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Inovace studia hydrobiologických disciplín s důrazem na rozšíření možností uplatnění absolventů biologických oborů PřF UP v praxi.

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Effect of substratum drying on the survival and migrations of bottom fauna

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Our main project team

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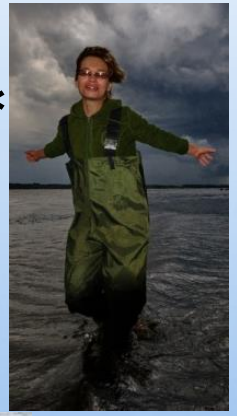

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Introduction

Transitional zones between land and water can be inhabited by very diverse and abundant bottom fauna. In that case such a zone is called an **ecotone zone**. Studies on bottom fauna in ecotone zones are missing in scientific literature.

Water level fluctuations are the most important factor for the fauna which inhabiting land-water transitional zones as well as near-shore zones of water bodies.

The impact of water level changes depends on:

- their range
- duration time
- regularity
- frequency
- season
- bottom type

http://www.panoramio.com/photo/3290764

Introduction

Water level fluctuations are especially common in temporary waters as well as in dam reservoirs and rivers.

http://serc.carleton.edu/eslabs/drought/4a.html

Drying lakes in California

http://www.suncitynews.com.au

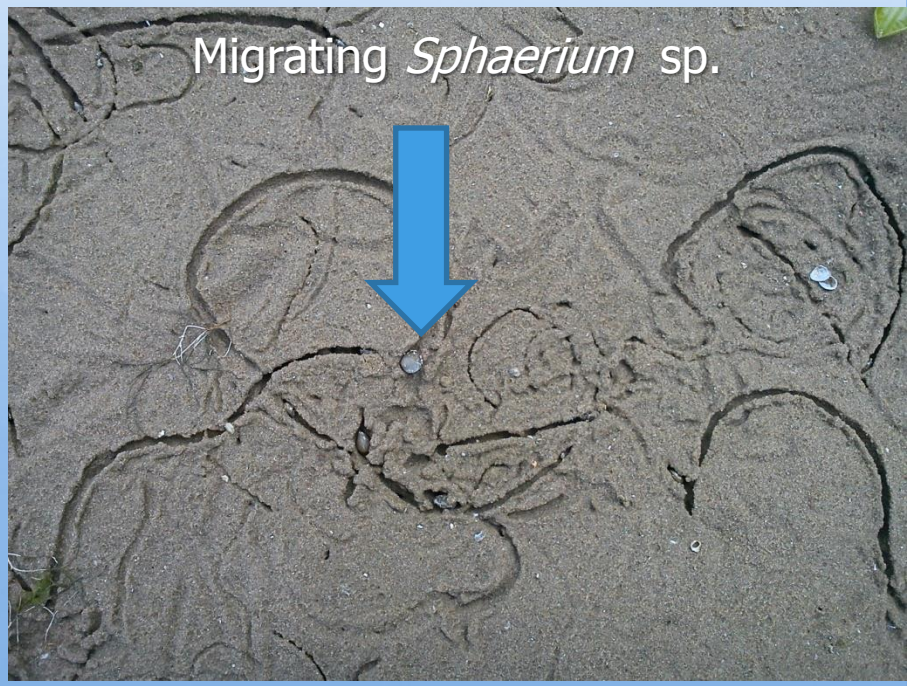
Introduction

The most dangerous situations are water level drop-downs and air exposures of bottom in summer, which may cause drying of substratum and its inhabitants.

Włocławek Reservoir, June 2003

Introduction

The most dangerous situations are water level drop-downs and air exposures of bottom in summer, which may cause drying of substratum and its inhabitants.



Włocławek Reservoir, June 2010

Introduction

The aim of the project was to study the near-shore fauna survival in desiccated substratum as well as the behavioural defences such as escape when the water level decreases.

We hypothesized that the fauna from the reservoir, in which water level fluctuations are common, should have some adaptations. ★

We tested many different species, for this presentation we chose results obtained for snails.

Introduction

Water level fluctuations may strongly affect gastropods, inhabiting near-shore areas of water bodies.

Gastropods are mobile animals, which seem to be able to respond to such events by migration.

http://www.discoverlife.org/

But in the field we observed huge amounts of dead specimens from *Viviparus* sp., which stayed on the exposed bottom.

Introduction

Planorbarius corneus
the great ramshorn

Size: 40 x 16 mm
Air-breathing
Sandy bottom

Size: 40 x 28 mm
Gill-breathing
Sandy bottom

Viviparus viviparus
the common river snail

http://www.habitas.org.uk
Dr Roy Anderson

http://www.flickr.com

Bithynia tentaculata
the faucet snail

Size: 18 x 9 mm
Gill-breathing
Sandy bottom

Size: 6.5 mm
Gill-breathing
Sandy bottom

Potamopyrgus antipodarum
the New Zealand mud snail

http://www.habitas.org.uk
Dr Roy Anderson

Purpose

The main aims of the study were:

- to check gastropod **survival** during air exposure
- to check the possibility of **horizontal and vertical migrations** of gastropods in response to substratum drying
- in the case of horizontal and vertical migration – to check **the moving distance**
- as well as the impact of **a sudden water level decrease**

Assumptions

What to do after the water level decrease ?

to stay on exposed substratum

to migrate horizontally following the decreasing water level

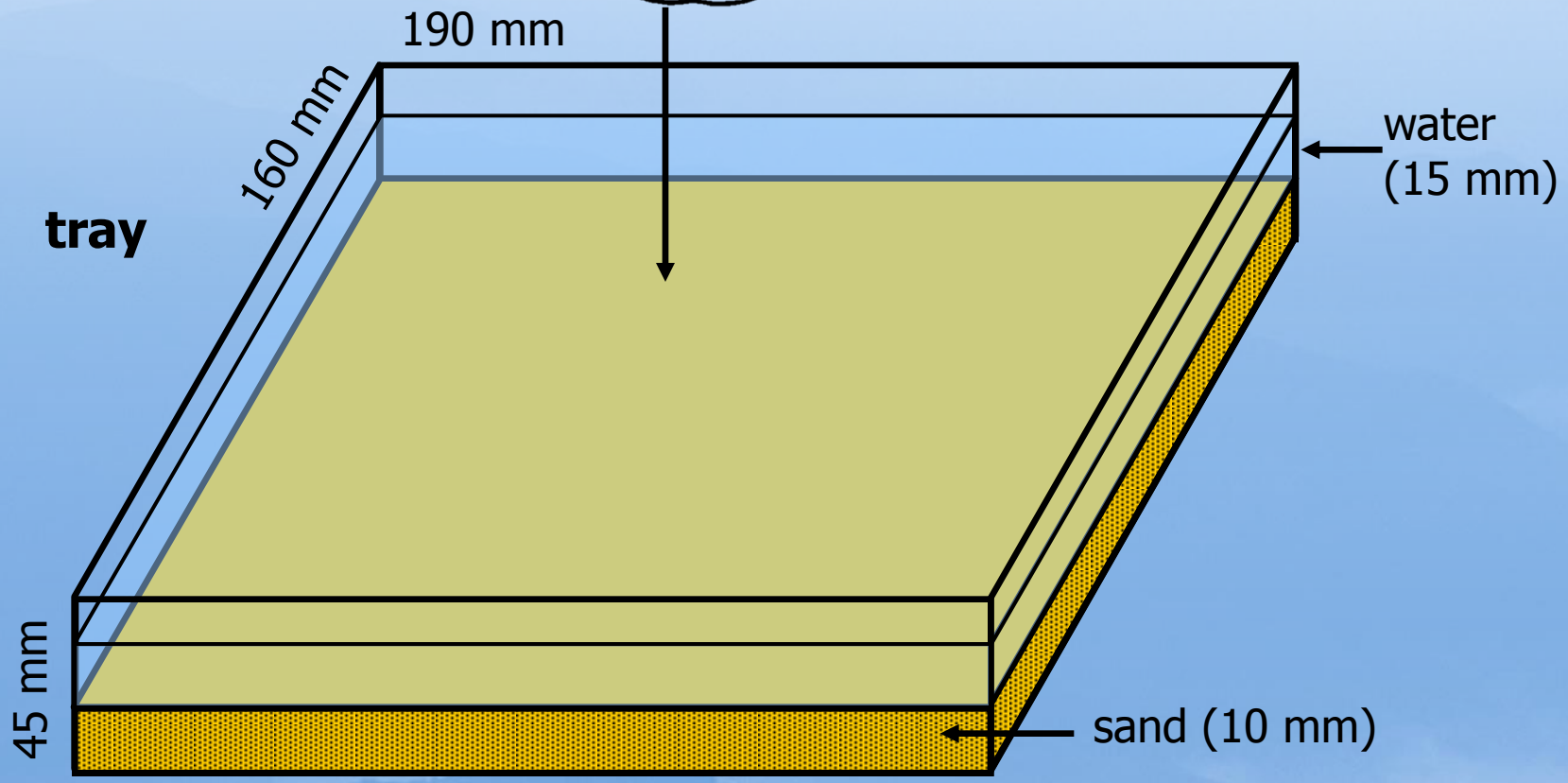
... and die in the case of further desiccation

water substratum

to migrate vertically to bury into substratum

Gastropod survival

Introduction of 7 to 20 gastropods
(depending on the size)

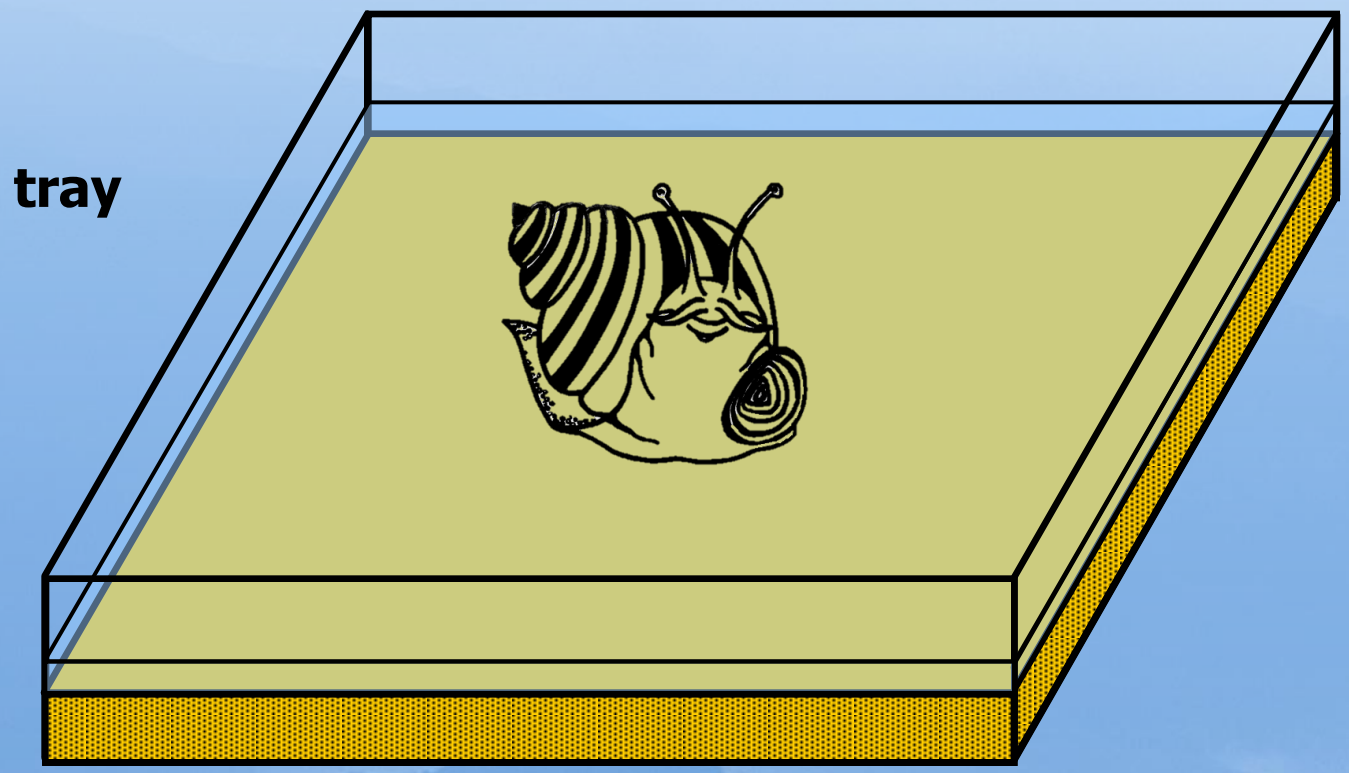


The experiments were carried out in 6 - 15 replicates

Gastropod survival

Water gradually evaporated

From time to time checking the gastropod survival and water content in substratum

