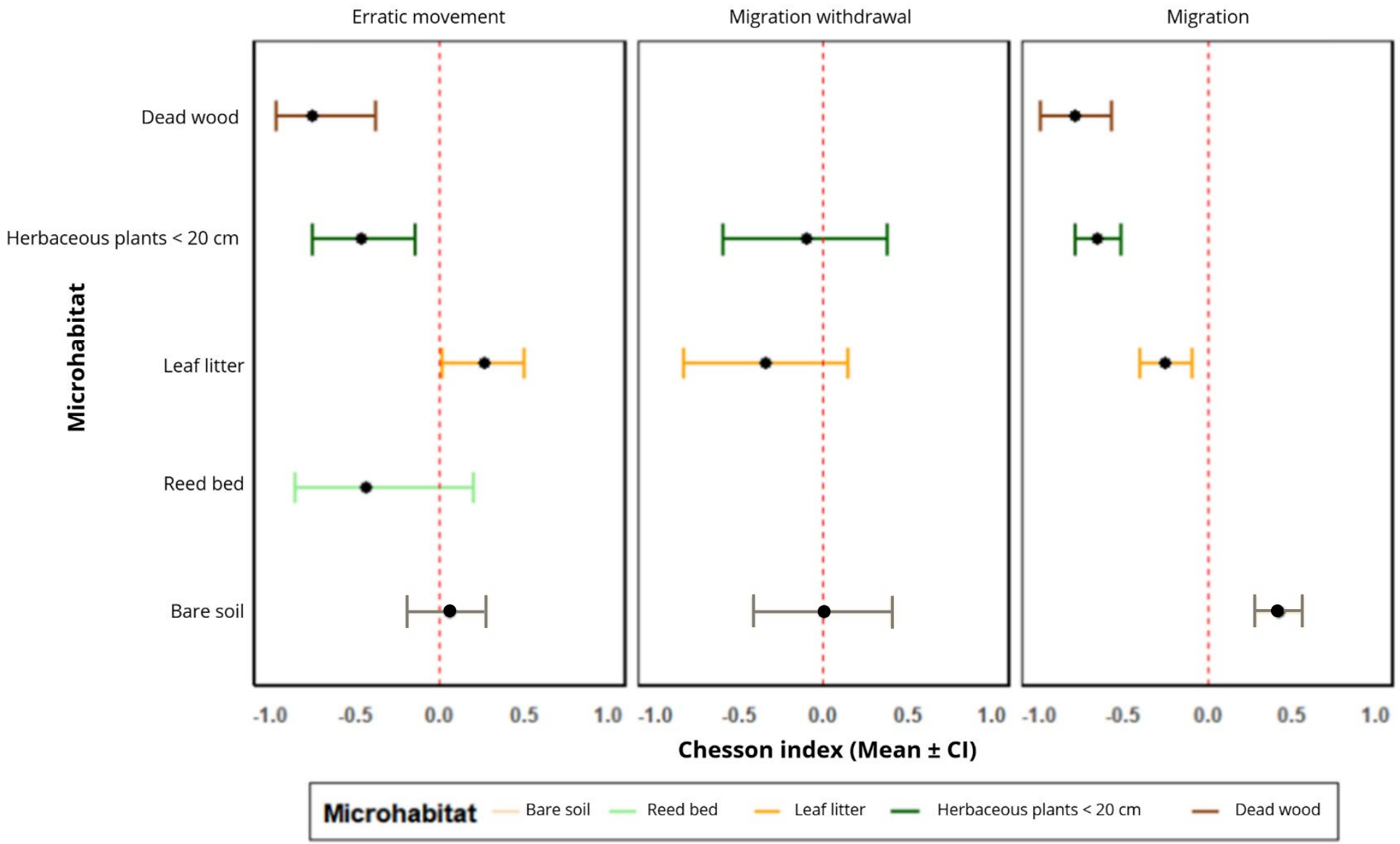
Microhabitats



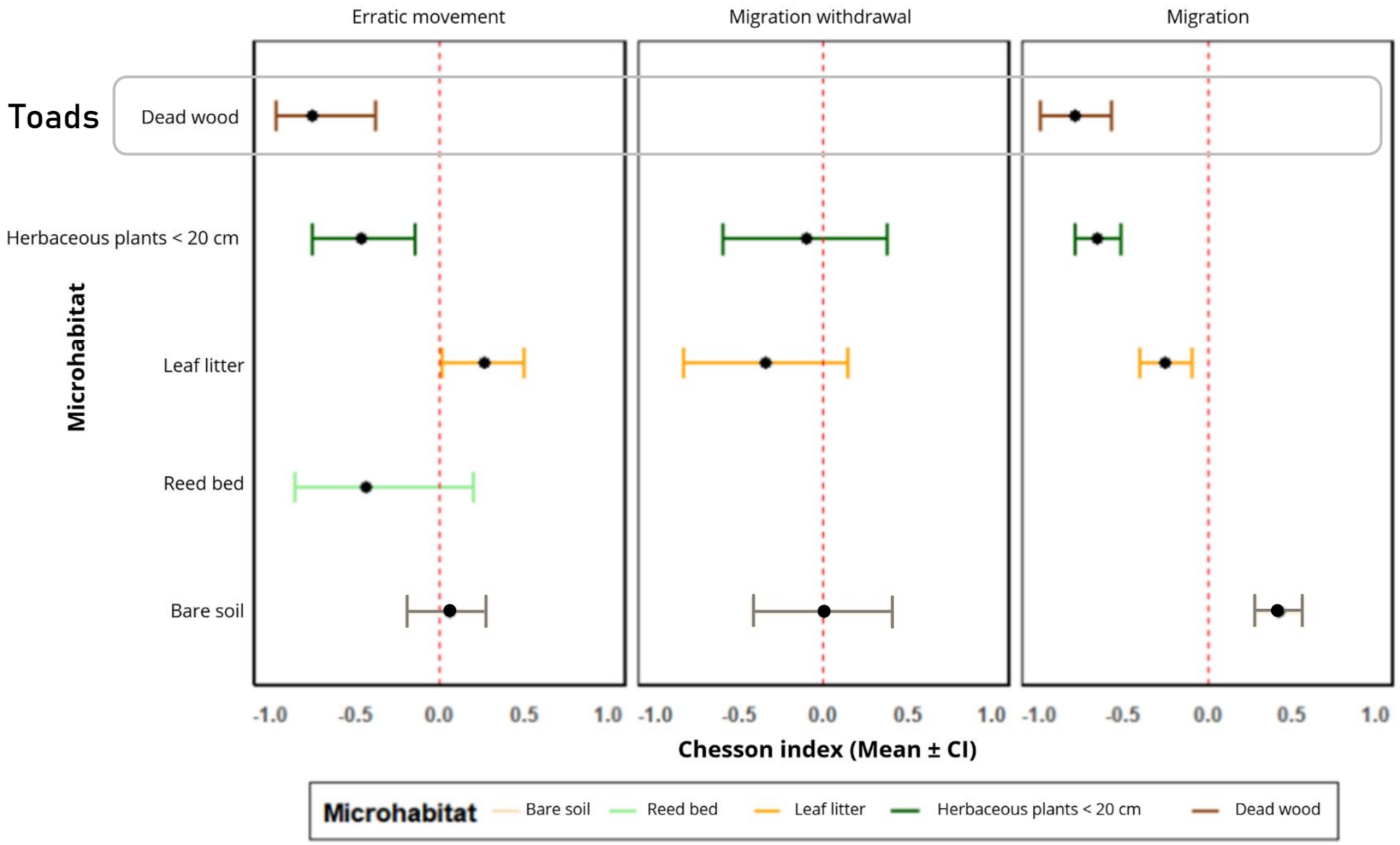
Microhabitat habitat selection

(bootstrapped Chesson's electivity index)

