OP-169 [Bee Health]
Influence of heat and humidity on the survival of the honey bees: A study within five Apis mellifera subspecies from the Mediterranean basin

Soledad Sagastume[1], Giovanni Cilia[2], Banan Al_shagour[3], Dilek Muz[4], Sami Alarsan[3], Marion Zammit Mangion[5]
Mustafa Necati Muz[4], Nizar Haddad[3], Antonio Nanetti[2], Mariano Higes[1], Raquel Martín Hernández[1]
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[3]NARC-National Agricultural Research Center, Baqa' 19381 (Jordan)
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Heat is a very damaging environmental stress factor for living organisms and is the most direct effect of climate change. Only organisms that are able to cope with environmental changes will undergo a process of adaptation that will allow them to survive and reproduce under the new conditions. On bees, the adverse effects of heat stress include multiple aspects such affecting their growth, development, task-related physiology, immunocompetence, foraging activity, and reproduction. Hence, it is expected that the new and increasingly hot environments coming from climate change affect to the life expectancy of the honey bees. On the other hand, humidity as single possible stressor seems to have lowest impact on bees, but it acts synergist when both variables get combined. The MEDIBEES Project seeks to study different subspecies of Apis mellifera living in Mediterranean basin, their adaptation, resistance and resilience to climate change. In order to understand the influence of the hotter and drier environments, six different conditions have been studied: 35ºC, 40ºC and 45ºC at 75% of relative humidity (RH), and 35ºC combining 15%, 30% and 50% of RH. This study presents the survival results of 5 subspecies: A.m. iberiensis in Spain, A.m. ligustica in Italy, A.m. anatoliaca in Turkey, A.m. syriaca in Jordan and A.m. ruttneri in Malta. During the study, the different groups of bees were fed ad libitum under each condition and food intake was monitored. Our results showed important differences according to the subspecies and a clear negative influence of heat on the survival rate of the bees, as in all cases the bees survived less than half of the days at 40ºC compared to 35ºC, and in no case they were able to survive 24 hours at 45ºC. With regard to humidity, the effect seemed to be less relevant along each subspecies, although differences in food intake should be thoroughly analysed. This study supports the importance of local breeds and warns of the problem of heat stress in hives.
These results are under the project 2011-MEDIBEES, which is part of the PRIMA programme supported by the European Union.

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY
23-27 SEPTEMBER

MEDI BEES

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Influence of heat and humidity on the survival of the honey bees: a study within five *Apis mellifera* subspecies from Mediterranean basin

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Castilla-La Mancha
CIAPA IRIAF
crea Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria
NARC المركز الوطني للبحوث الزراعية National Agricultural Research Center
NAMIK KEMAL ÜNİVERSİTESİ 2006

OBJECTIVES

MEDIBEES Project

Resilience to heat and dry environments of *A. mellifera* subspecies in Mediterranean basin