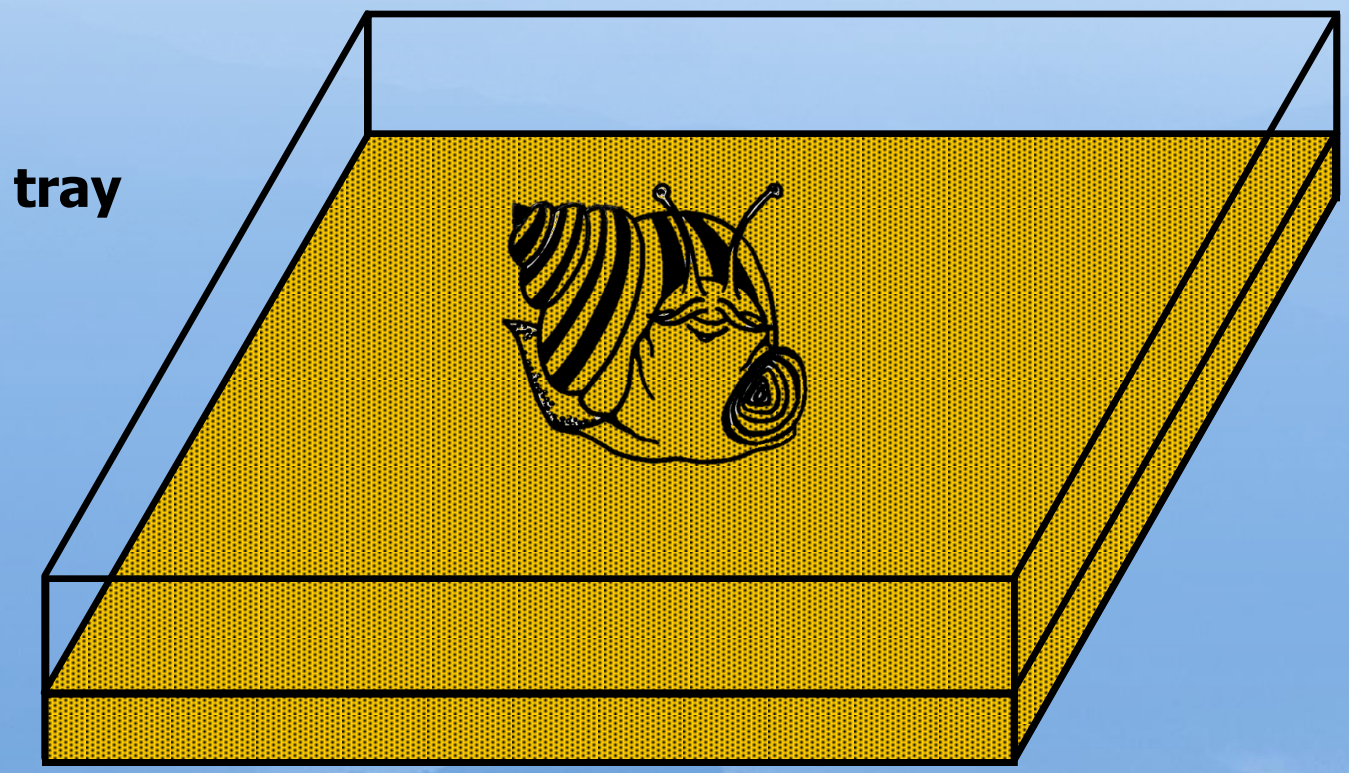


Parallel control in trays with constant water level

Gastropod survival

Water gradually evaporated

From time to time checking the gastropod survival and water content in substratum



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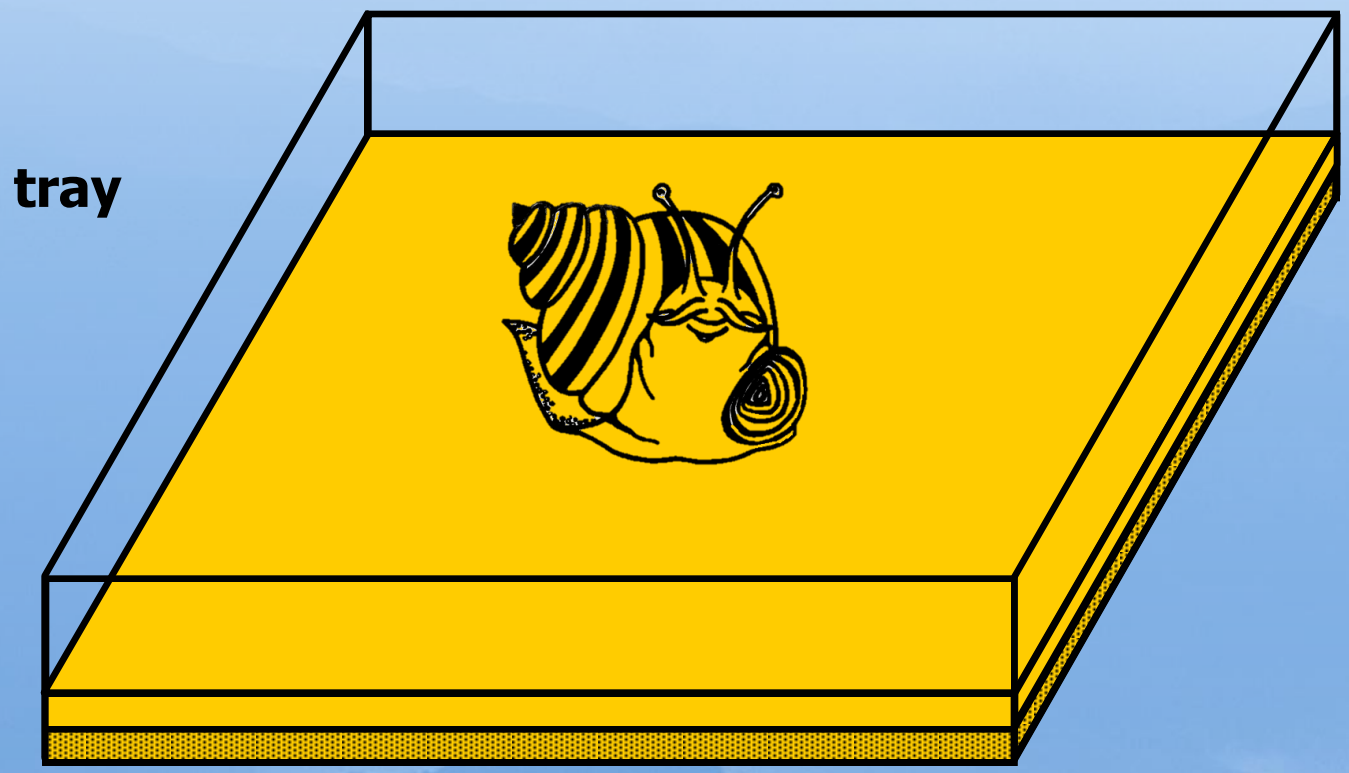


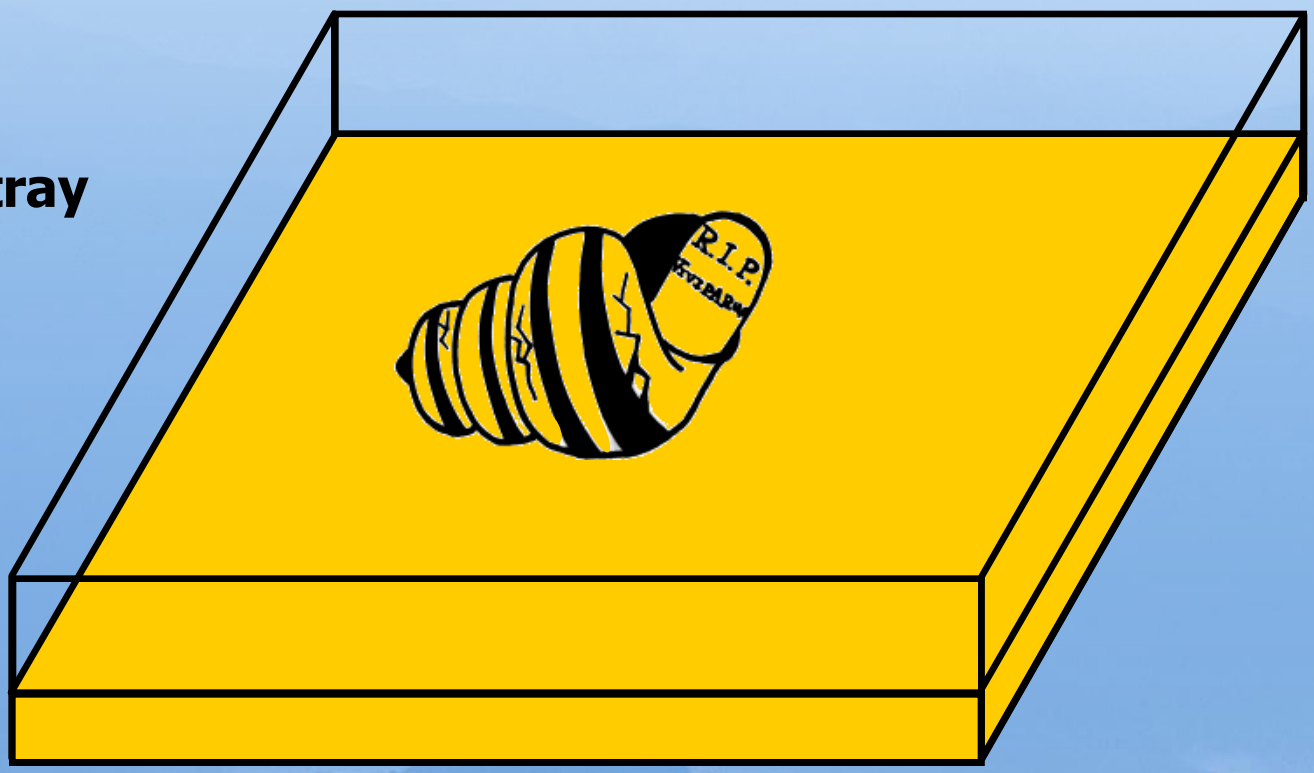
Parallel control in trays with constant water level