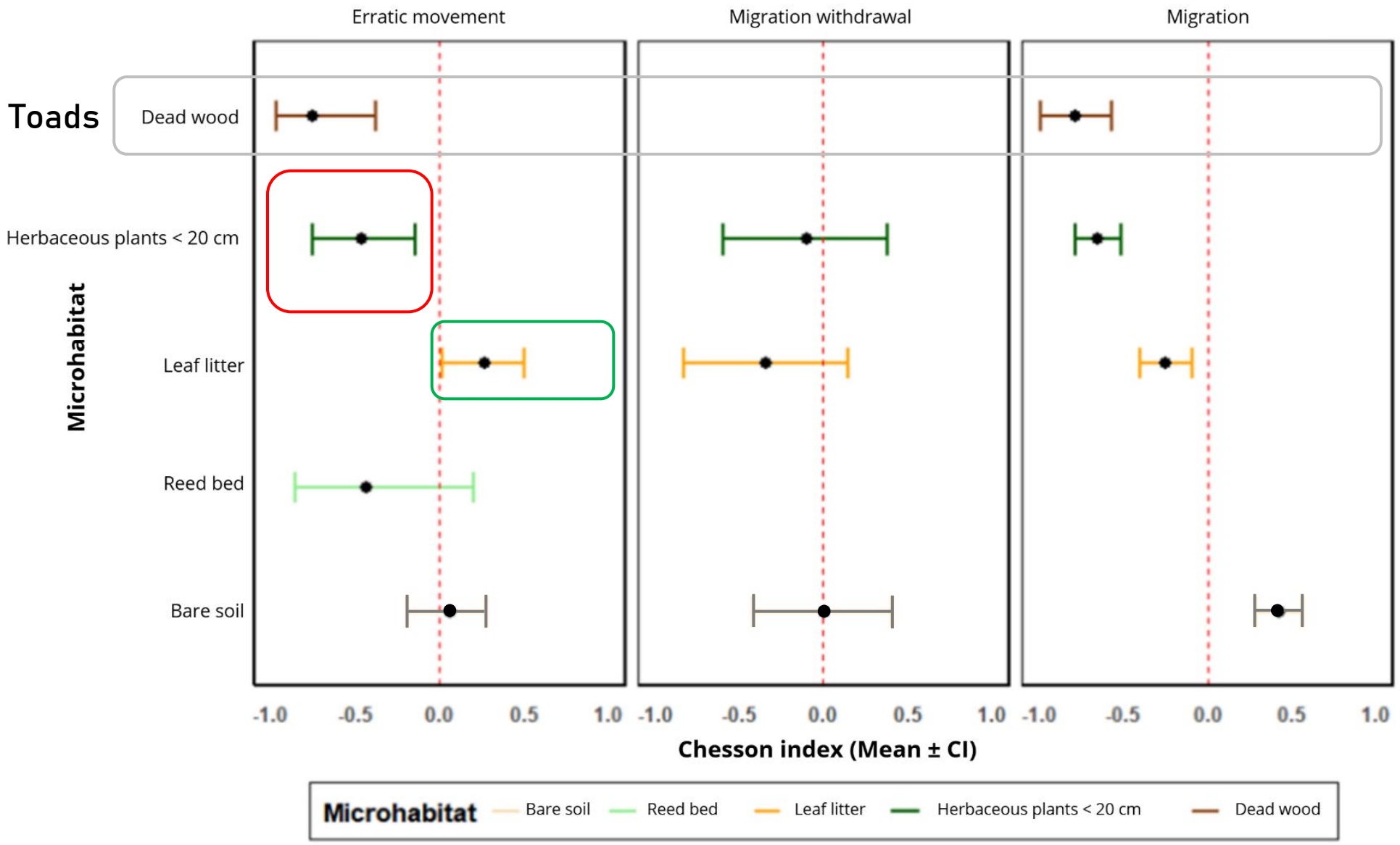
Microhabitats



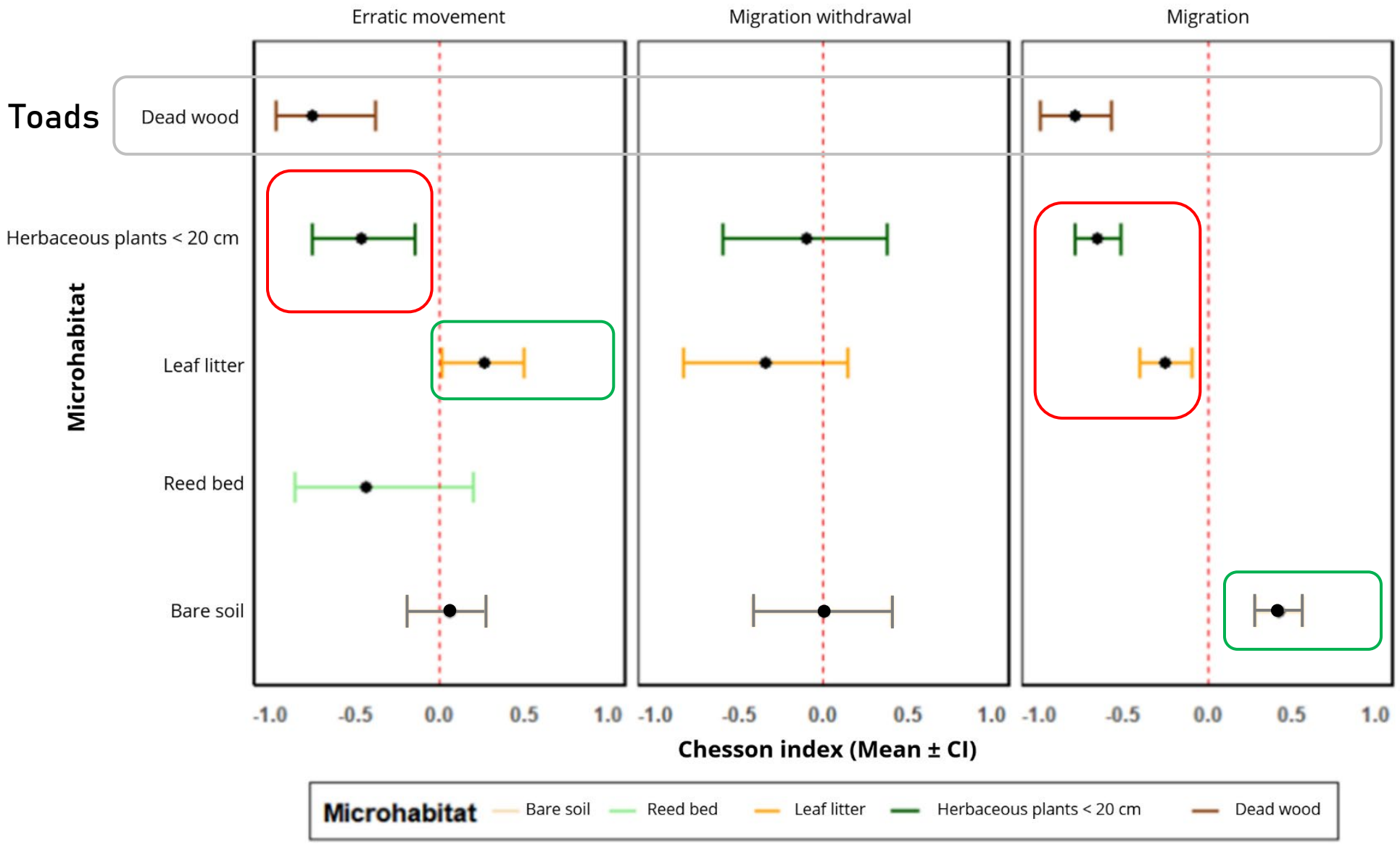
Microhabitats



Microhabitats



Microhabitats

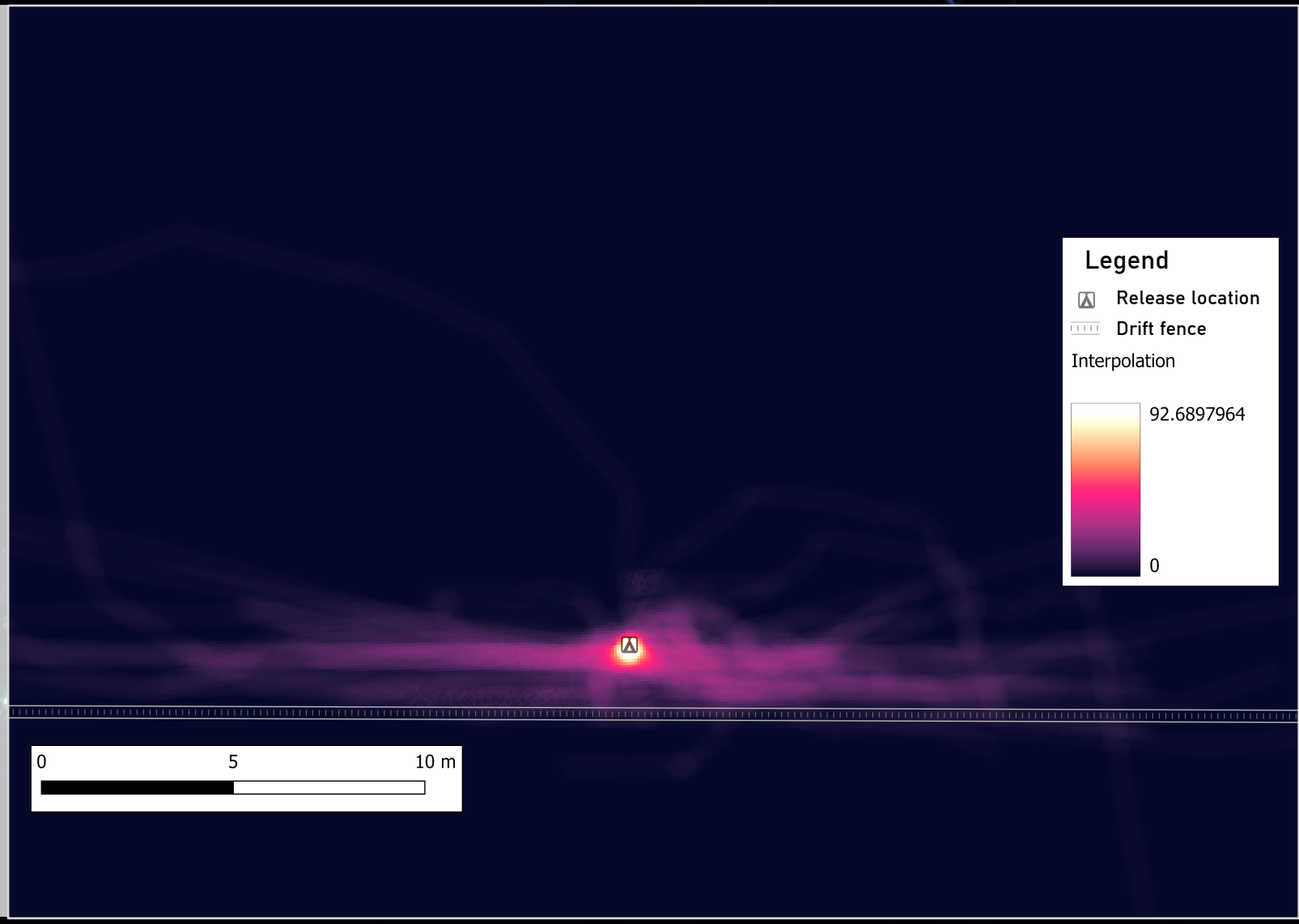


Stereotypical behaviours

Migration (n = 72)

- Long distances
- Higher straightness
- Selection of bare soil, avoidance of leaf litter

→ Stays at the fence

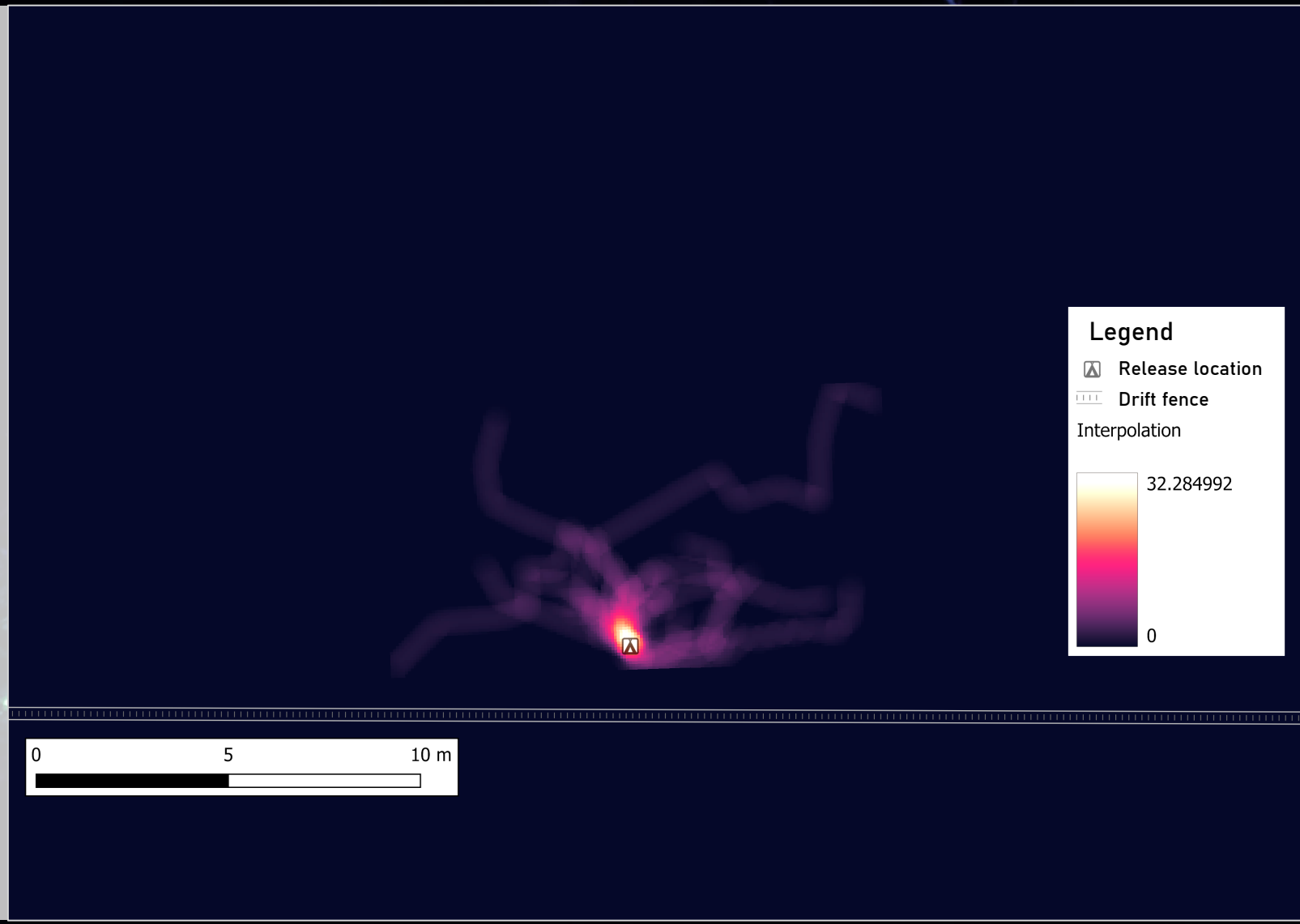


Stereotypical behaviours

Erratic mouvement
(n = 22)