OBJECTIVES

MEDIBEES Project

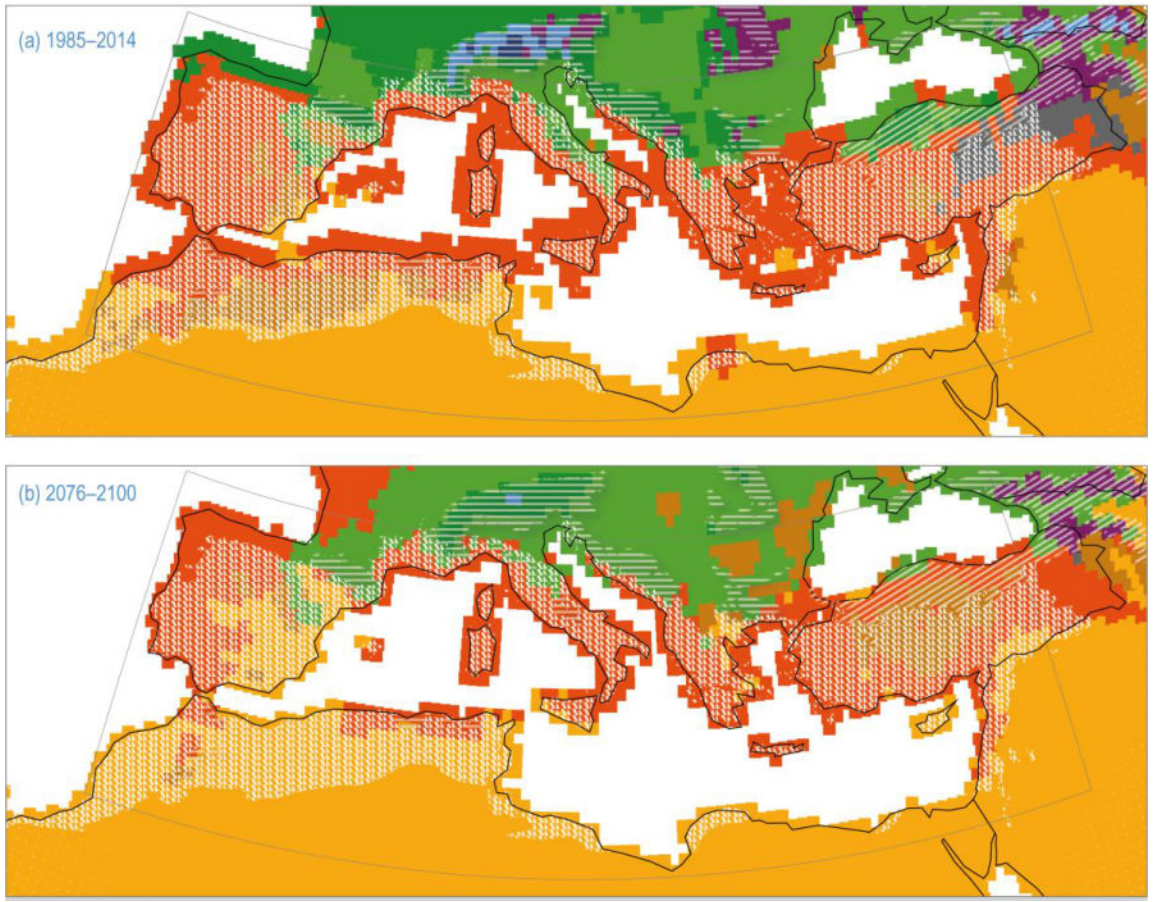
ADAPTABILITY

LOCAL BREEDS

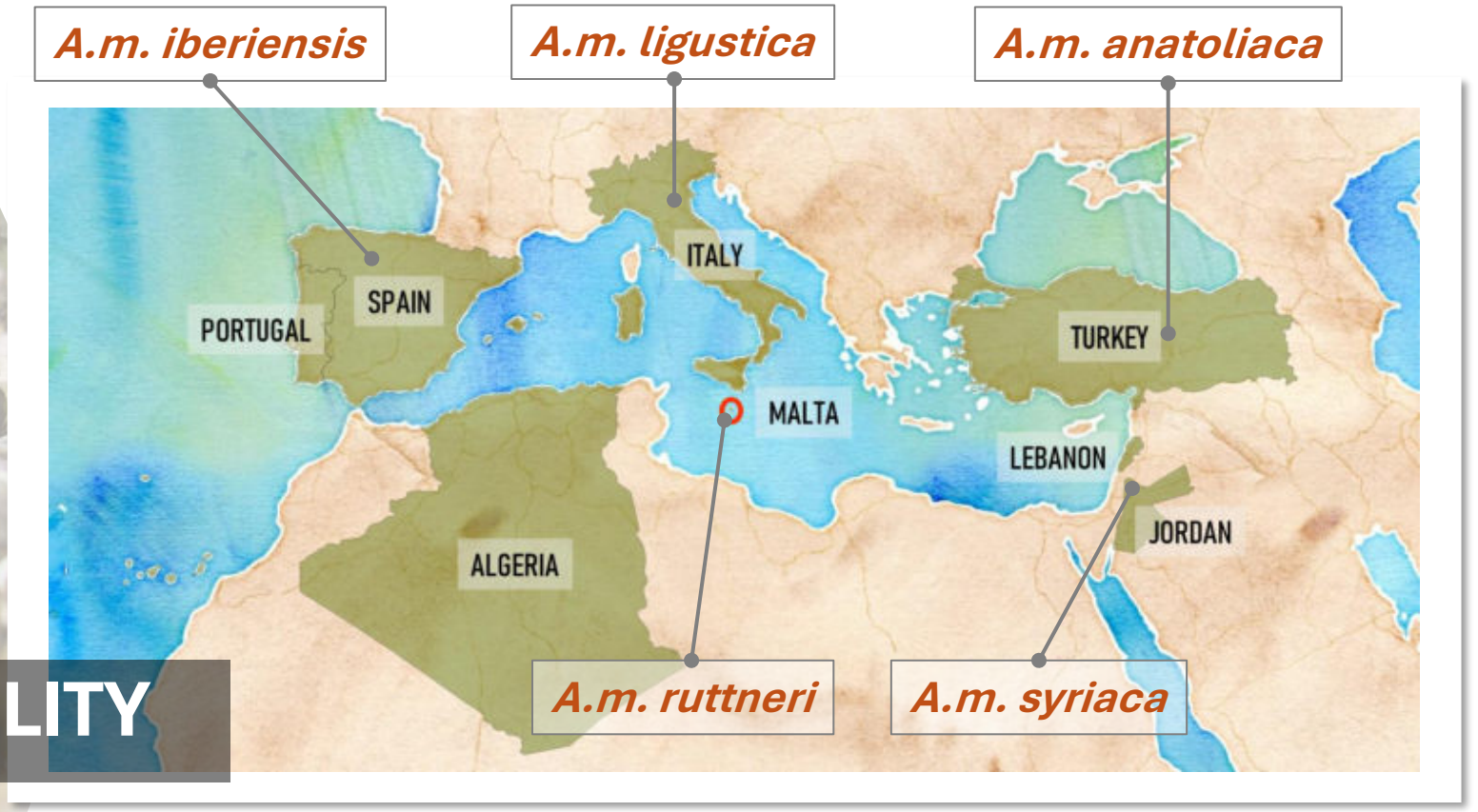
IPCC Sixth Assessment Report

Cross-Chapter Paper 4: Mediterranean Region

Bioclimatic regions (Köppen-Geiger classification) and terrestrial biodiversity hotspots in the Mediterranean region



OBJECTIVES

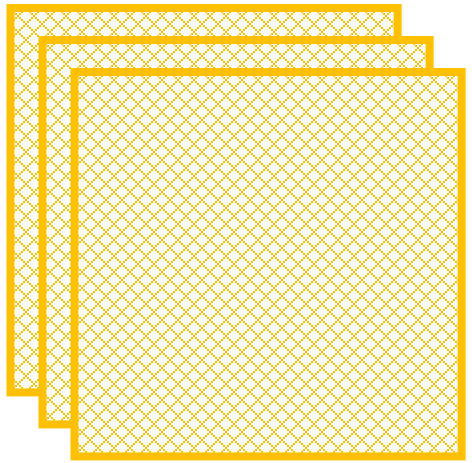


ADAPTABILITY

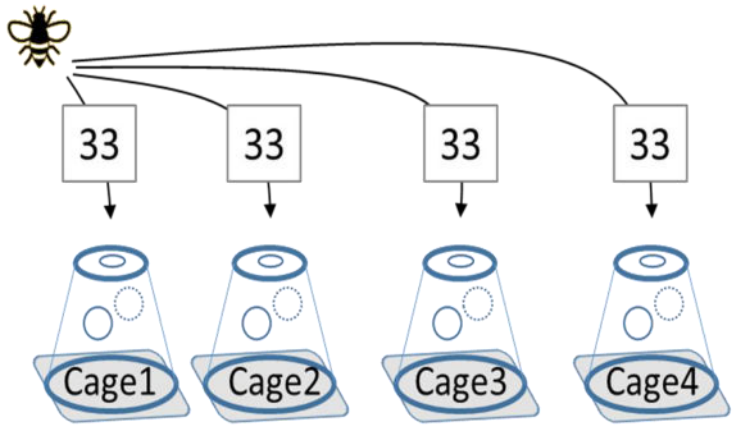
- Effect of temperature and humidity on bee survival