Gastropod survival

Water gradually evaporated

Checking the gastropod survival and water content in substratum

The end of the experiment after obtaining 100% mortality of gastropods

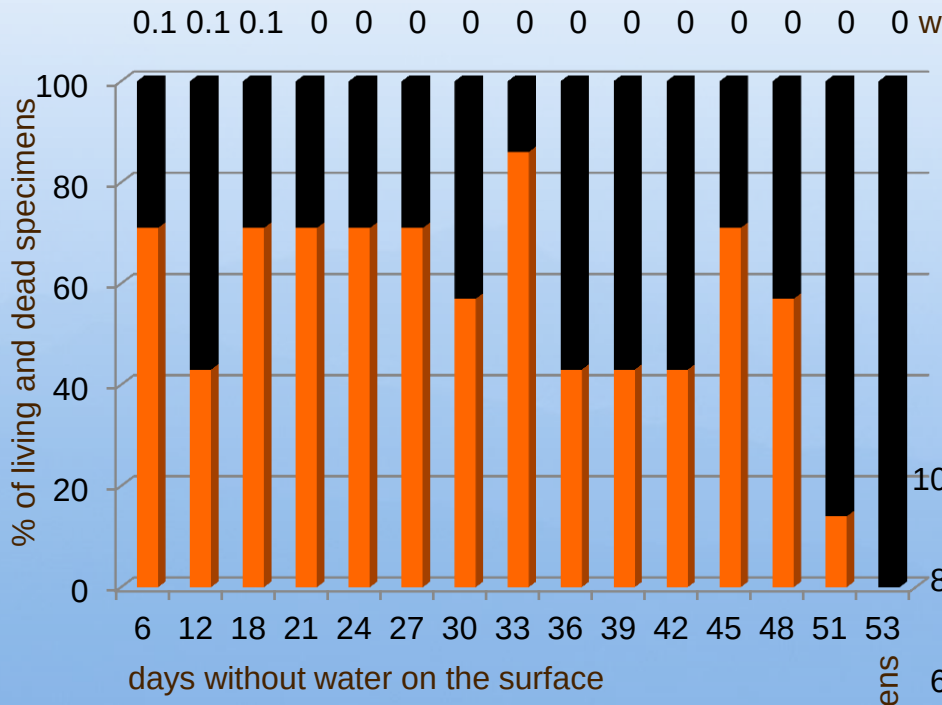


duration:
6 - 53 days

Analysed variable: time – days without the water on the surface, which caused 50% and 90% mortality of gastropods (LT 50, LT 90)

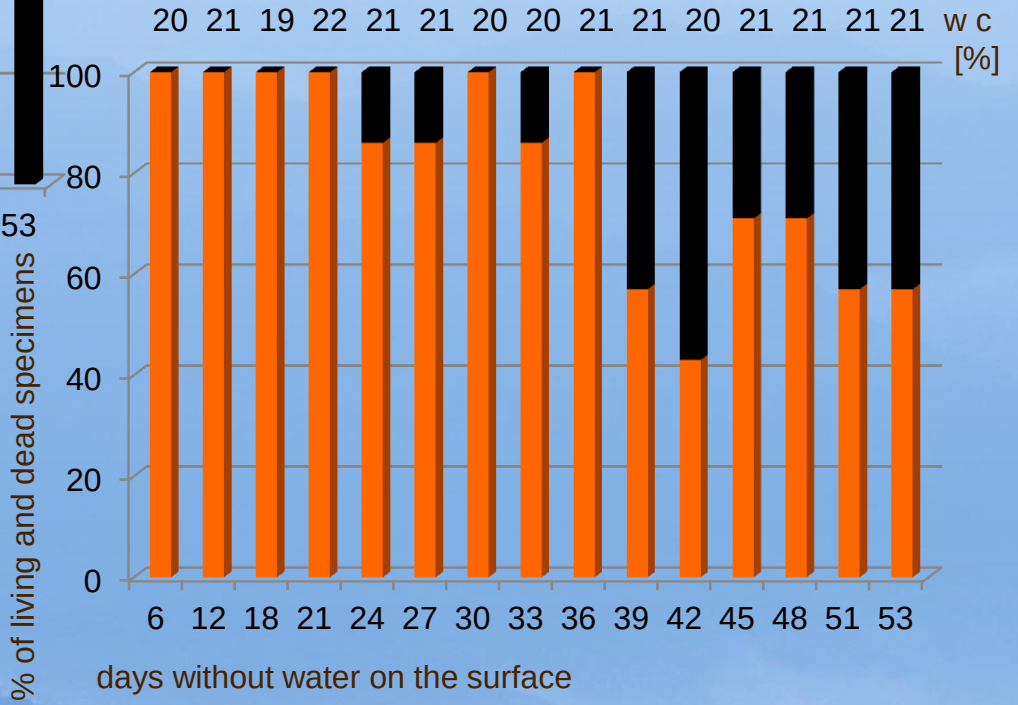
Survival of *Planorbarius corneus*

drying trays



N = 15 x 7 individuals

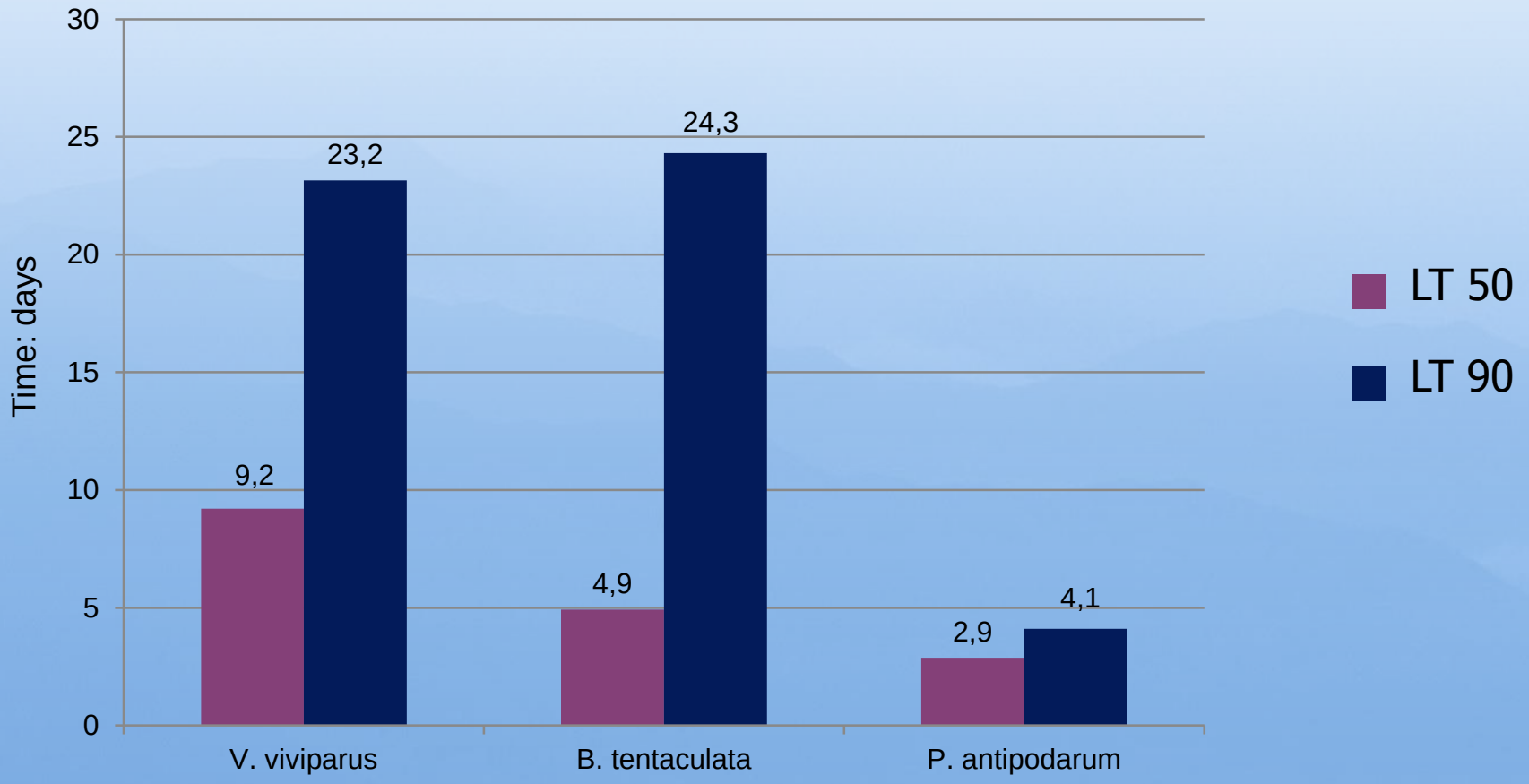
control trays



- 57% snails survived after 48 days, 14% after 51 day, in 53 day all were dead
- High mortality in the control

Survival of snails: comparison of LT 50 and LT 90

Probit analysis

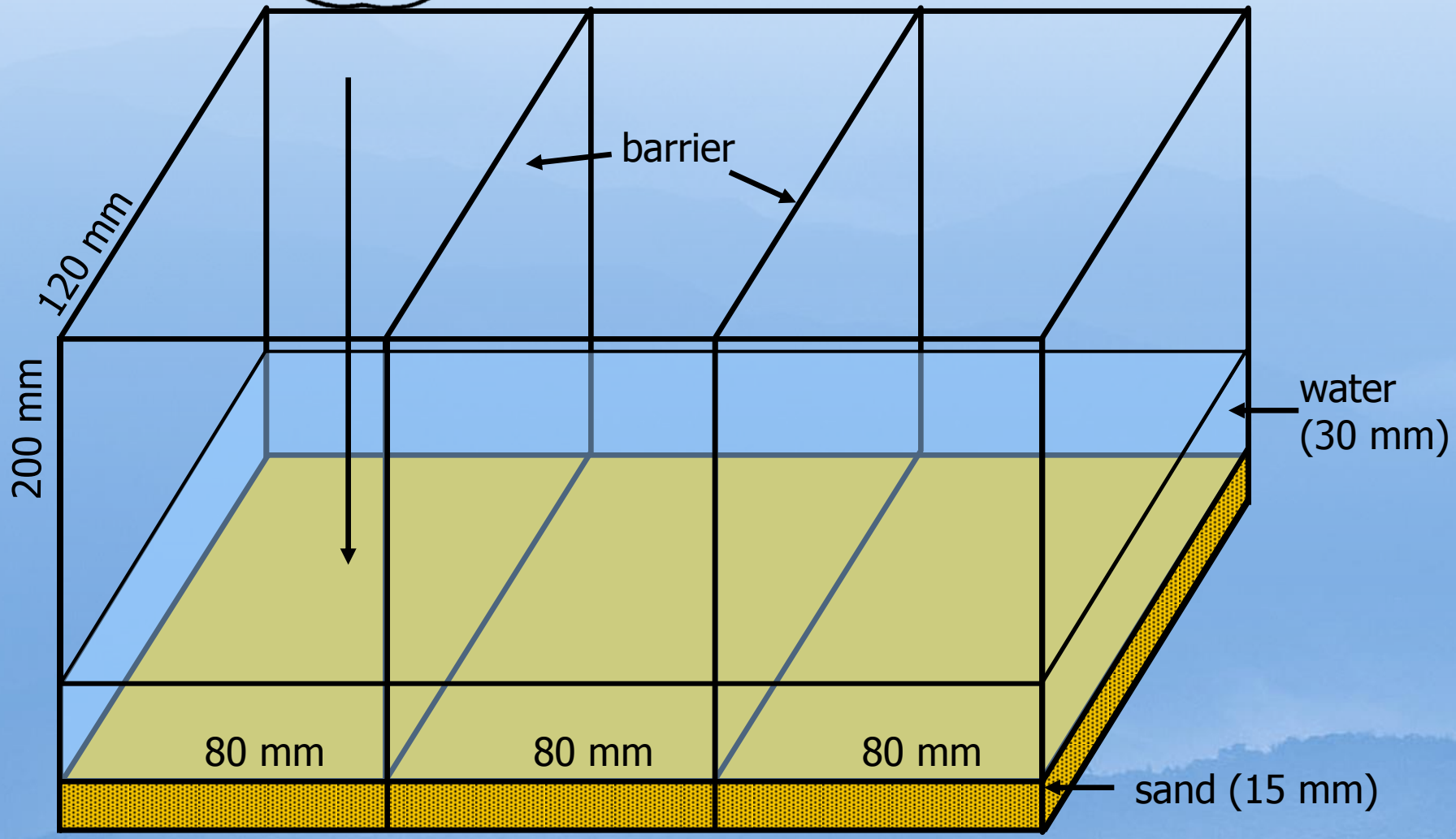


- *Planorbarius corneus* was the most resistant:

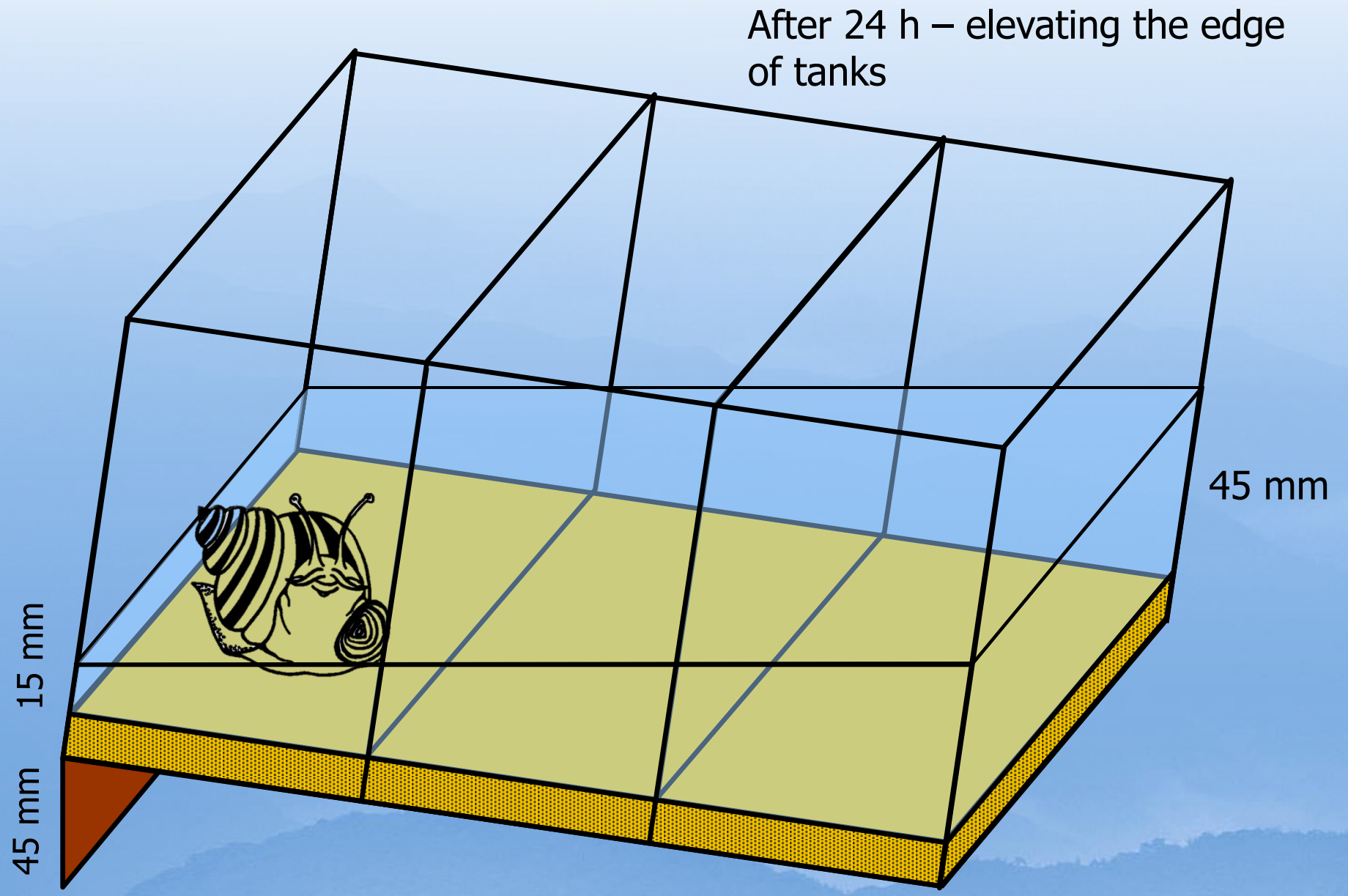
14% snails survived after 51st day, in 53rd day all snails were dead

Horizontal migrations

Introduction of 5 to 20 gastropods
(depending on the size)