- Selection of leaf litter

→ Foraging for food or shelter

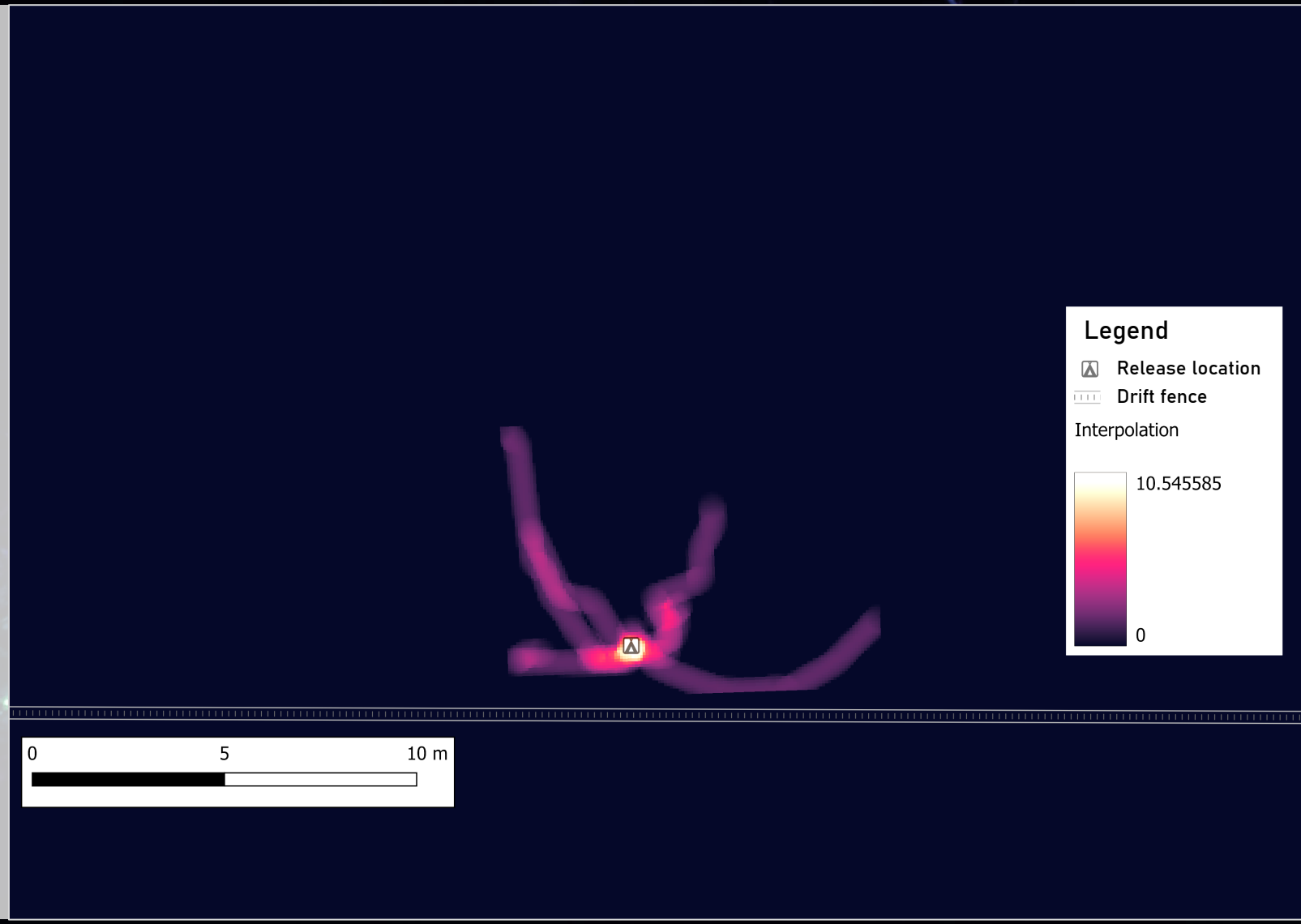


Stereotypical behaviours

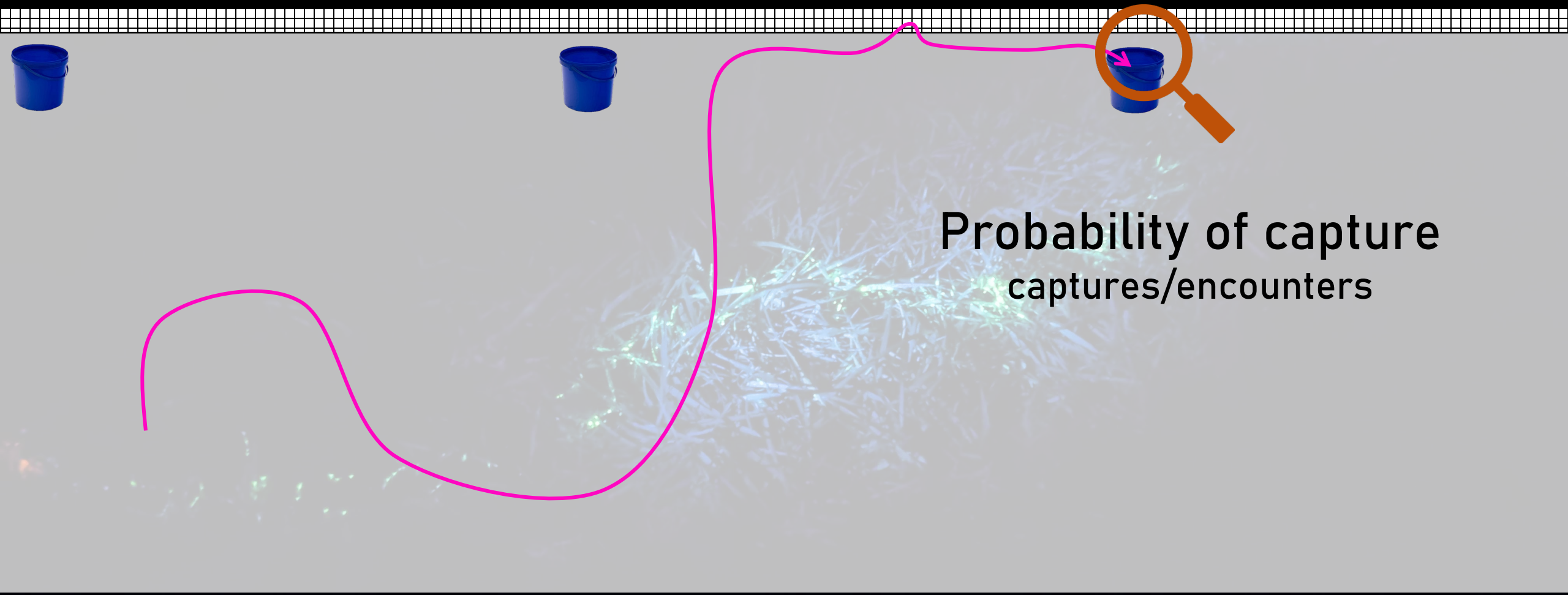
Migration withdrawal (n = 9)

- Rapid withdrawal

→ Lack of motivation



Capture probability



Probability of capture

captures/encounters

Capture probability

Capture probability

11 % of individuals confronted to a captation device avoided it

→ 1 captation device : 0.89

→ 2 captation devices : 0.99

Special notice

Lack of overhang

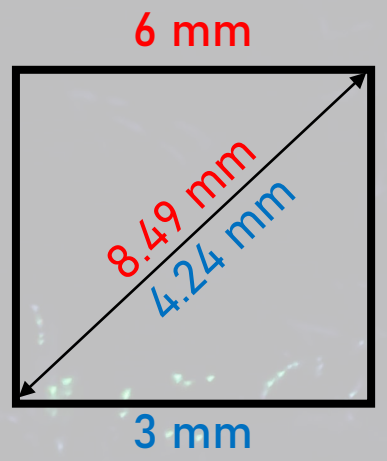
Special notice

Newts getting stuck in wire meshing (6 mm)

Special notice

Newts getting stuck in wire meshing (6 mm)

Mean head width of *L. helveticus* :
Females = 7,6 mm
Males = 6,8 mm
(Bettencourt-Amarante *et al. 2024)*