MATERIAL & METHODS

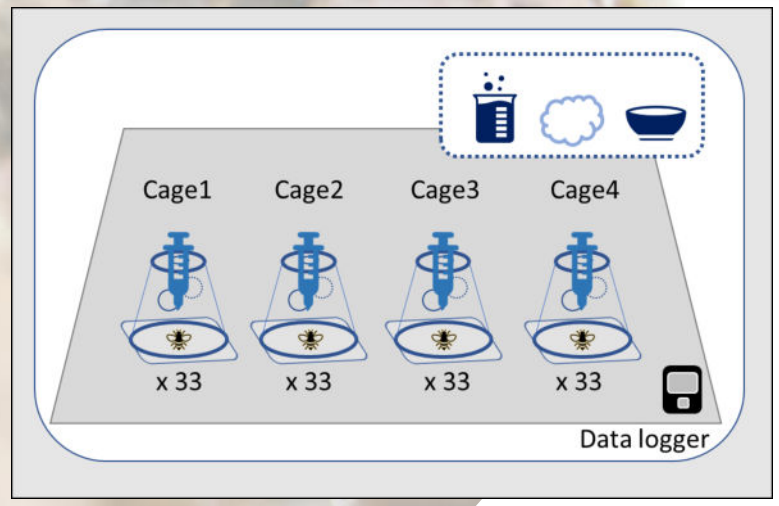
Brood combs



Newly emerged bees

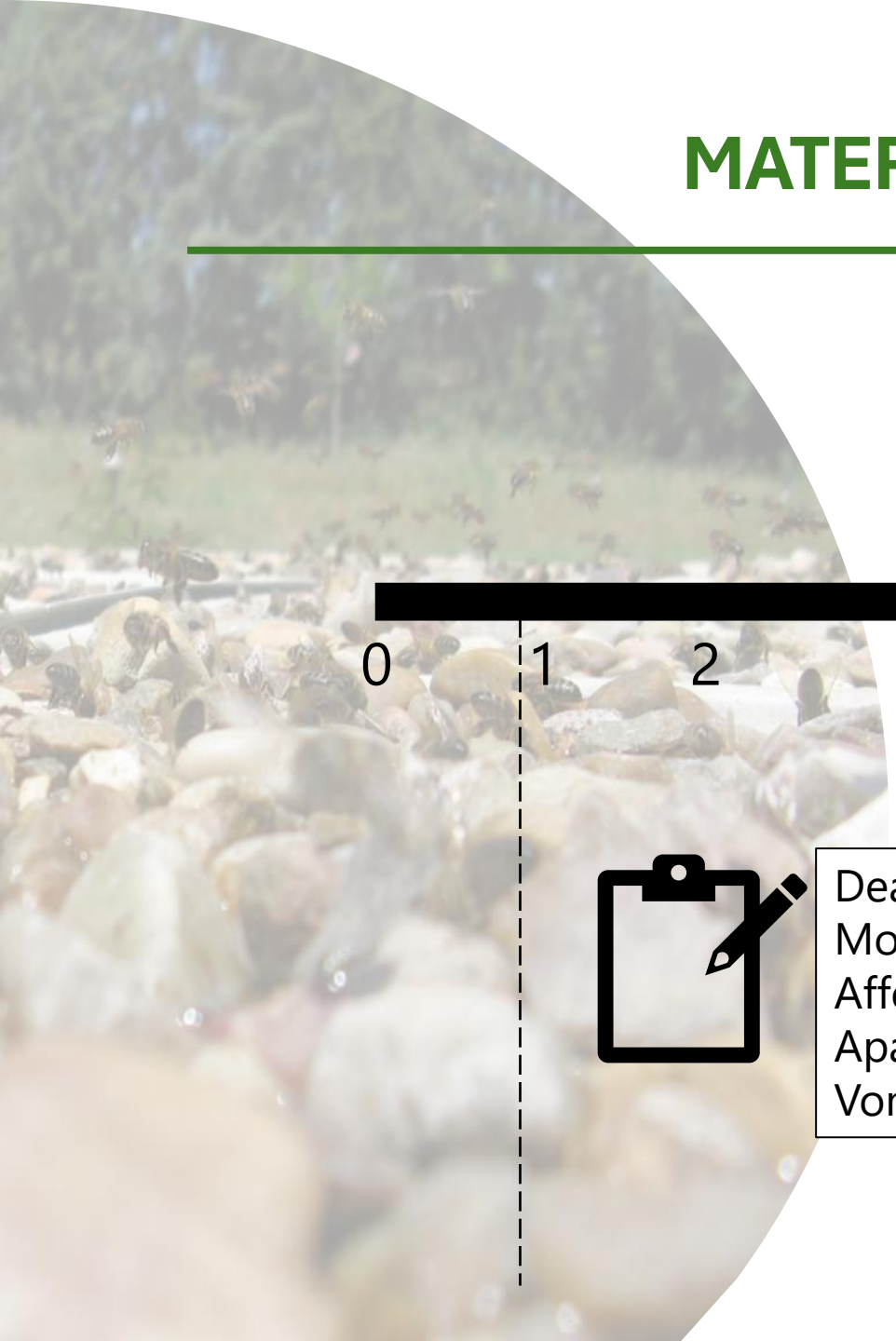


MATERIAL & METHODS



35°C 75%	40°C 75%	45°C 75%	
35°C 15%	35°C 30%	35°C 50%	

MATERIAL & METHODS



MATERIAL & METHODS

Death day

0 1 2 ...

Dead
Moribund
Affected
Apathy
Vomiting

Food intake control

Cage5
(Evaporation control)