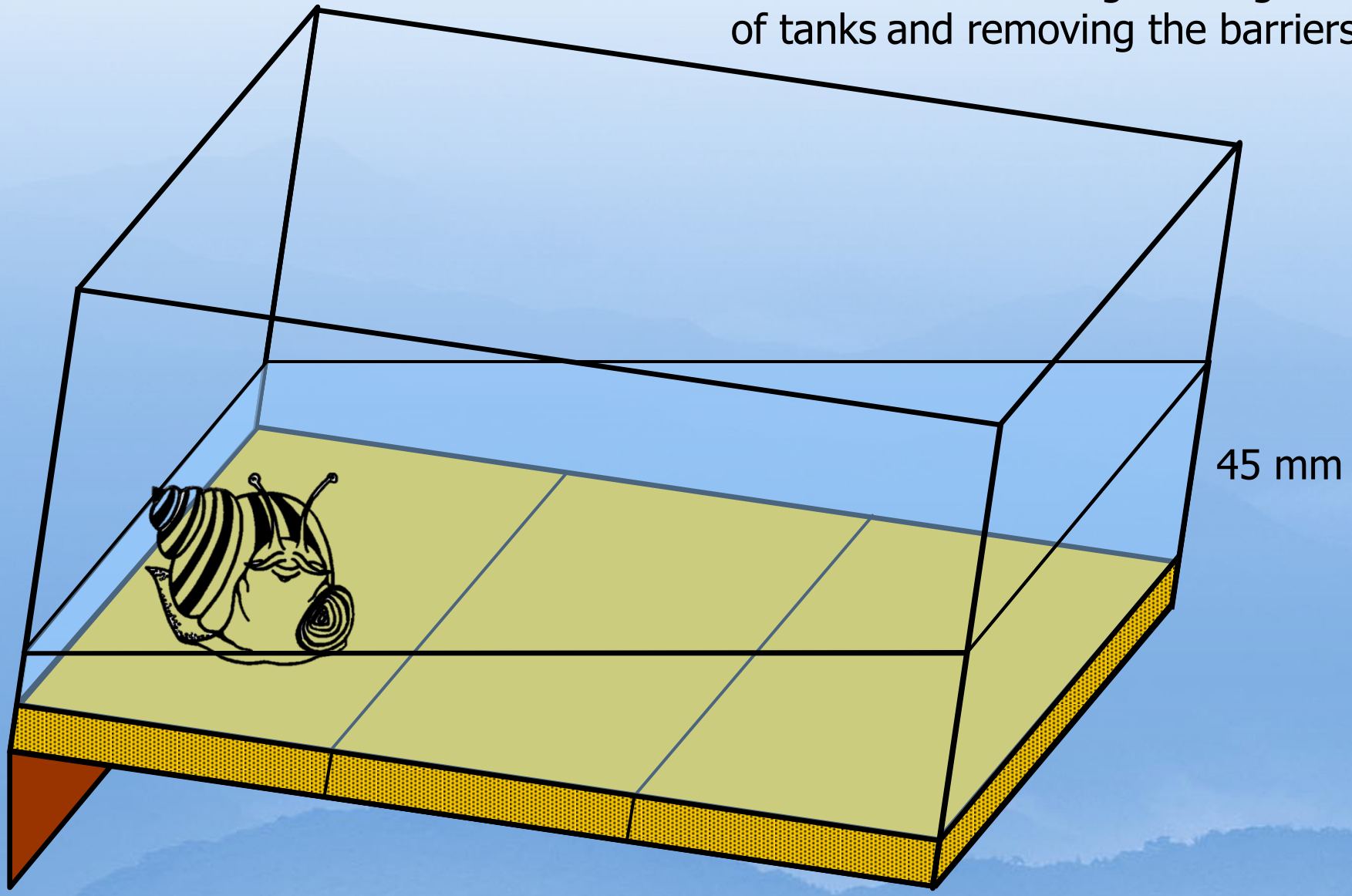


Horizontal migrations



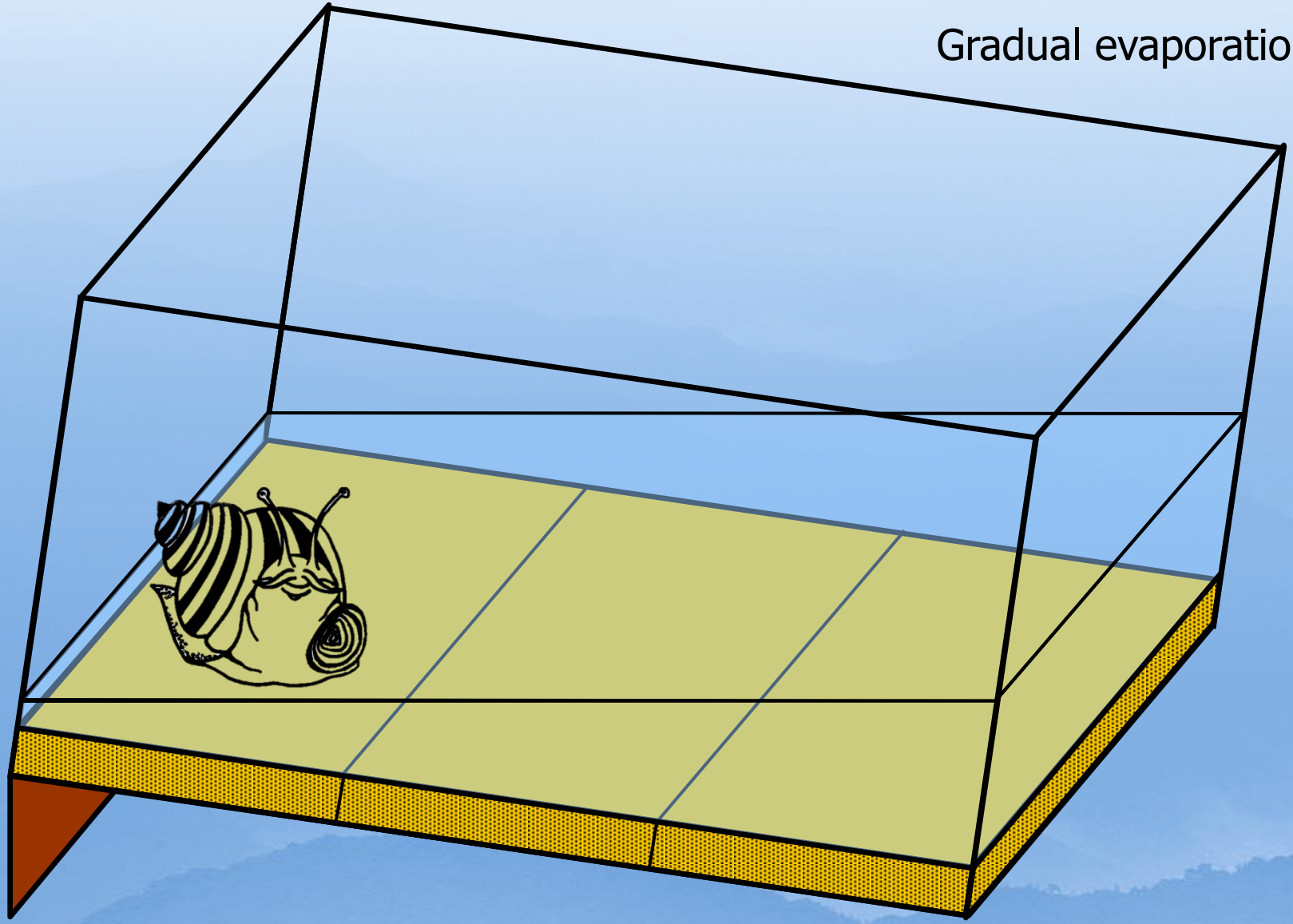
Horizontal migrations

After 24 h – elevating the edge of tanks and removing the barriers



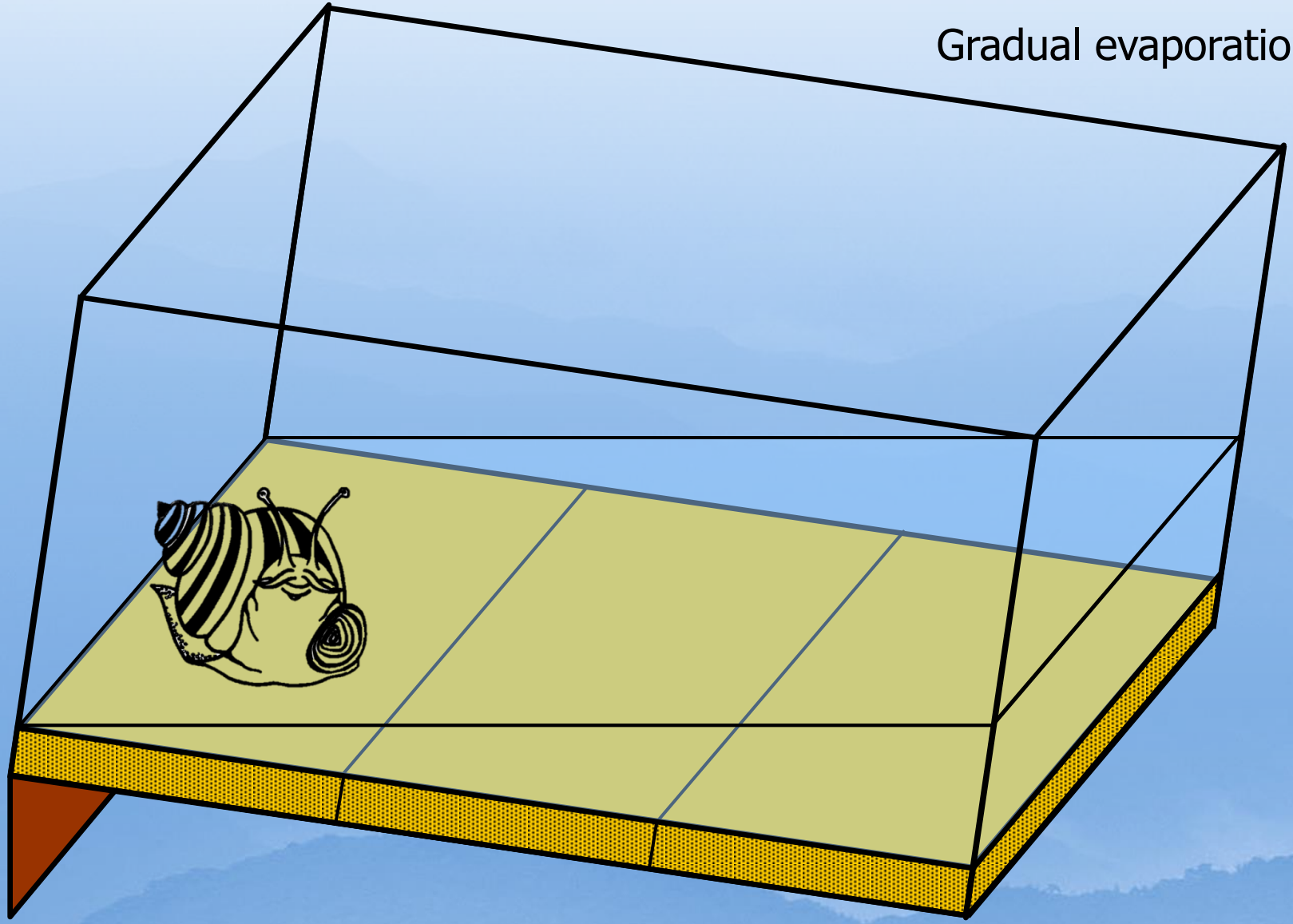
The experiments were carried out in 5 replicates

Horizontal migrations



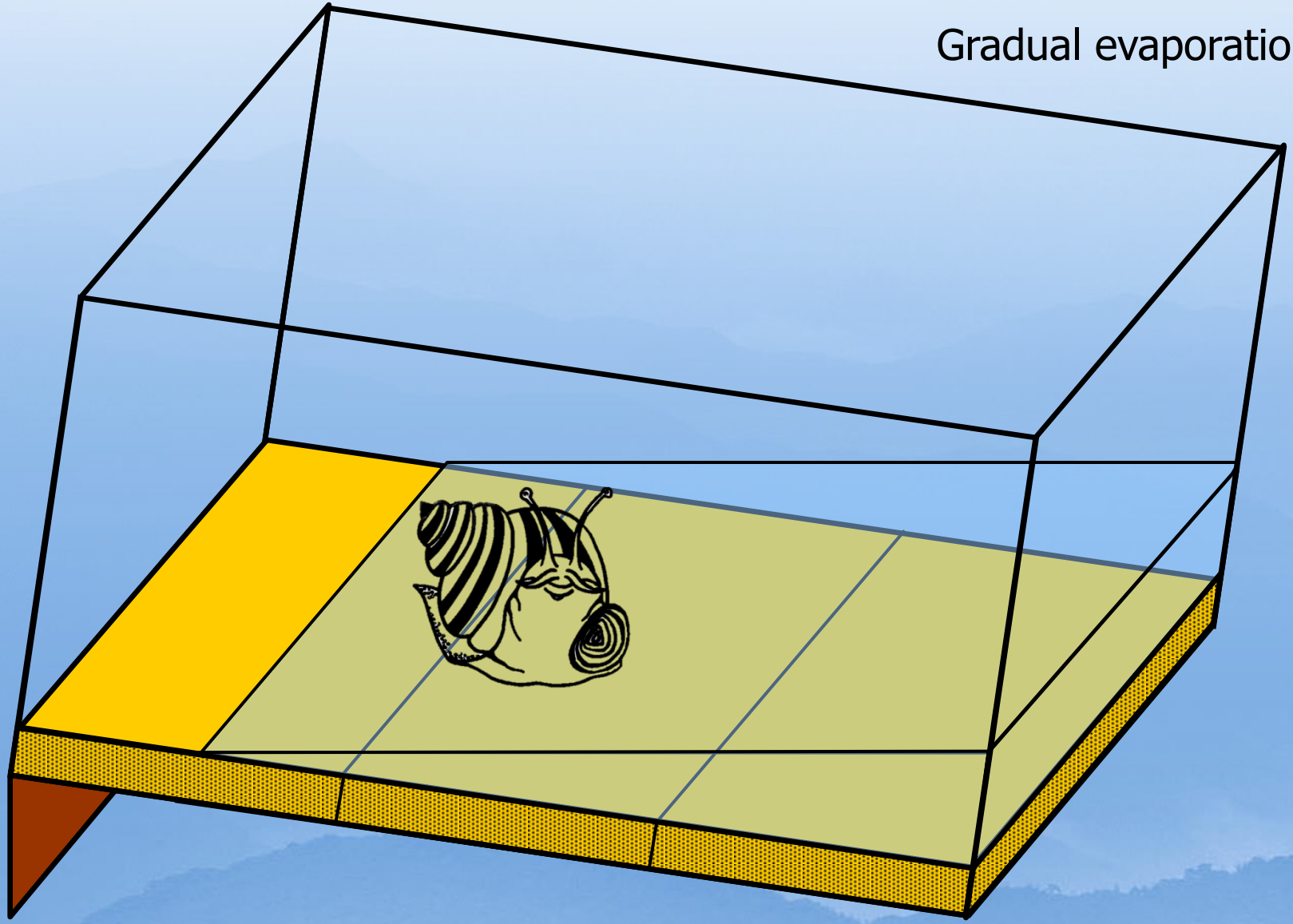
Parallel control in tanks with constant water level

Horizontal migrations



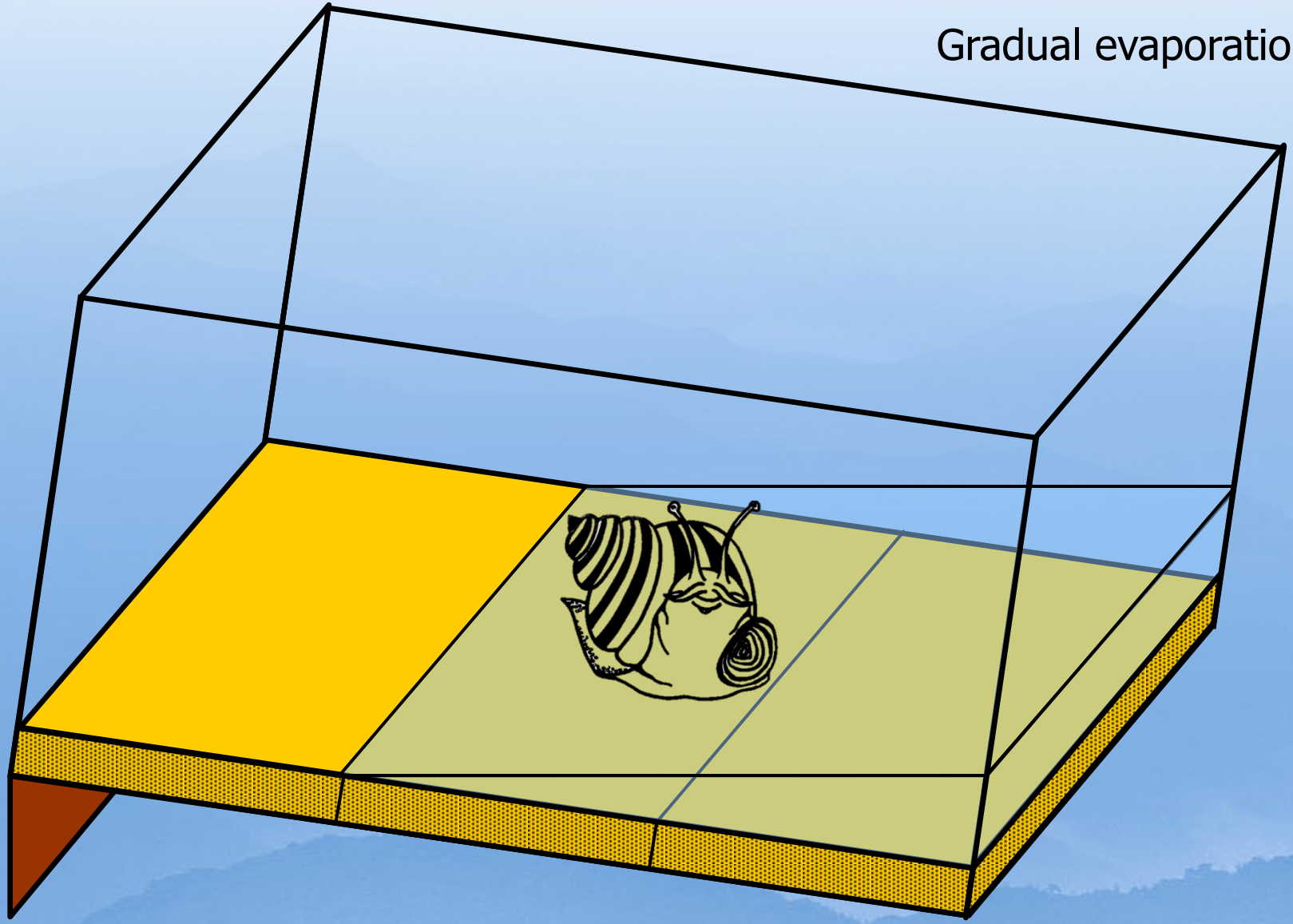
Parallel control in tanks with constant water level