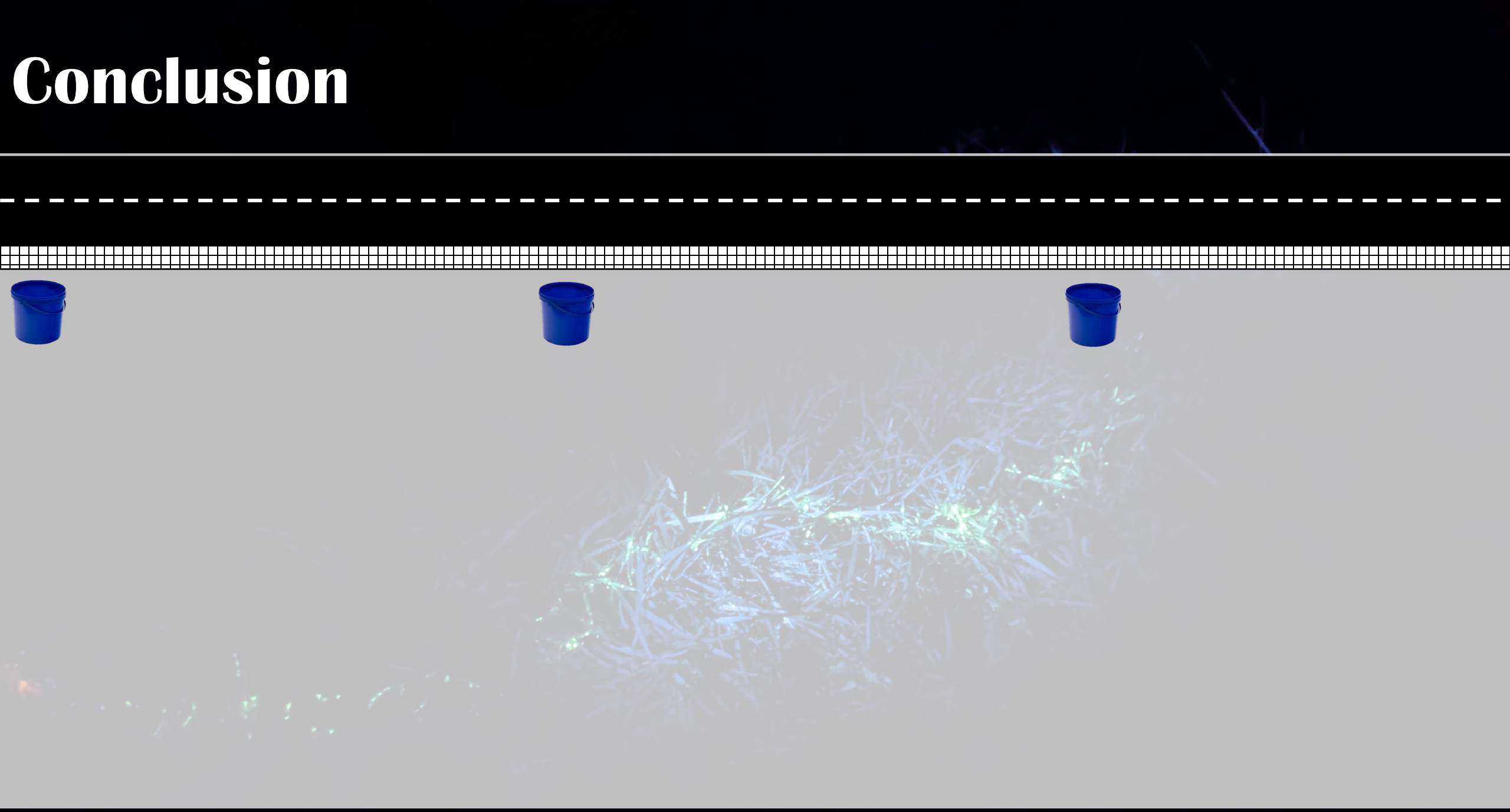
Special notice

Fence not properly burried

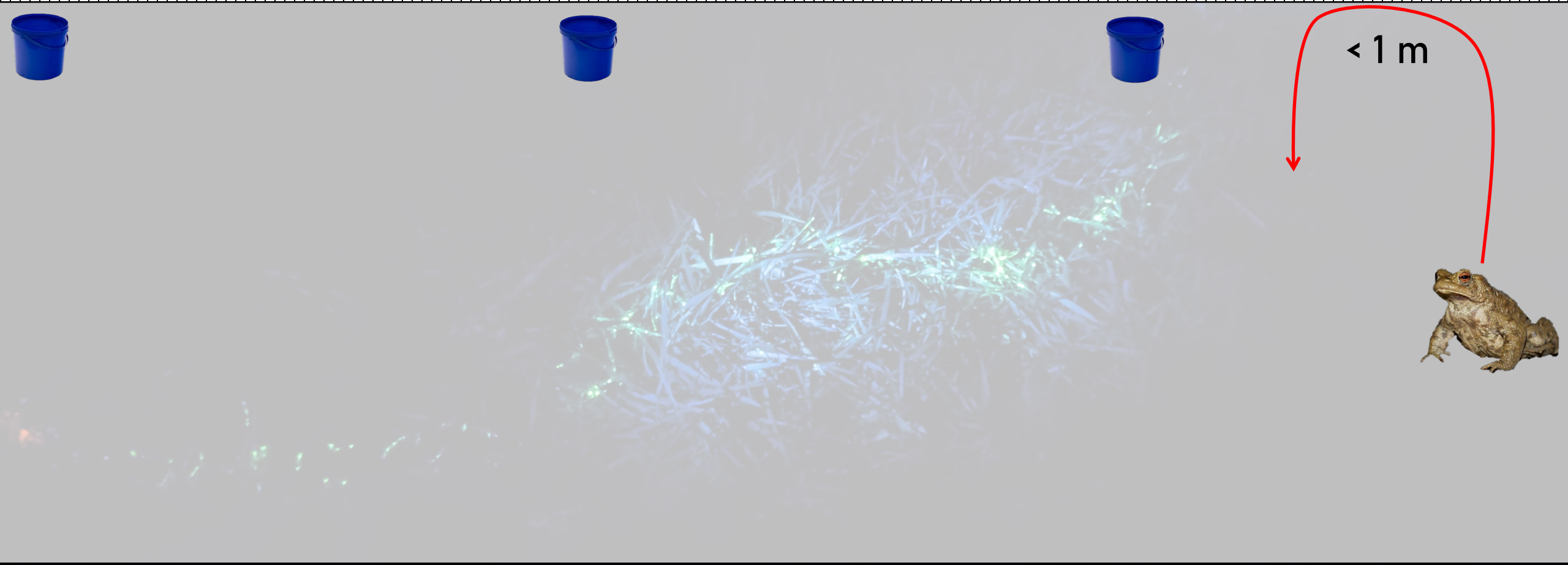
Special notice

Poorly placed captation device

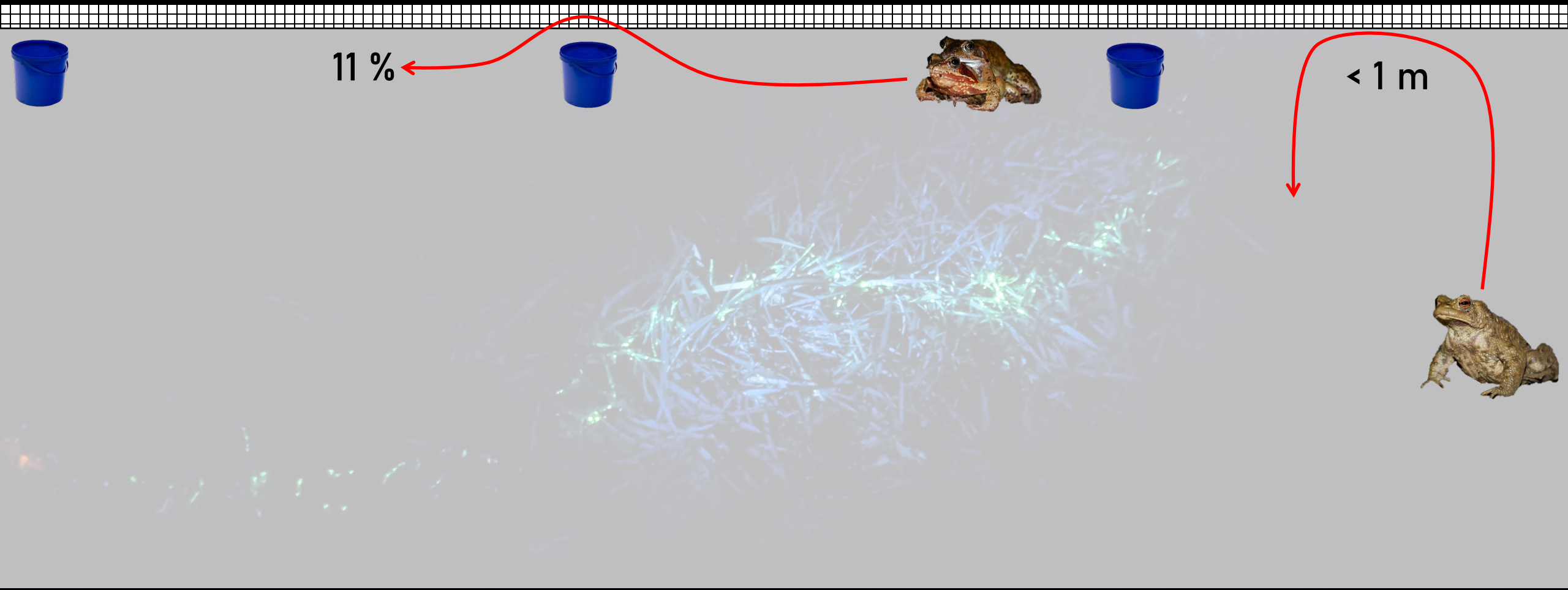
Conclusion



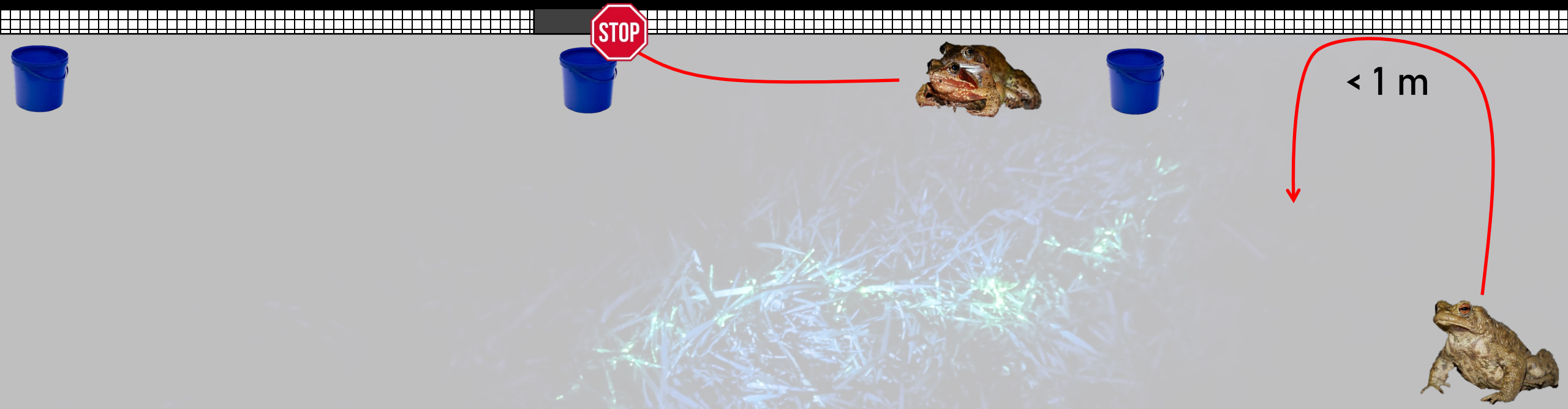
H1 - Migration Withdrawal



H2 - Captation device avoidance

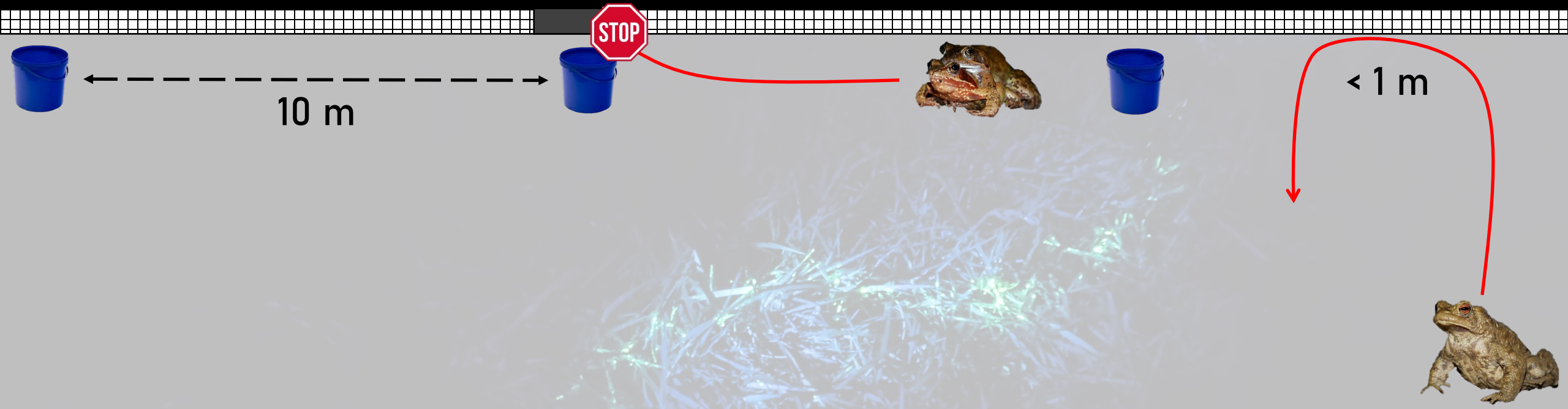


H2 - Captation device avoidance



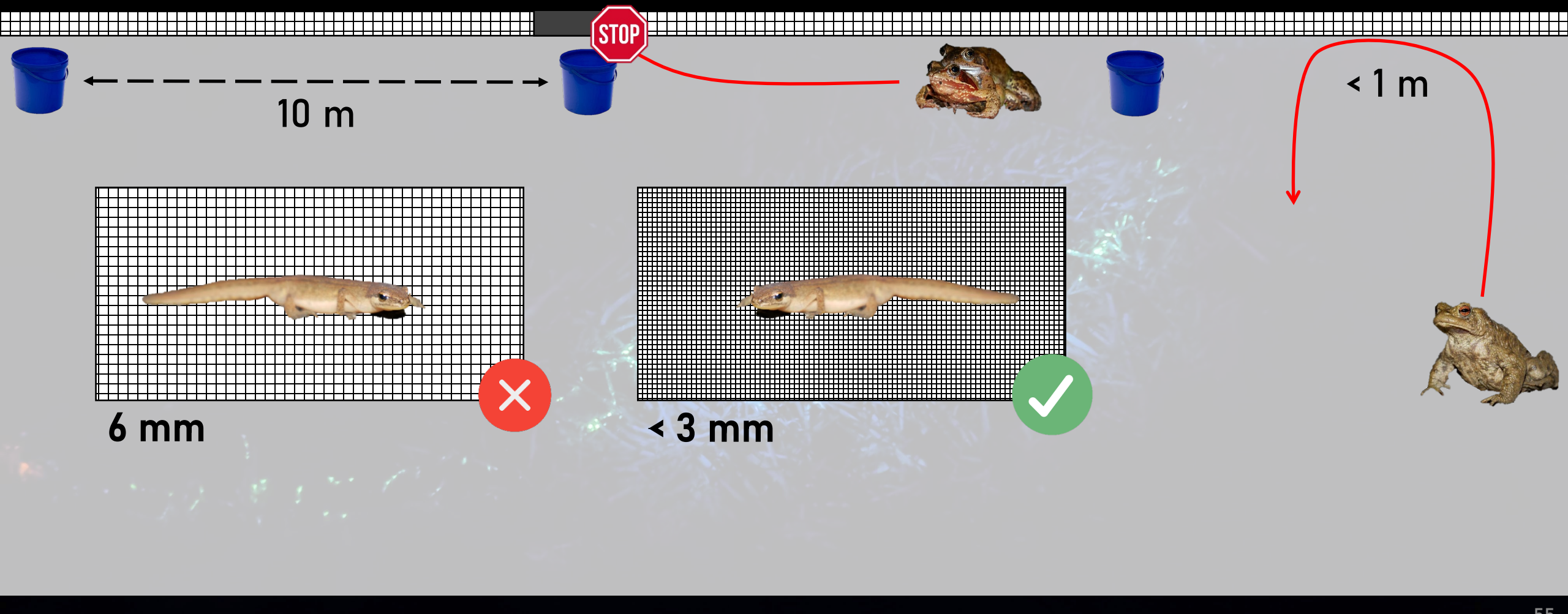
Use plastic/metal plates to prevent climbing

H3 - Captation device spacing

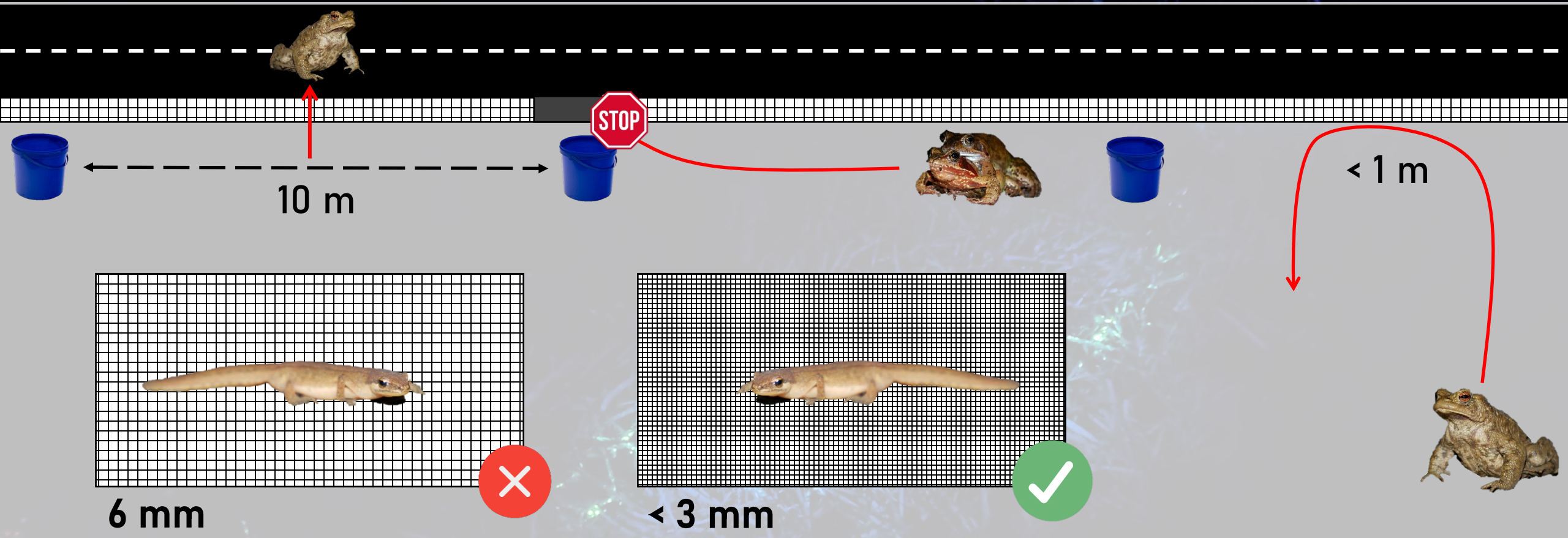


Assures atleast a 0.89 probability of capture

Bonus - Mesh size



Bonus - Structural guidelines



Common structural advices should be followed

Thank you for your attention !

And special thanks to :

Cécile SORIANO
Clara TANVIER
Mila WITCHER
Bleuenn LE BORGNE
Pierre LEMBRE
Tistou LUISIERE
Magnus MAGNARD
Lucas DURY

For their help in the field !

Meven Le Brishoual

Behaviour categorisation

Convert segment lenght & bearings into coordinates

$$\varphi_x = \varphi_0 + (\sin\theta \cdot d)$$
$$\lambda_x = \lambda_0 + (\cos\theta \cdot d)$$

With :

φ_x : the unknown longitude

φ_0 : the longitude of the last coodinates

θ : the segment bearing

d : the segment length

λ_x : the unknown lattitude

λ_0 : the lattitude of the last coordinates

Haversine formula

$$D = 2r \cdot arcsin\left(\sqrt{sin^2\left(\frac{\varphi_2 - \varphi_1}{2}\right) + \cos\varphi_1 \cdot \cos\varphi_2 \cdot sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right)$$

With :

r : Earth's radius

φ_1, φ_2 : the lattitude of points 1 and 2

λ_1, λ_2 : the longitude of points 1 and 2

Statistical analyses

Controlling for suitable tests :