MATERIAL & METHODS

Similar incubators

Video training

PROTOCOLS

Task 3.1. Tolerance to environmental stressors

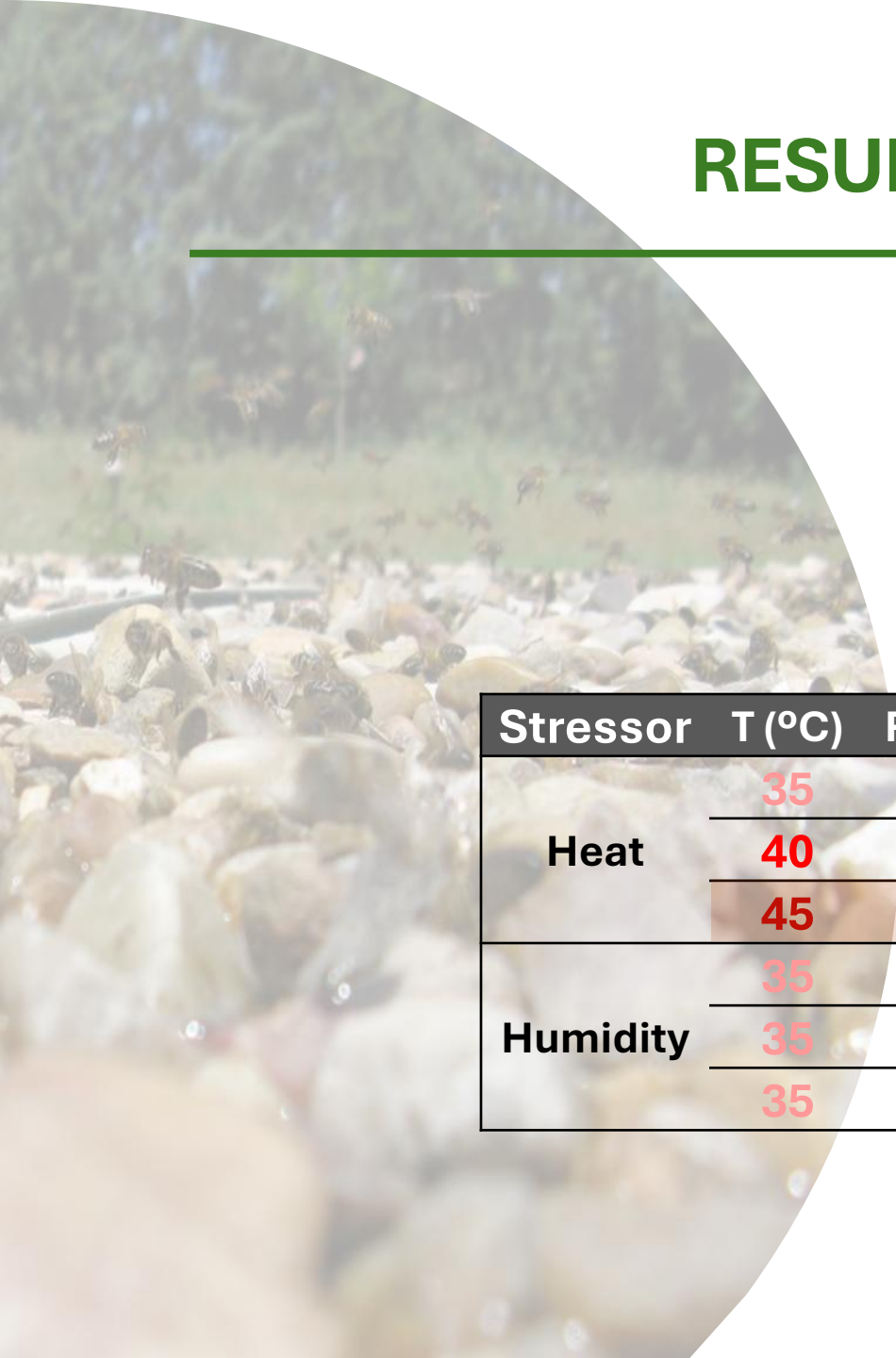
WP3

This protocol is based on

Abou-Shaara *et al.*, 2012

Each laboratory performed the same protocol

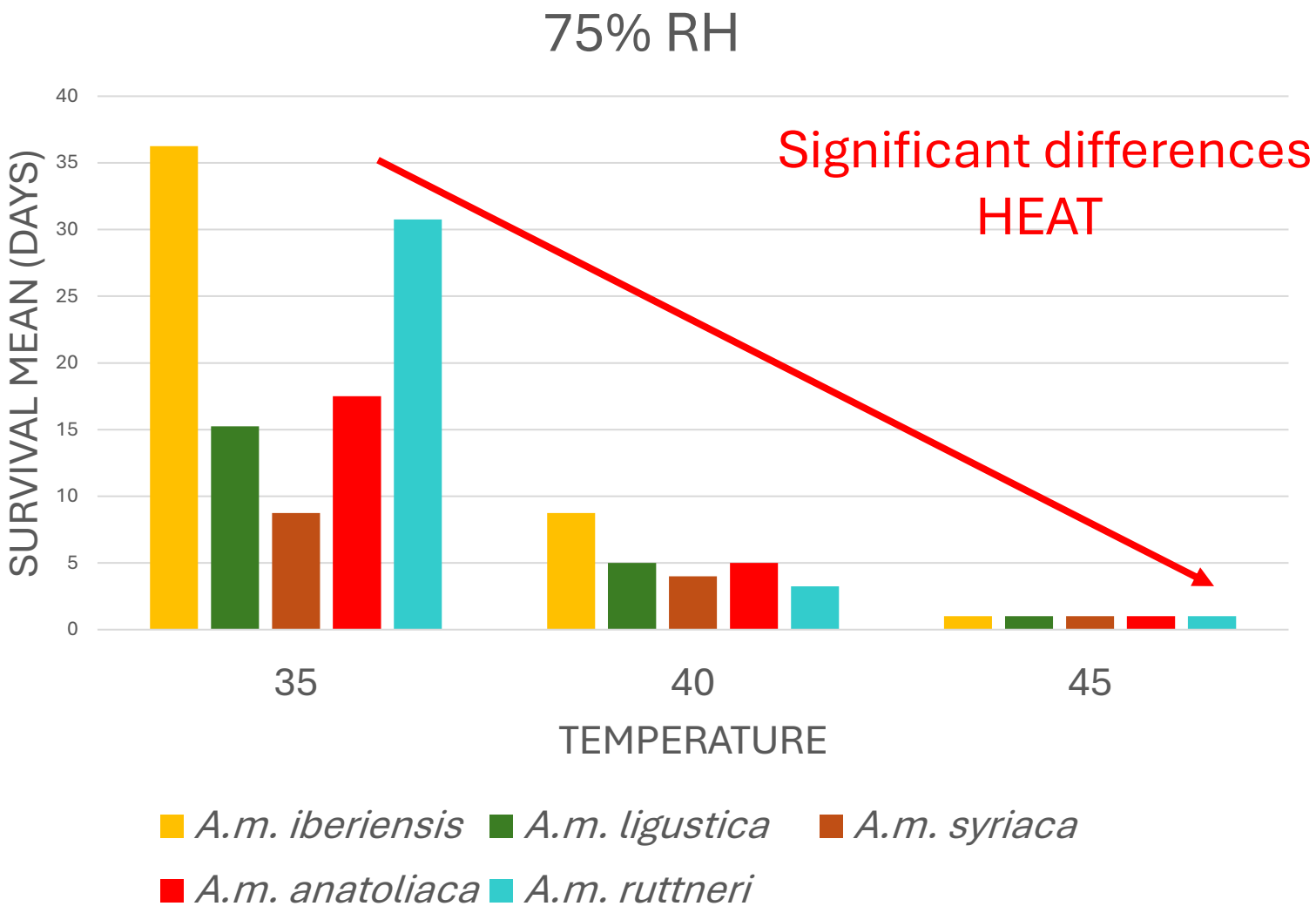
RESULTS



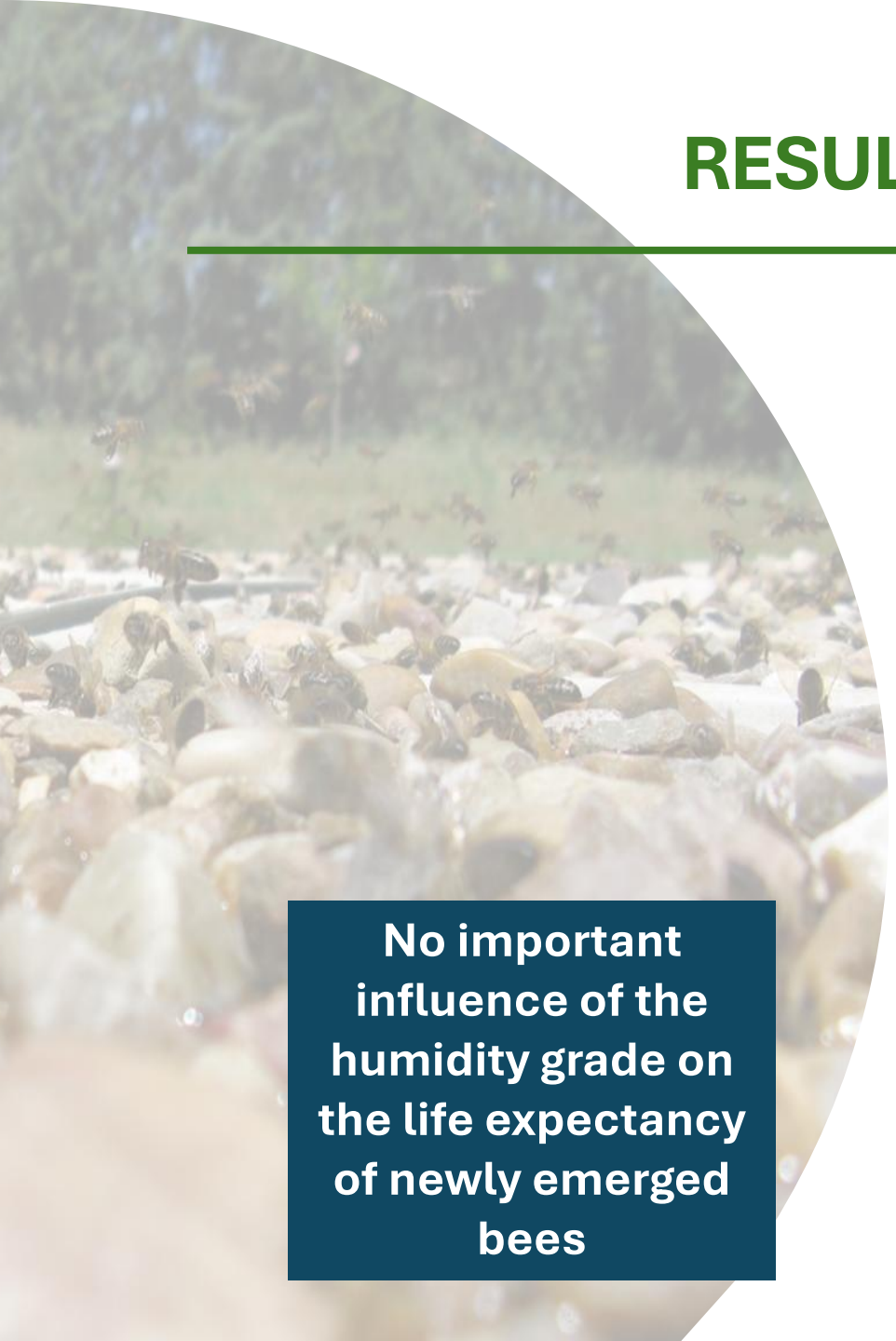
Survival mean (days)

Stressor	T (ºC)	RH (%)	*Apis mellifera*				