Horizontal migrations



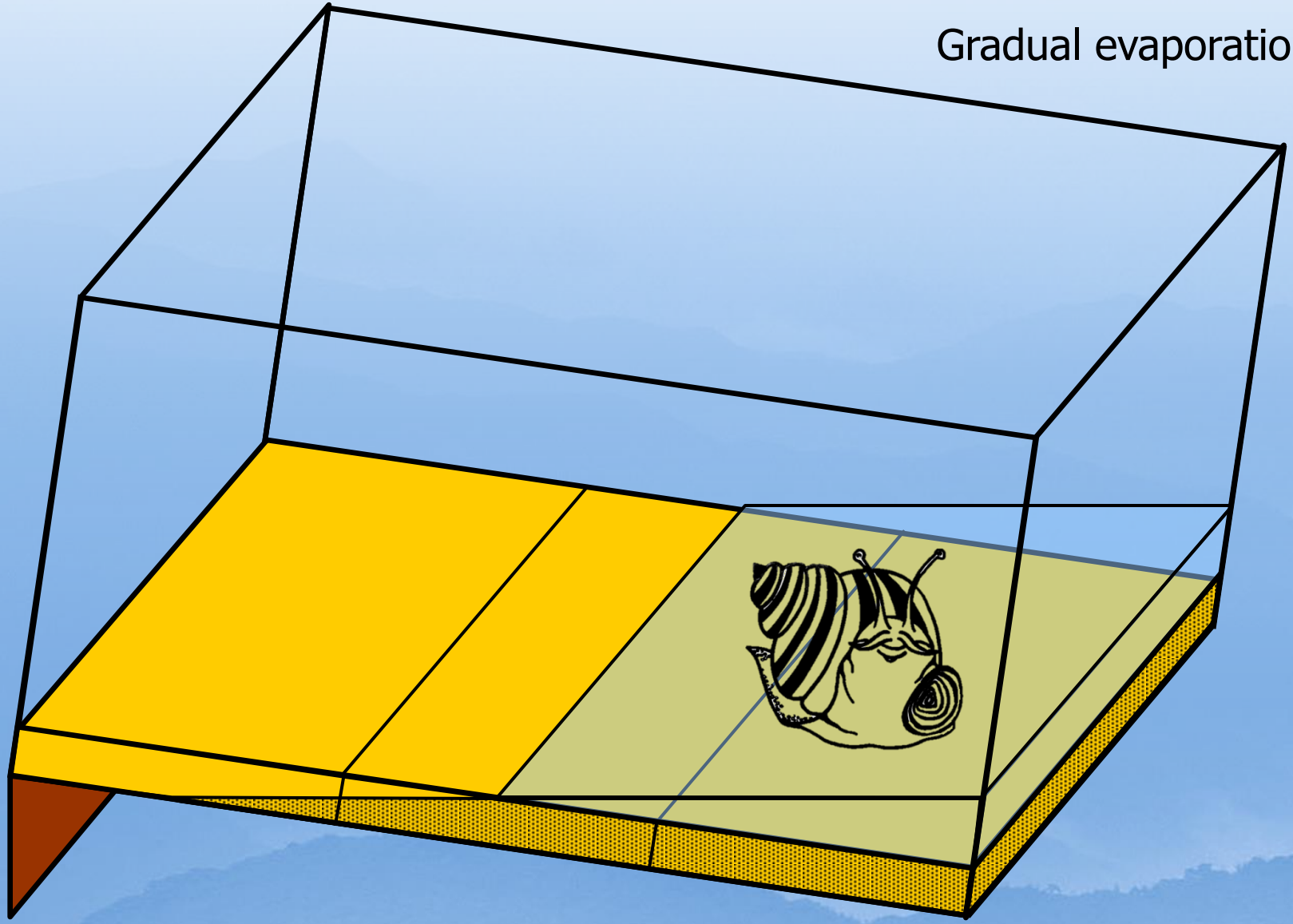
Parallel control in tanks with constant water level

Horizontal migrations



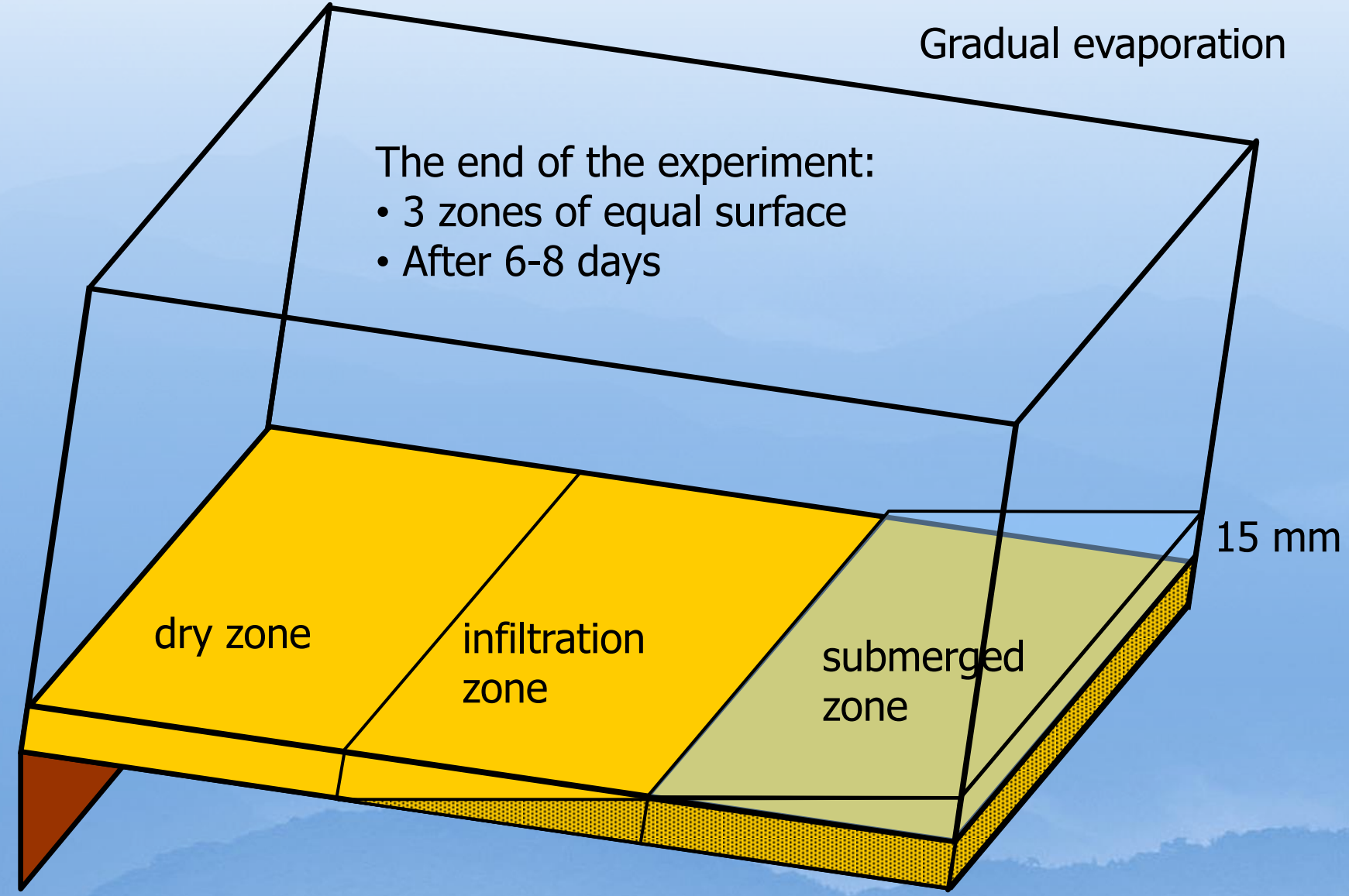
Parallel control in tanks with constant water level