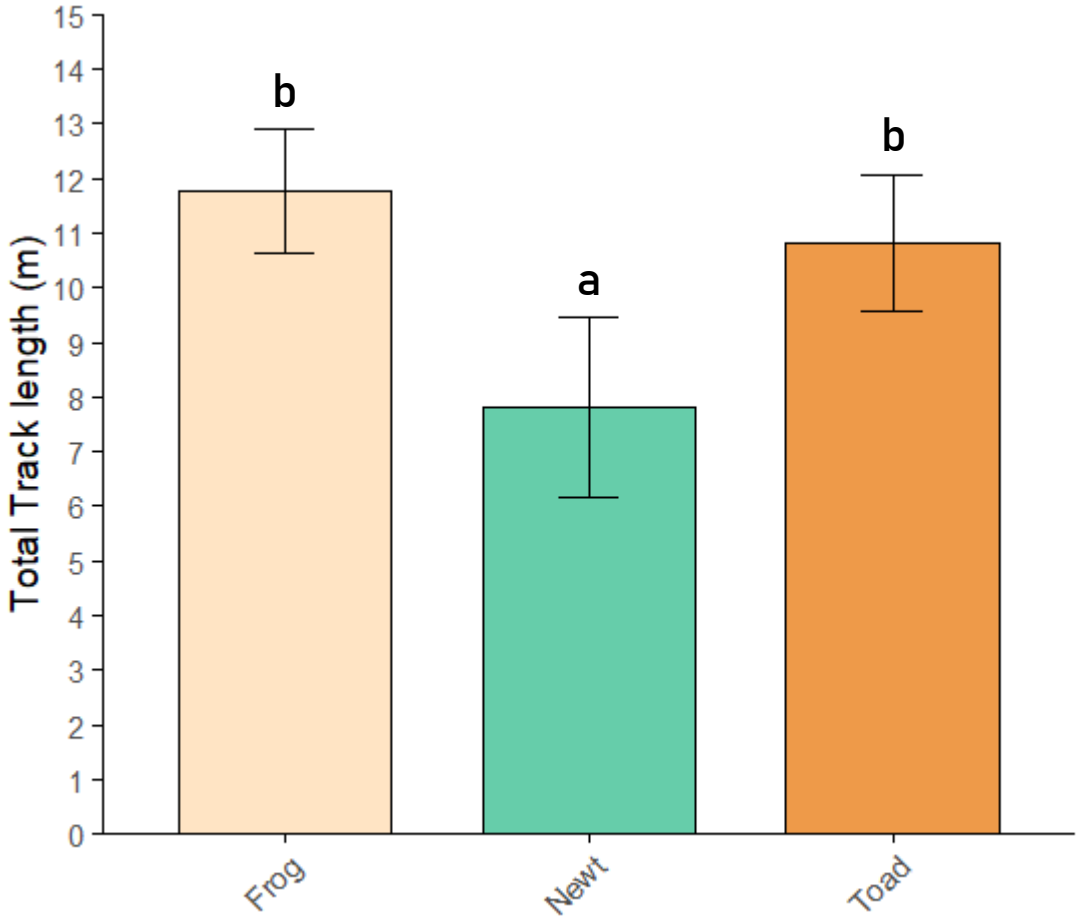
- No effect of paint colour, or sex → discarded for further analyses
- Impact of taxa on track length → LMM
- Frogs didn't withdraw → discarded when taxa had an effect
- Climbing, migration vs withdrawal : toads only

Taxa - track length

: 11.77 m (± 1.15)

: 7.82 (± 1.65)

: 10.83 (± 1.25)

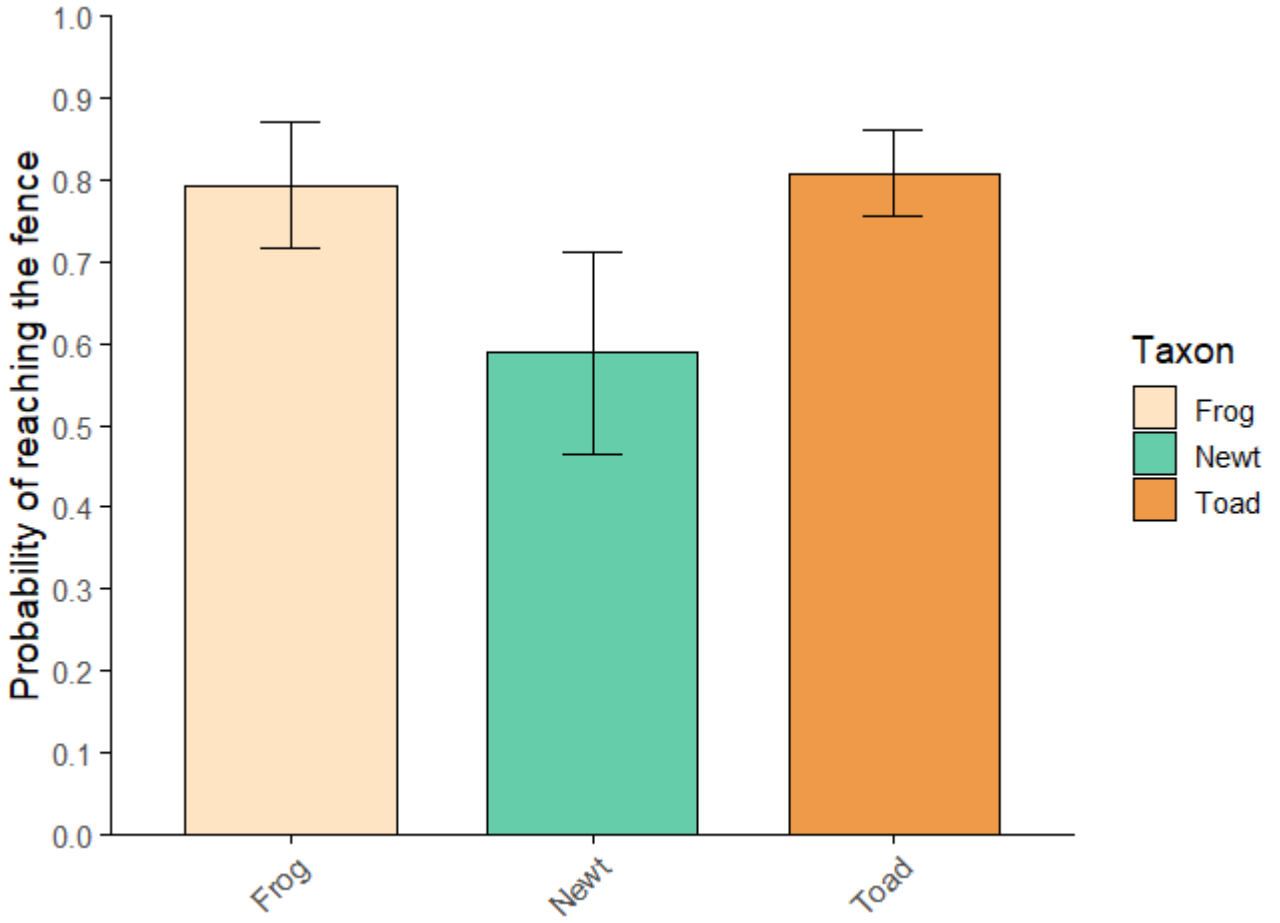


LM(log), Anova : $p < 0.01$ (Tukey post hoc)

Taxa - reaching the fence

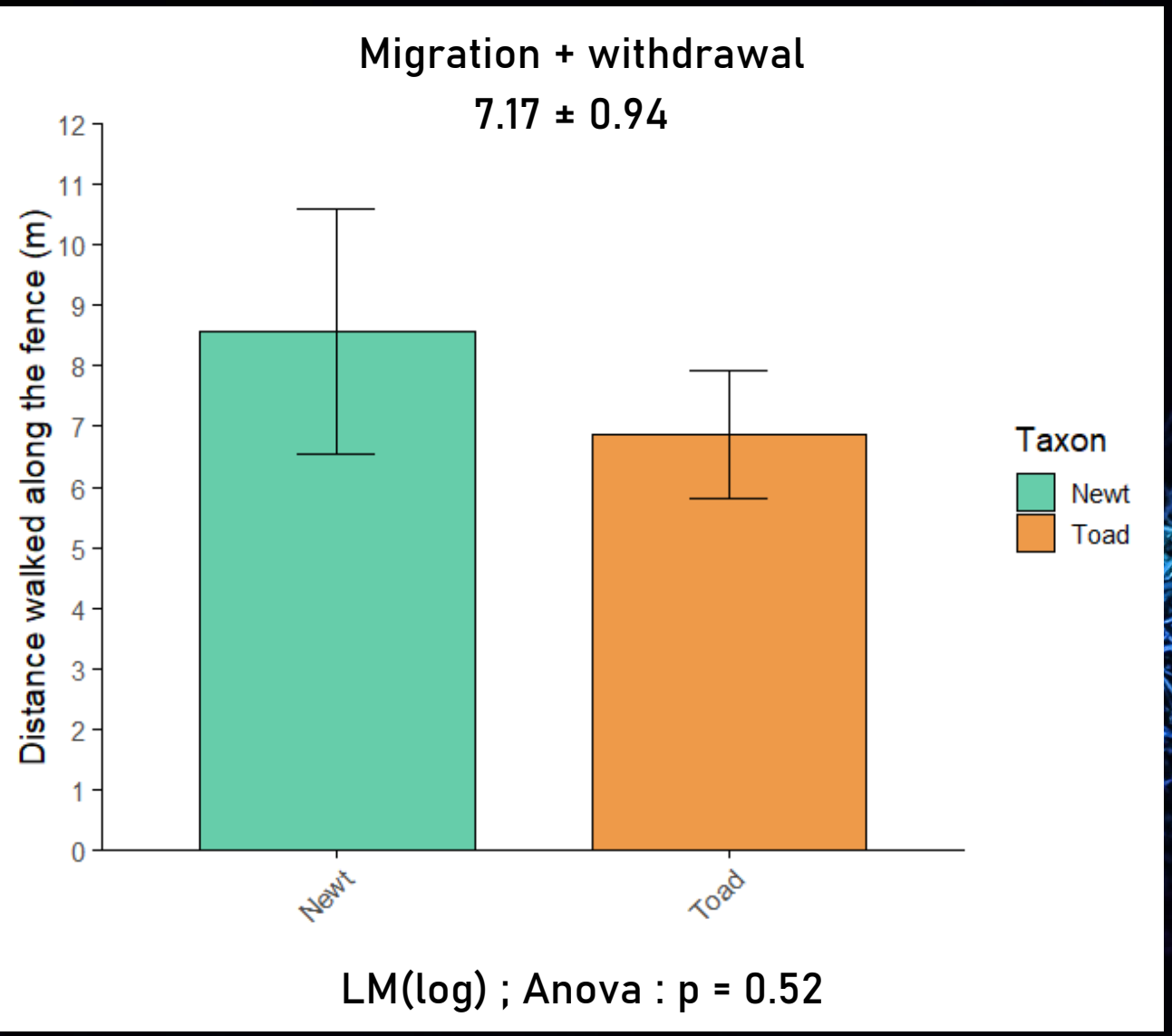
Probability of reaching the fence :

0.77 (± 0.04)