			iberiensis	*ligustica*	*anatoliaca*	*syriaca*	*ruttneri*
Heat	35	75	36.25	15.25	17.5	8.75	30,75
	40	75	8.75	5	5	4	3.25
	45	75	1	1	1	1	1
Humidity	35	15	29.5	12.5	12	8	1.5
	35	30	29	15.50	19	6.66	18
	35	50	32.75	15	22	7	20.25

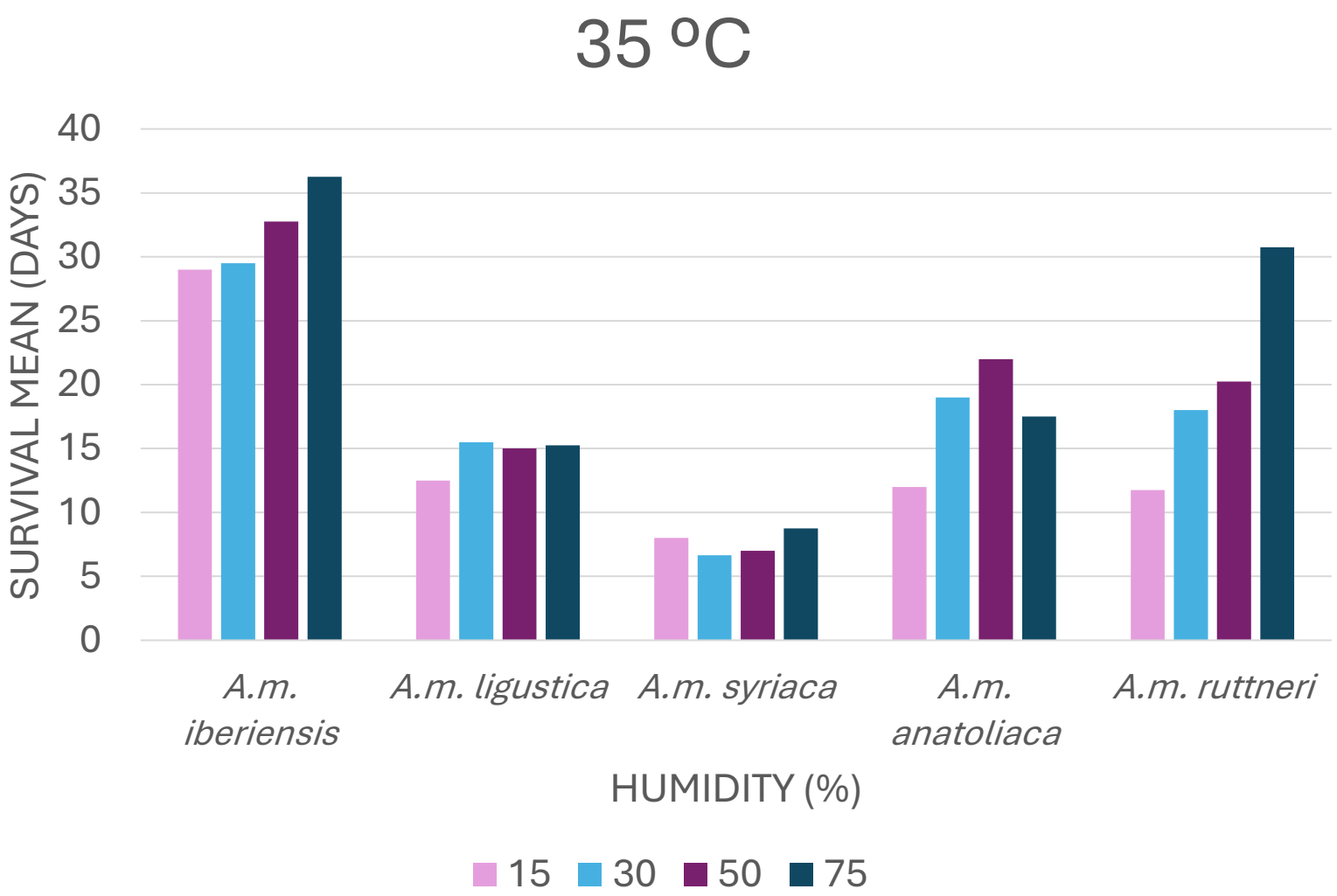
RESULTS


75% RH
SURVIVAL MEAN (DAYS)
40
35
30
25
20
15
10
5
0
35
40
45
TEMPERATURE
Significant differences
HEAT
A.m. iberiensis
A.m. ligustica
A.m. syriaca
A.m. anatoliaca
A.m. ruttneri