Horizontal migrations



Parallel control in tanks with constant water level

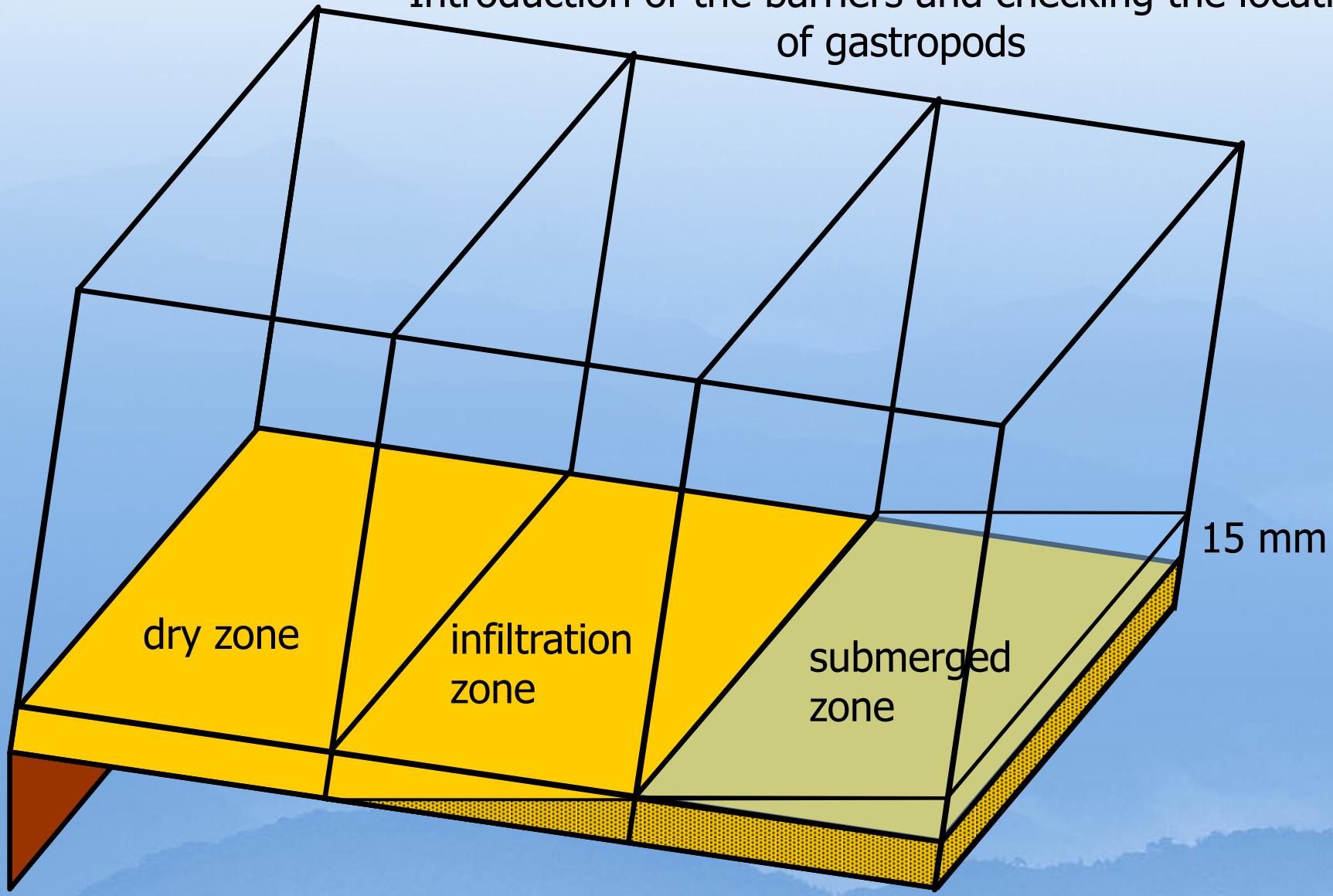
Horizontal migrations



Parallel control in tanks with constant water level

Horizontal migrations

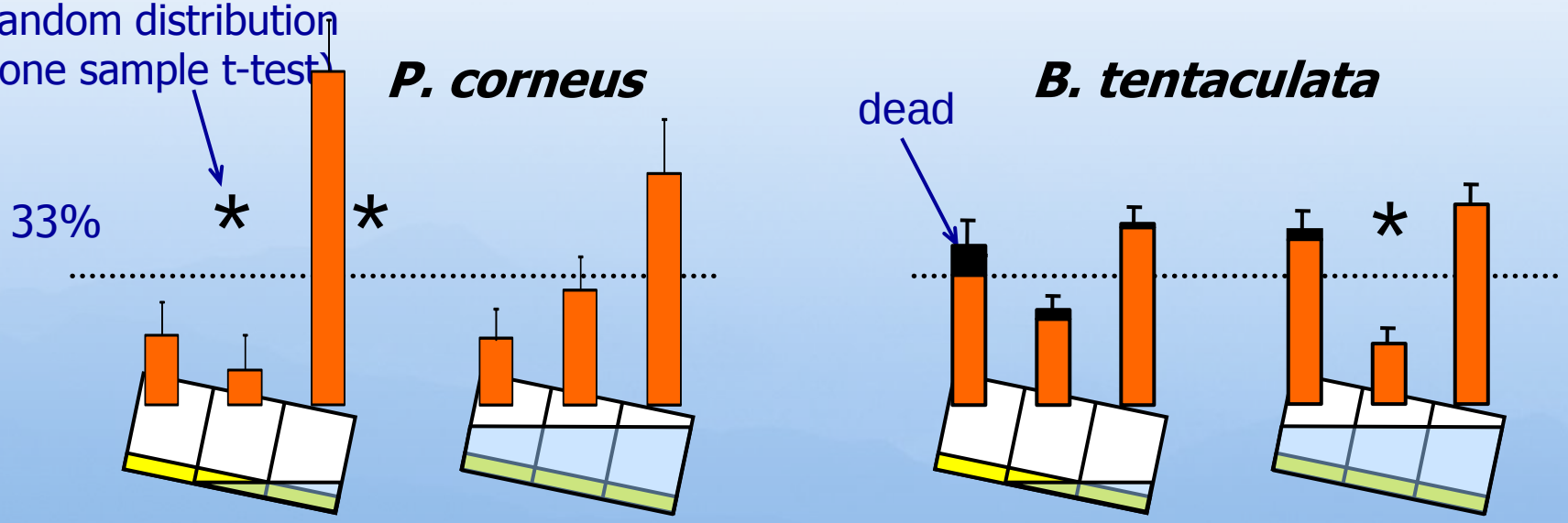
Introduction of the barriers and checking the location of gastropods



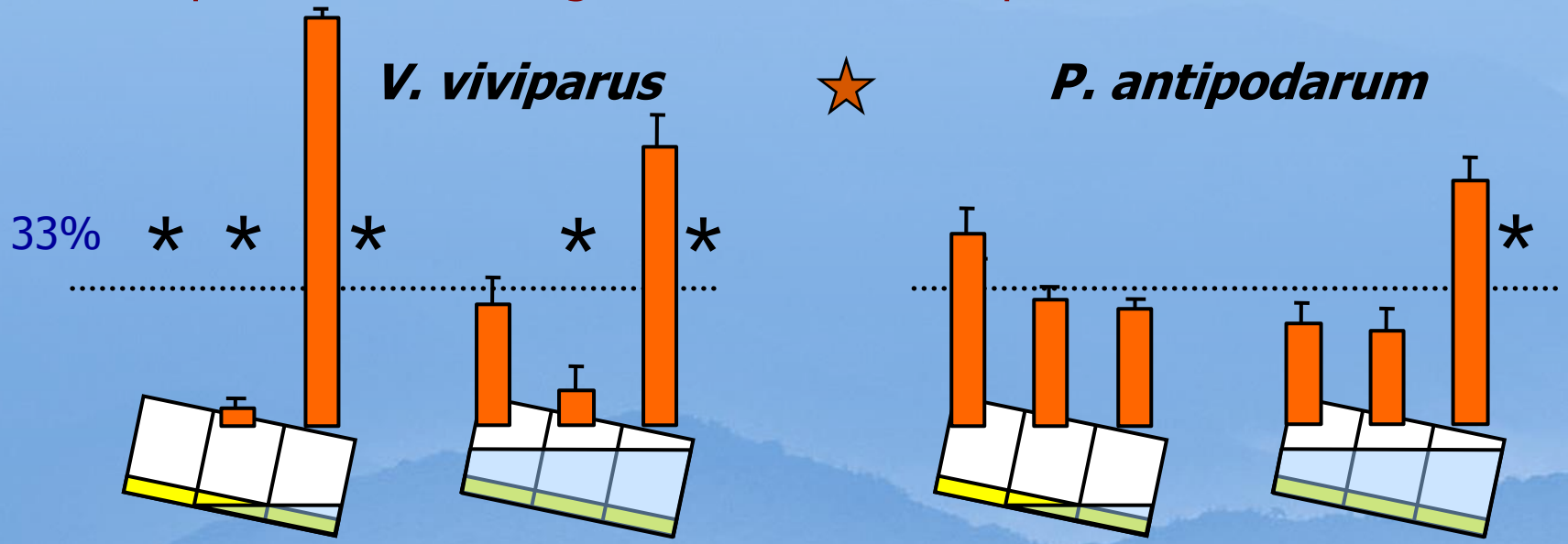
Parallel control in tanks with constant water level

Horizontal migrations (24 cm)

significant deviation from random distribution (one sample t-test)



- P. c. preferred submerged zone
- No preferences



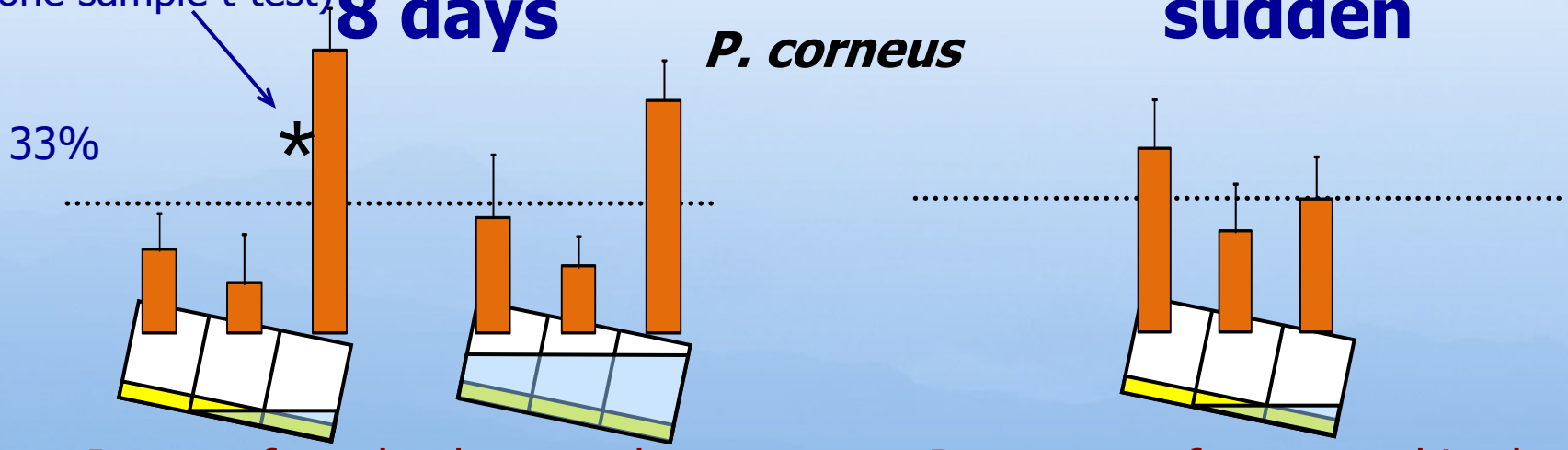
- V. v. preferred submerged zone
- P. a. stayed in the dry zone

Horizontal migrations (48 cm)
two times longer distance

significant deviation from random distribution (one sample t-test)