GLM, Anova : p = 0.19

Taxa - distance walked along the fence

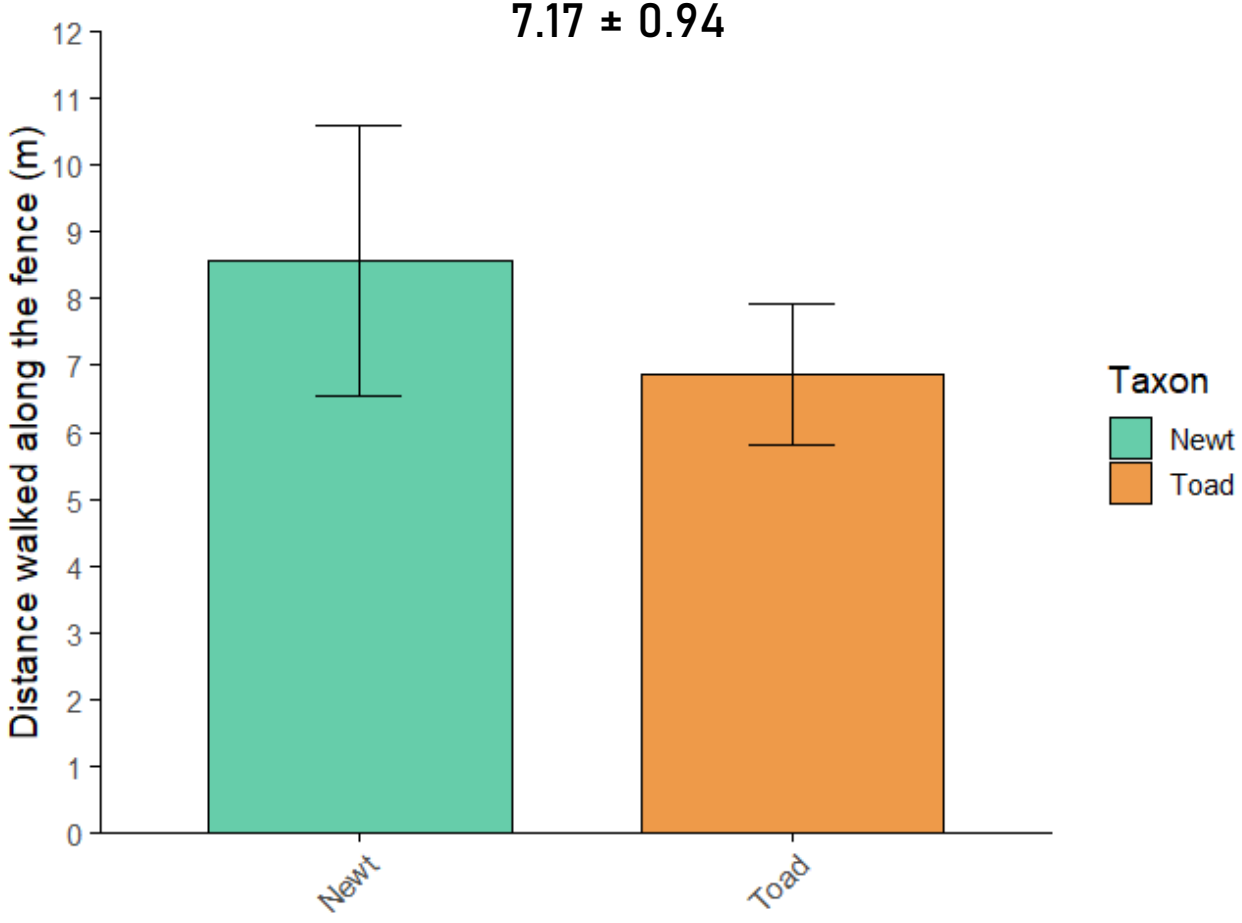


LM(log) ; Anova : p = 0.52

Taxa - distance walked along the fence

Migration + withdrawal

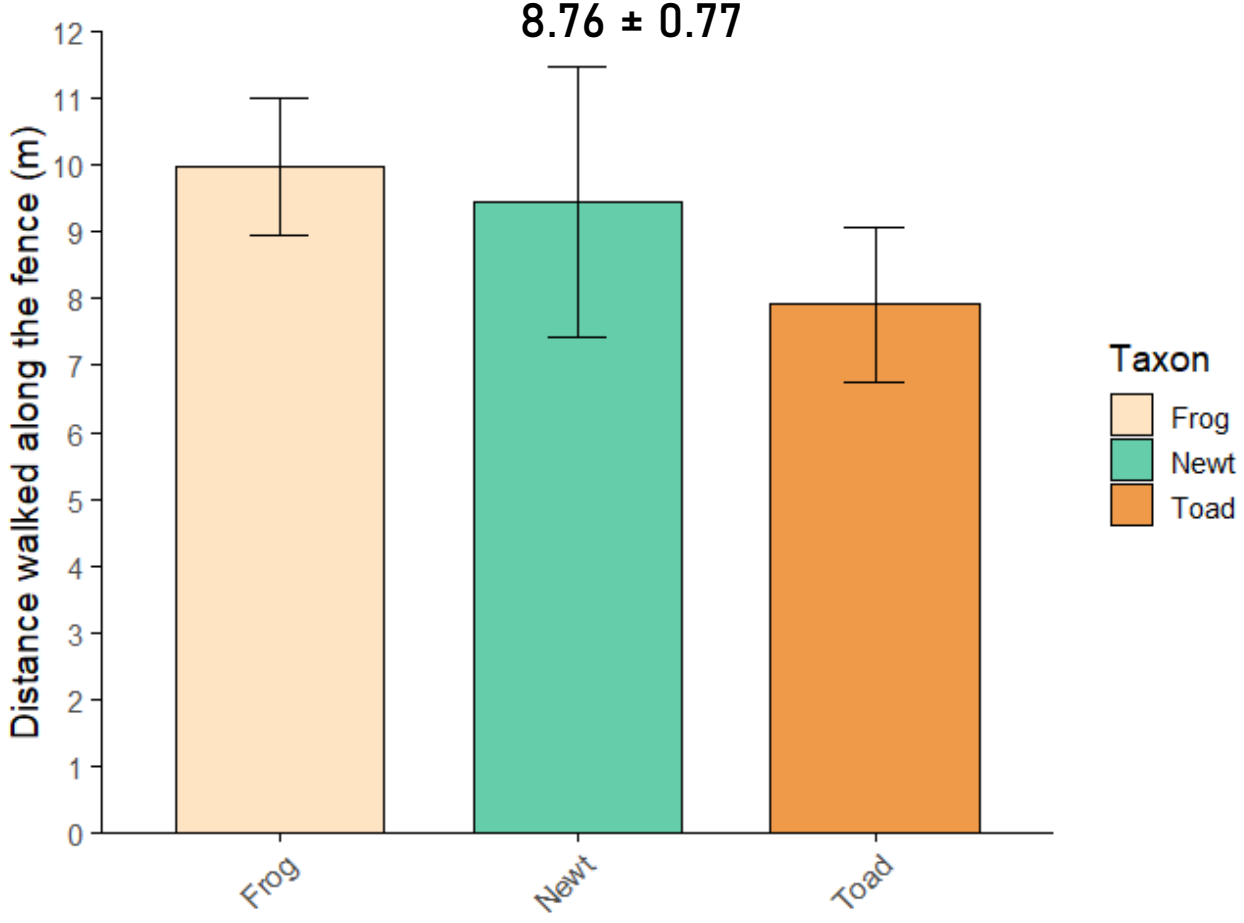
7.17 ± 0.94



LM(log) ; Anova : p = 0.52

Migration only

8.76 ± 0.77

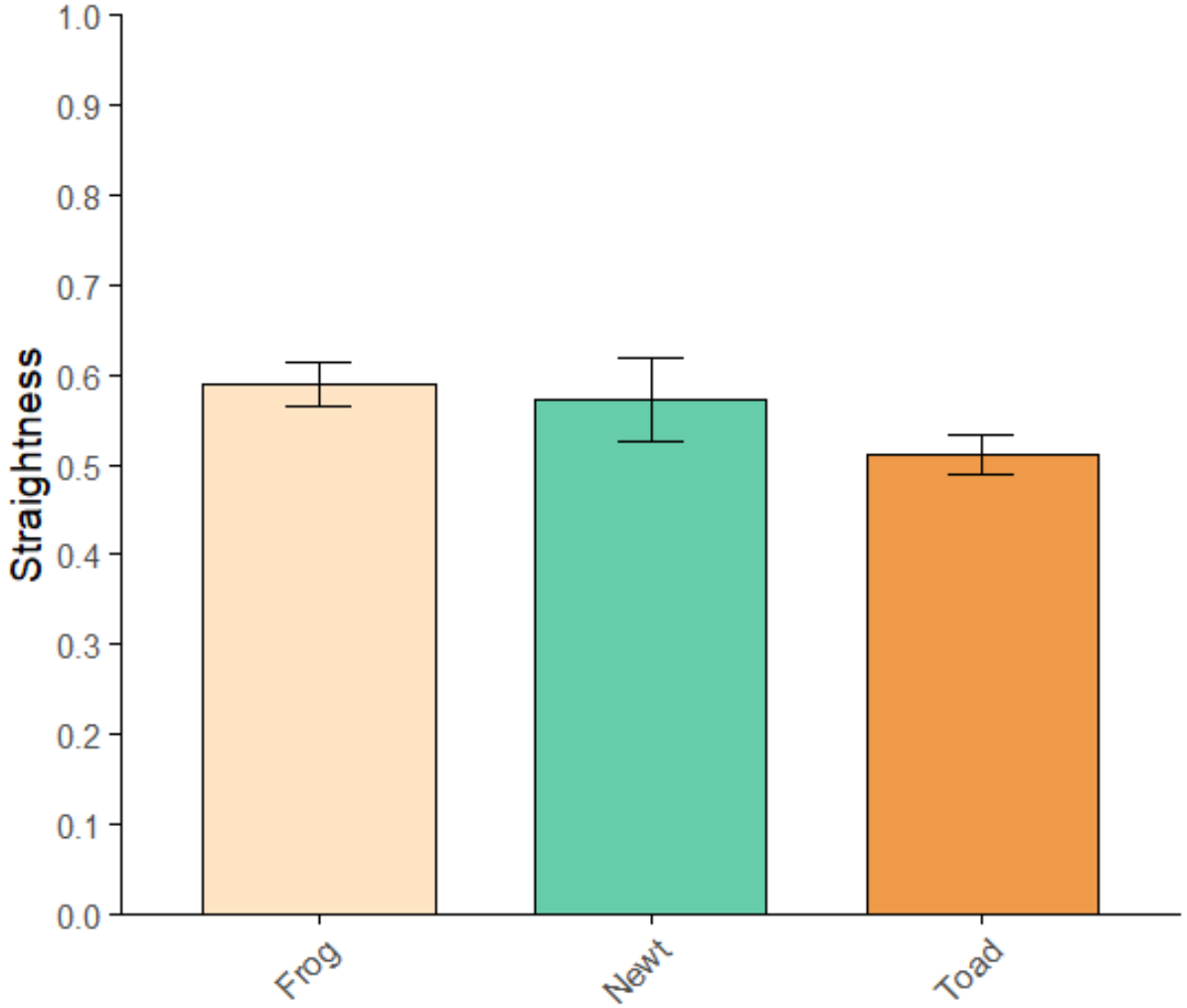


LM(log) ; Anova : p = 0.10