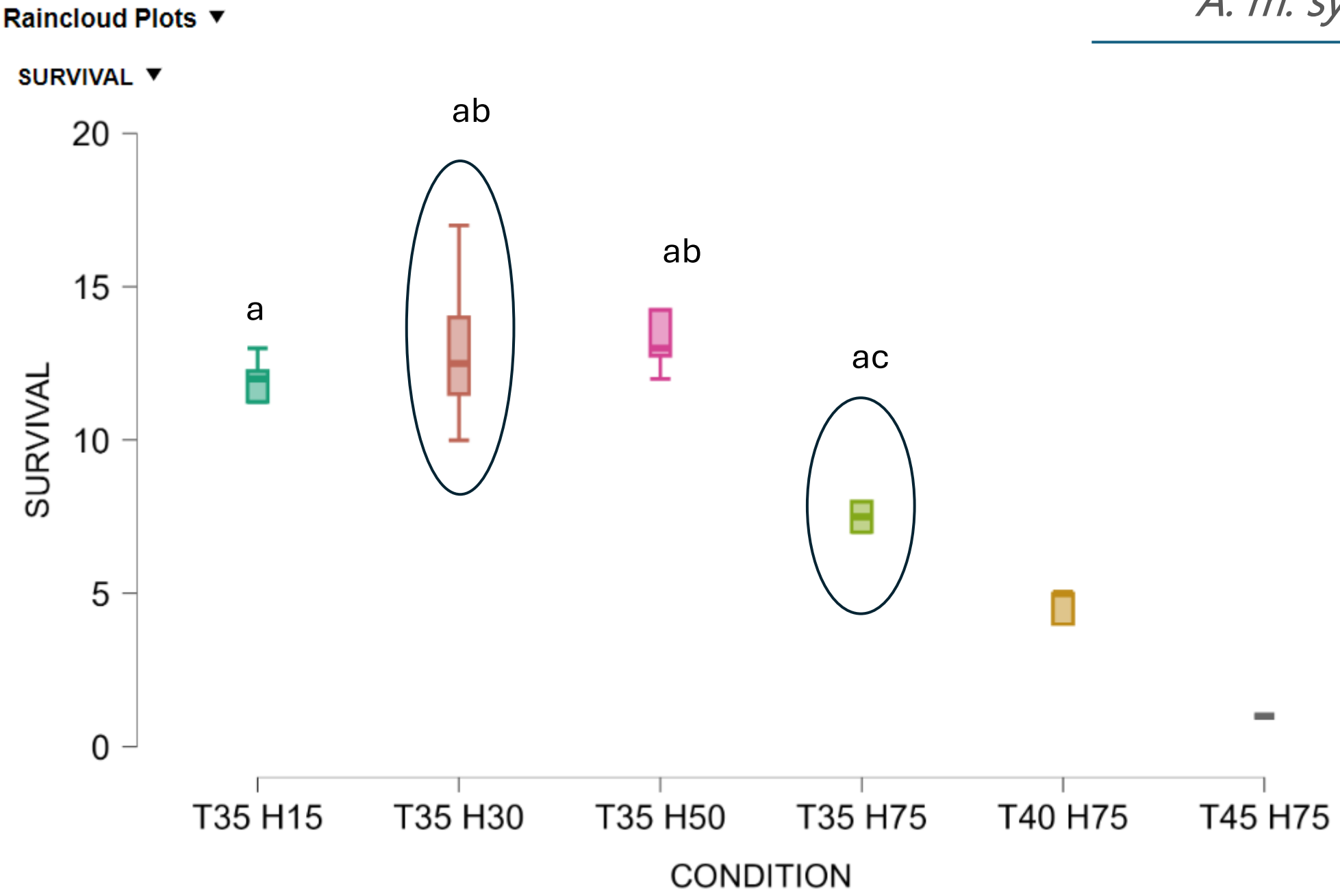
RESULTS

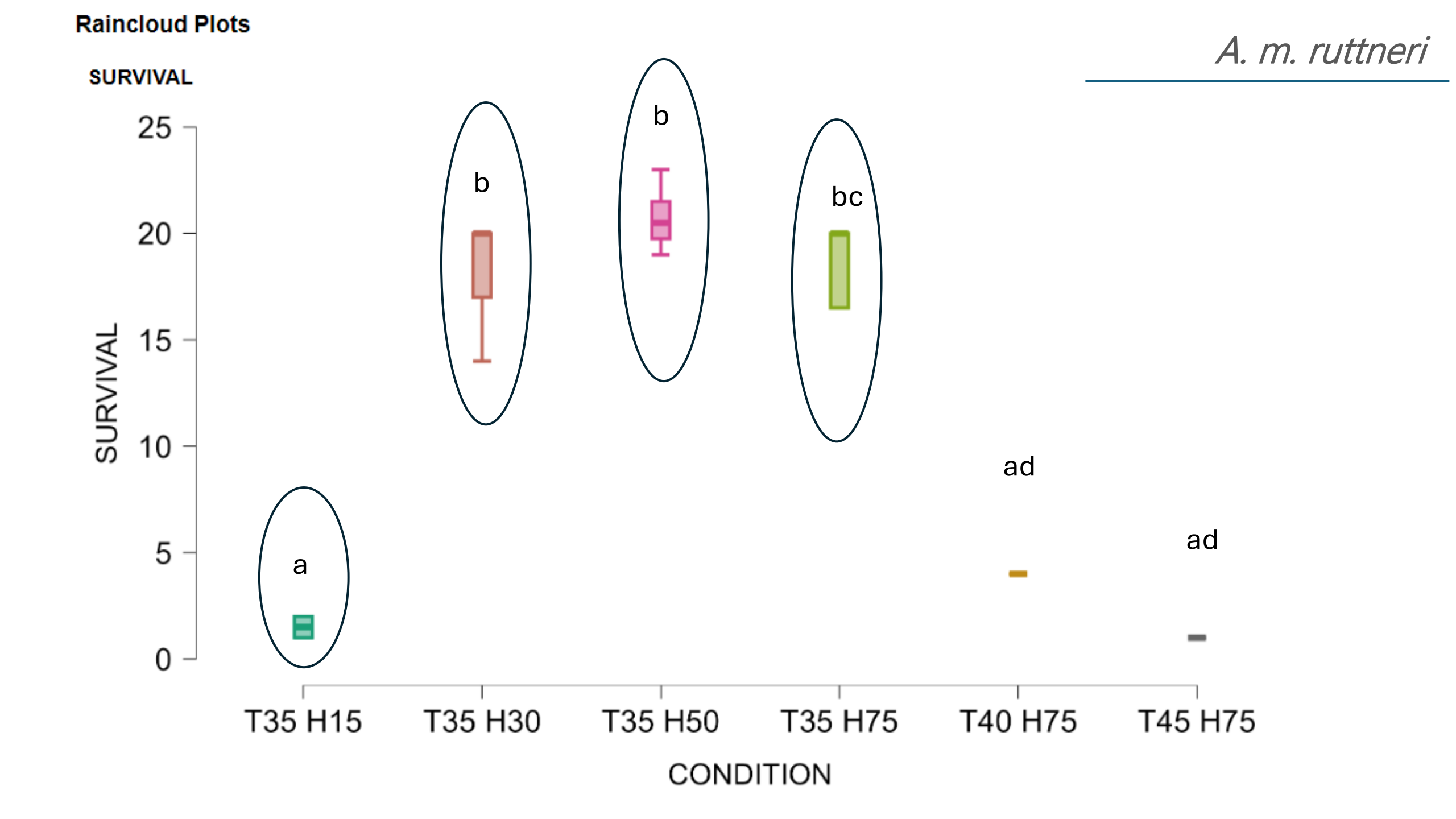


No important influence of the humidity grade on the life expectancy of newly emerged bees