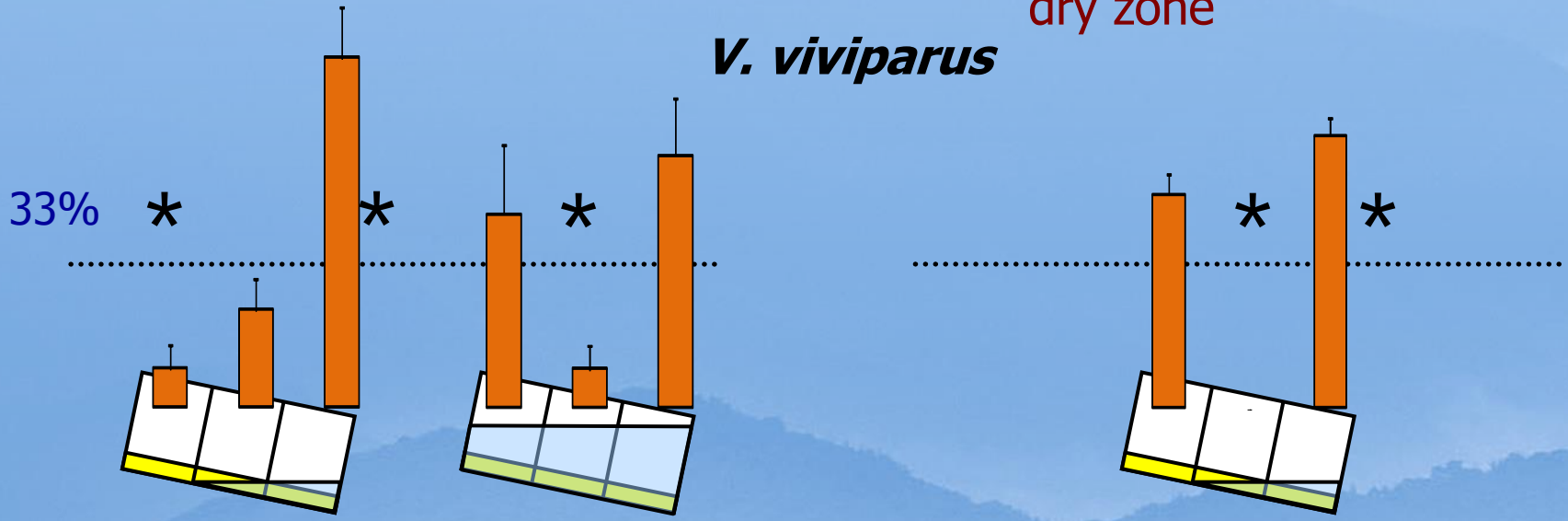
8 days | **sudden**

P. corneus



- P. c. preferred submerged zone
- P. c. more often stayed in the dry zone

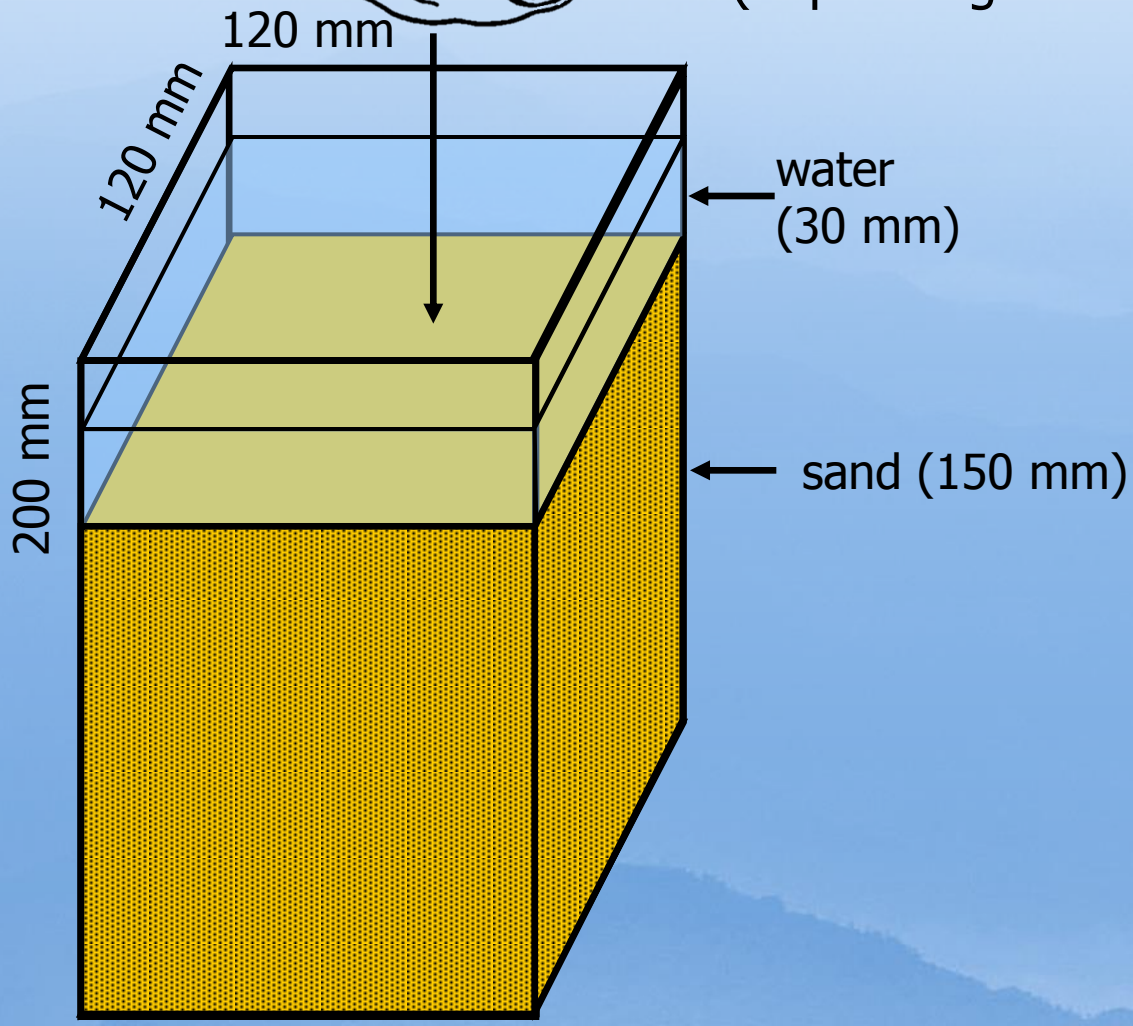
V. viviparus



- V. v. preferred submerged zone
- V. v. migrated or stayed passive

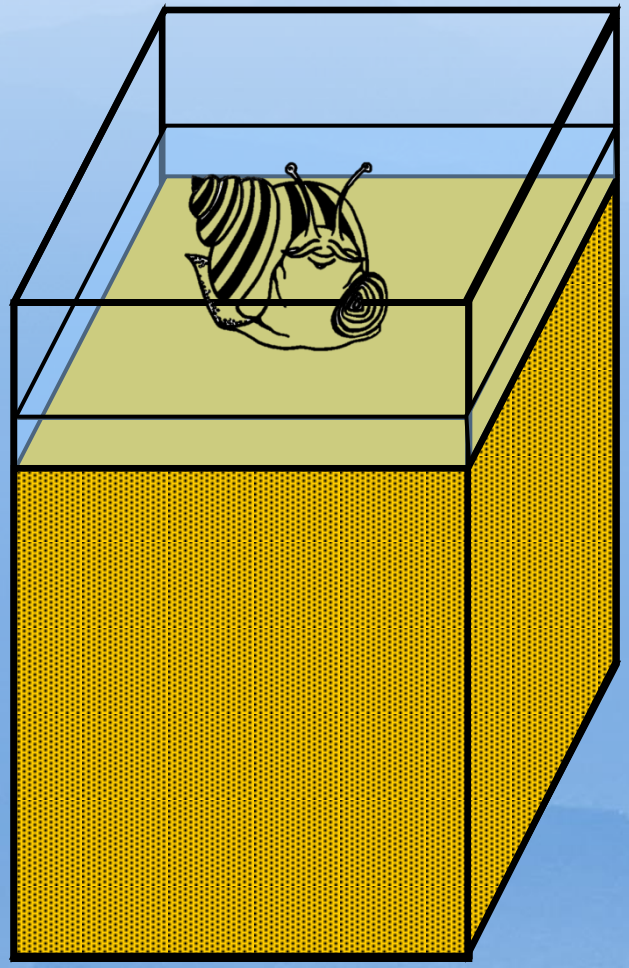
Vertical migrations

Introduction of 5 to 20 gastropods
(depending on the size)



The experiments were carried out in 5 replicates

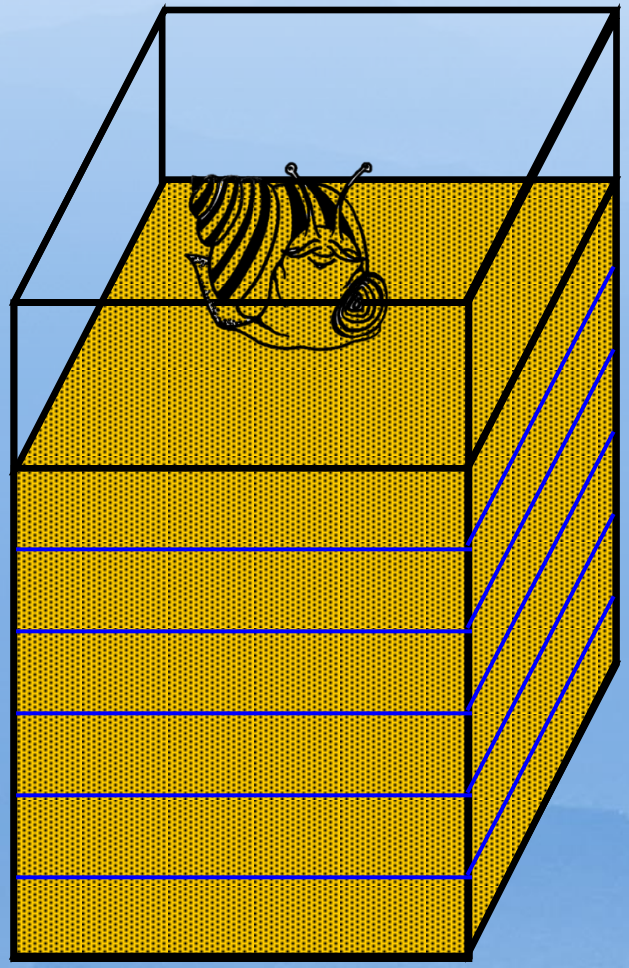
Vertical migrations



Gradual evaporation

Parallel control in tanks with constant water level

Vertical migrations



Gradual evaporation

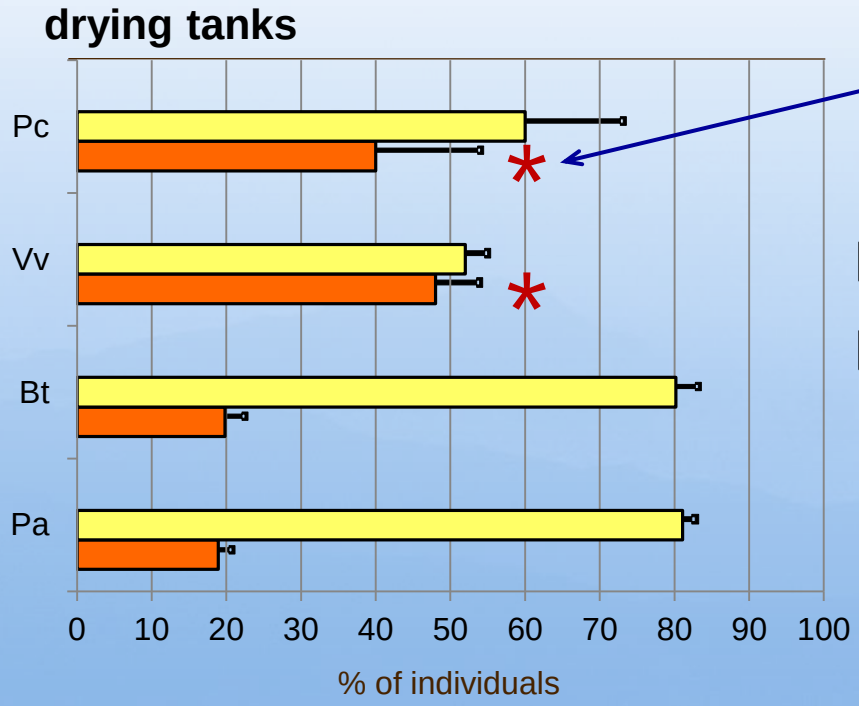
After the water level declined below the surface of substratum:

- substratum was divided into 25 mm layers
- the position of gastropods was checked

Duration: till 5-8 days

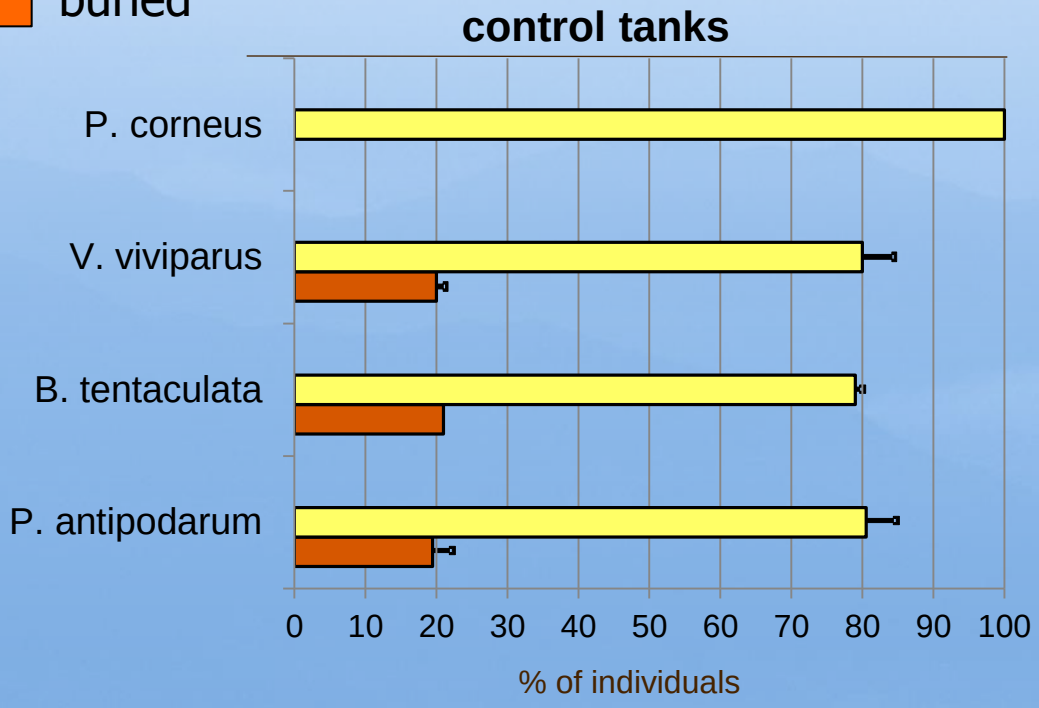
Parallel control in tanks with constant water level

Vertical migrations



significant differences (t-test)

Snail position
surface
buried



All species demonstrated a tendency to bury in the substratum

- Only in the case of *P. corneus* and *V. viviparus* there was the effect of substratum drying

Summary and conclusions

Planorbarius corneus, Viviparus viviparus as well as *Bithynia tentaculata* were **resistant** to substratum drying.

Moreover, *P. corneus* and *V. viviparus* exhibited horizontal migrations as well as burying into substratum.

These two species are well-adapted to water level changes:
they are resistant and they can escape from dangerous area.

However, horizontal migrations were less pronounced at a longer distance as well as in the case of a sudden water level drop.

Poznańska M., Goleniewska D., Gulanicz T., Kakareko T., Jermacz Ł., Kobak J.: Effect of substratum drying on the survival and migrations of a freshwater pulmonate snail *Planorbarius corneus* (Linnaeus, 1758). Hydrobiologia. DOI: 10.1007/s10750-014-2130-z.

Summary and conclusions

Bithynia tentaculata was resistant to substratum drying.

This species did not exhibit any escape behaviour, which is the most efficient strategy to survive substratum drying.

It appears that *P. antipodarum* was less adapted to air exposure, which is surprising, as this species is reported to occur above the water level.

Snails drawn by - A. Dzierżyńska

Thank you for your attention!

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