Taxa - straightness

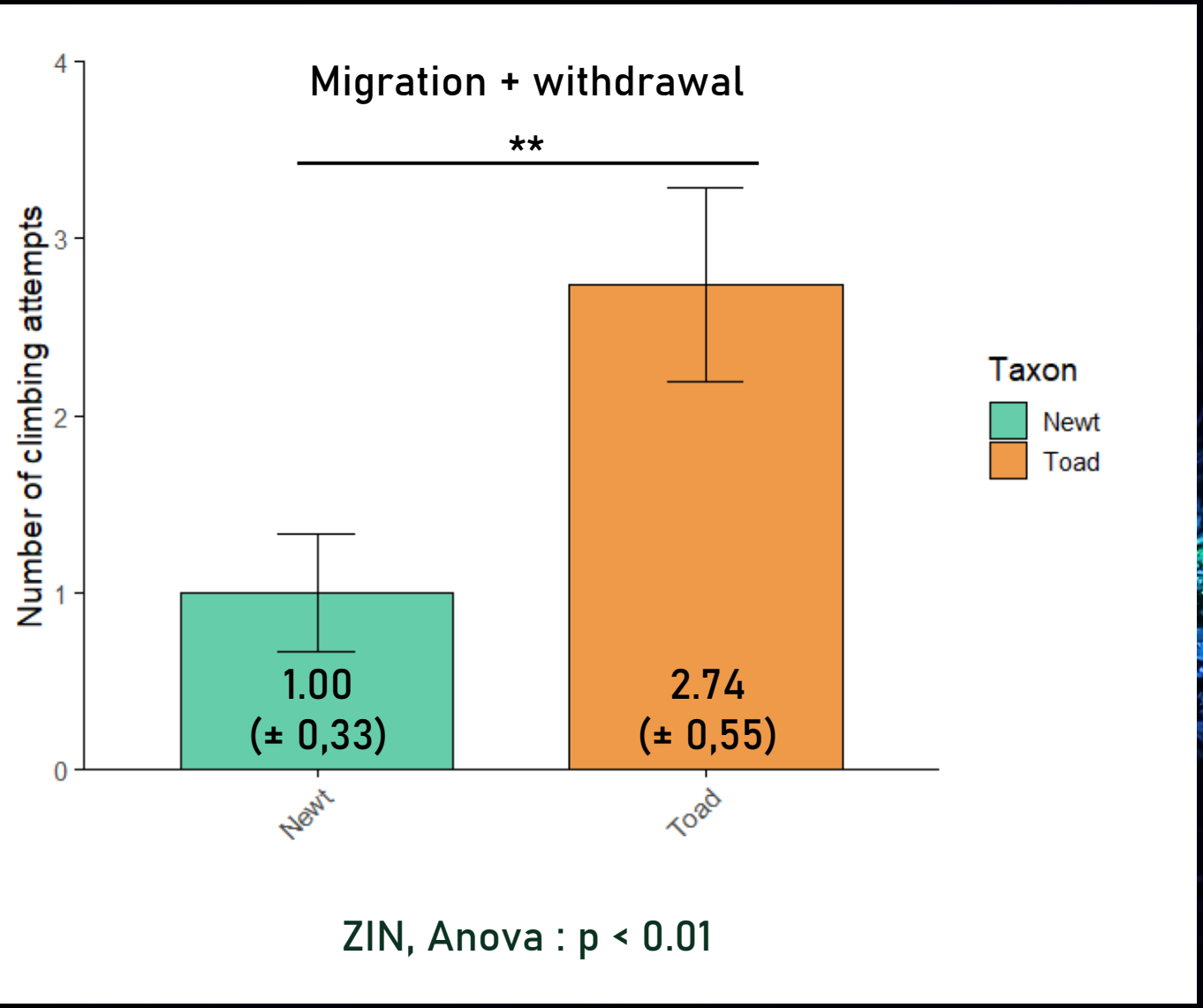
Mean straightness :

0.54 (± 0.02)



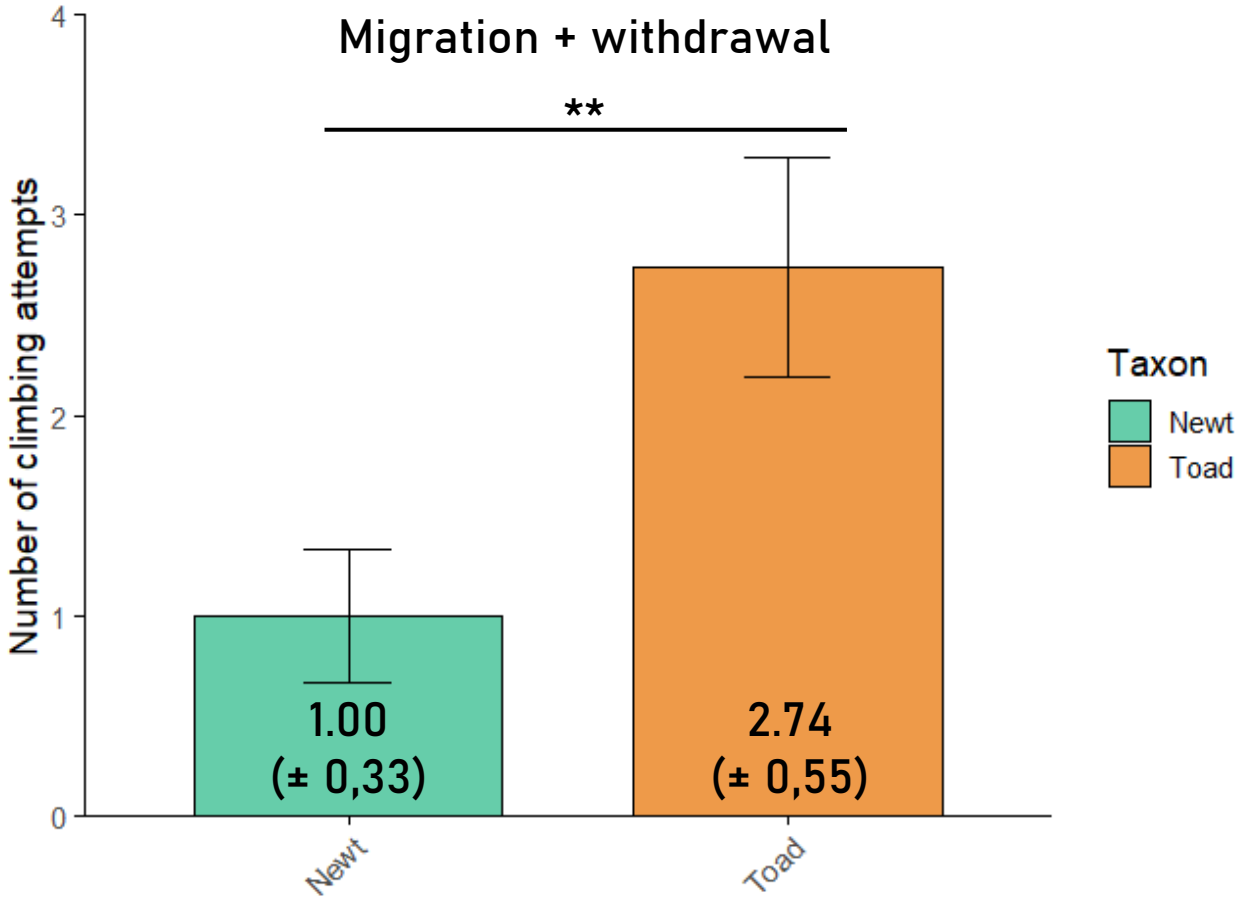
LM ; Anova : p = 0.08

Taxa - climbing attempts

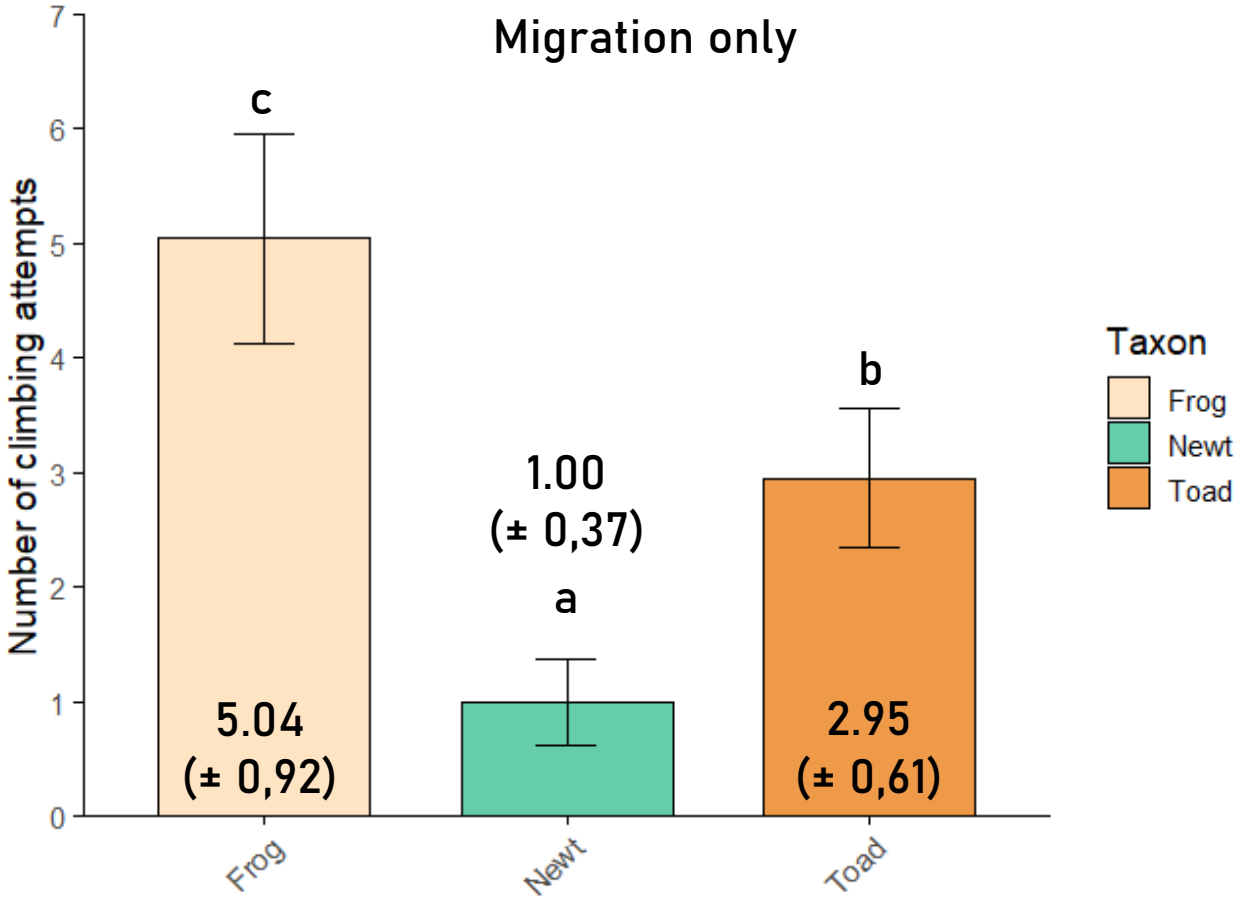


ZIN, Anova : p < 0.01

Taxa - climbing attempts



ZIN, Anova : p < 0.01



ZIN, Anova : p < 0.05 (Tukey post hoc)

Taxa - microhabitats