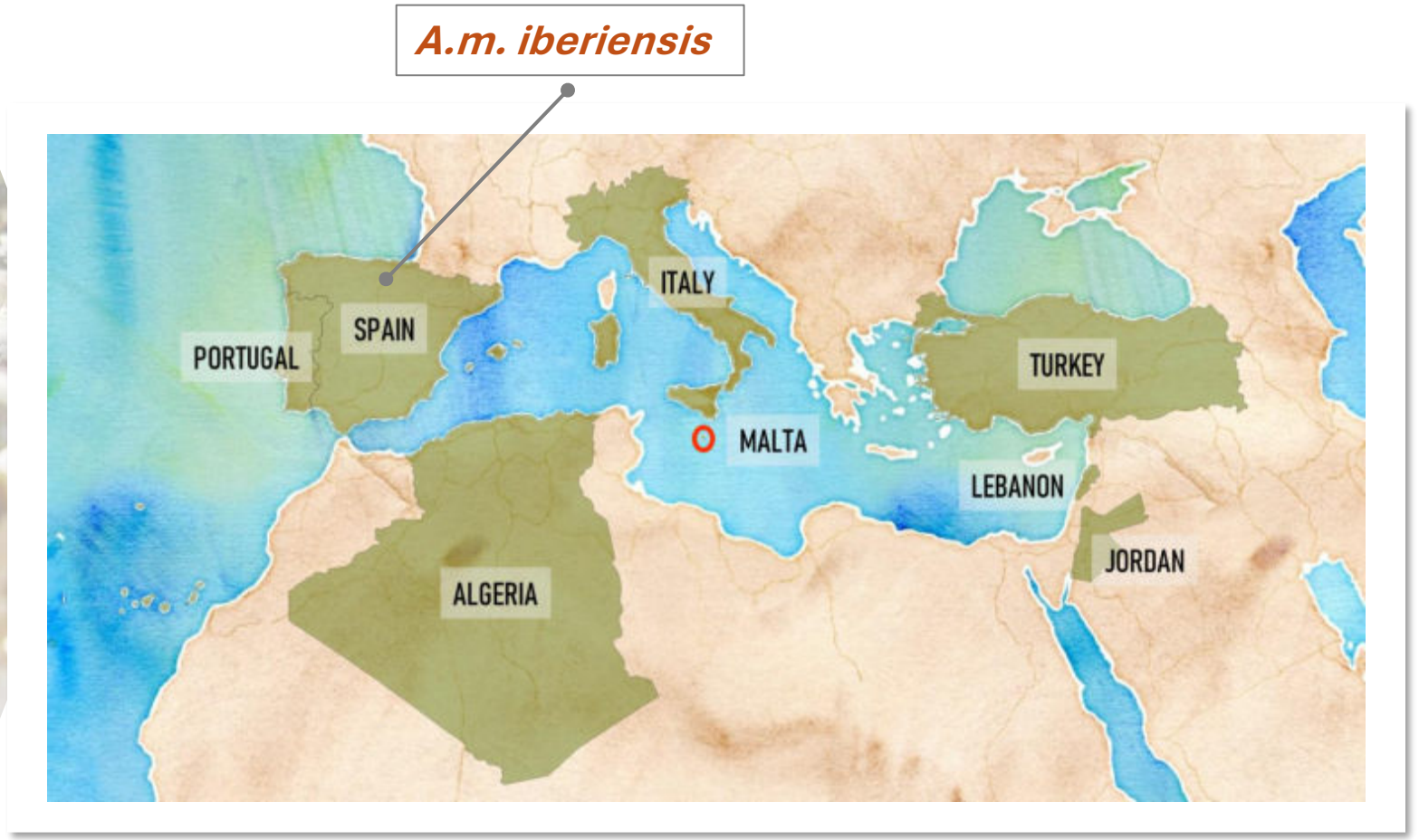


A. m. syriaca


Raincloud Plots
SURVIVAL
20
15
10
5
0
SURVIVAL
a
ab
ab
ac
T35 H15
T35 H30
T35 H50
T35 H75
T40 H75
T45 H75
CONDITION

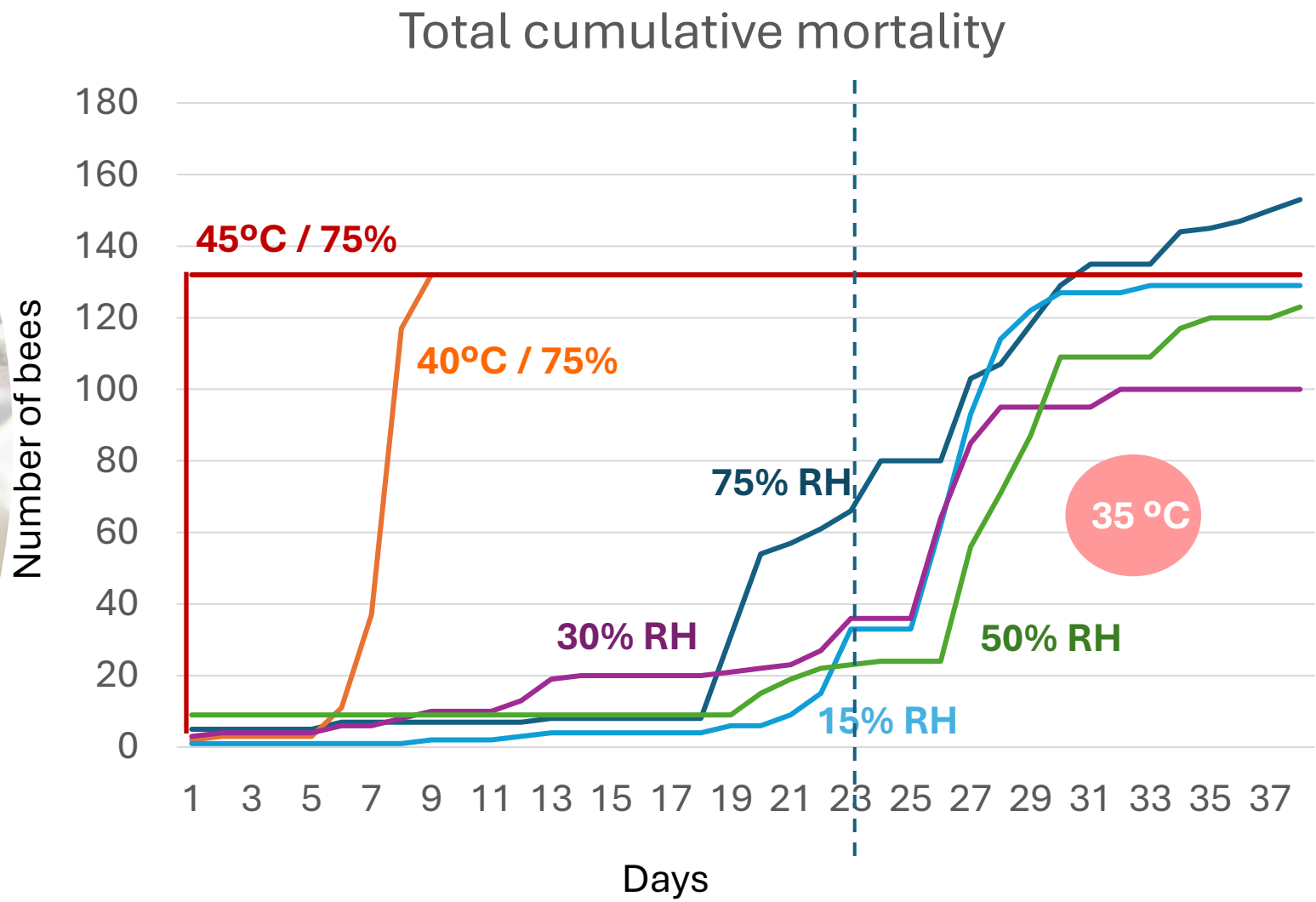

Raincloud Plots
SURVIVAL
A. m. ruttneri
SURVIVAL
25
20
15
10
5
0
a
b
b
bc
ad
ad
T35 H15
T35 H30
T35 H50
T35 H75
T40 H75
T45 H75
CONDITION

RESULTS


A.m. iberiensis
PORTUGAL
SPAIN
ITALY
MALTA
TURKEY
LEBANON
JORDAN
ALGERIA

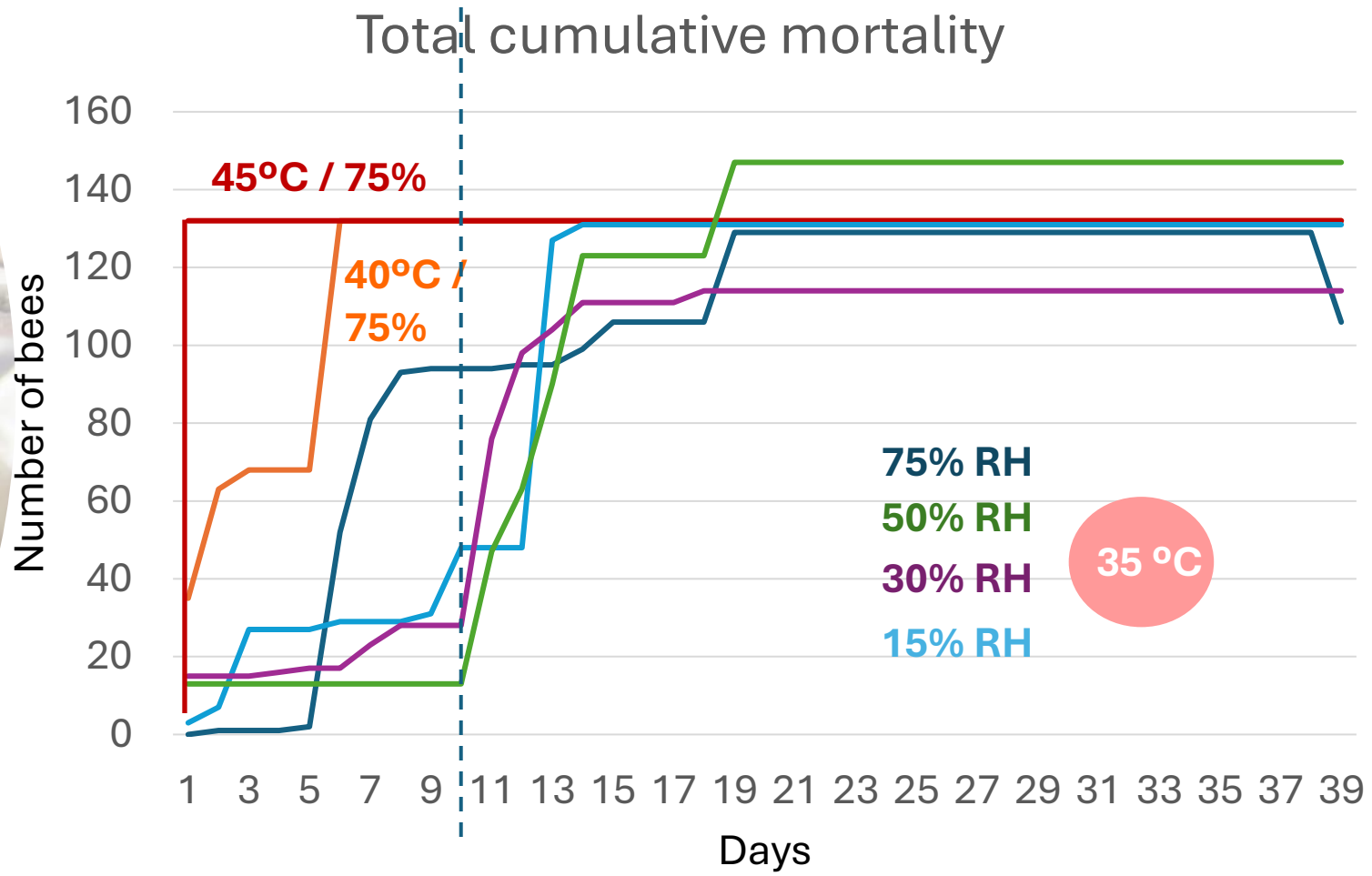
RESULTS

A.m. iberiensis

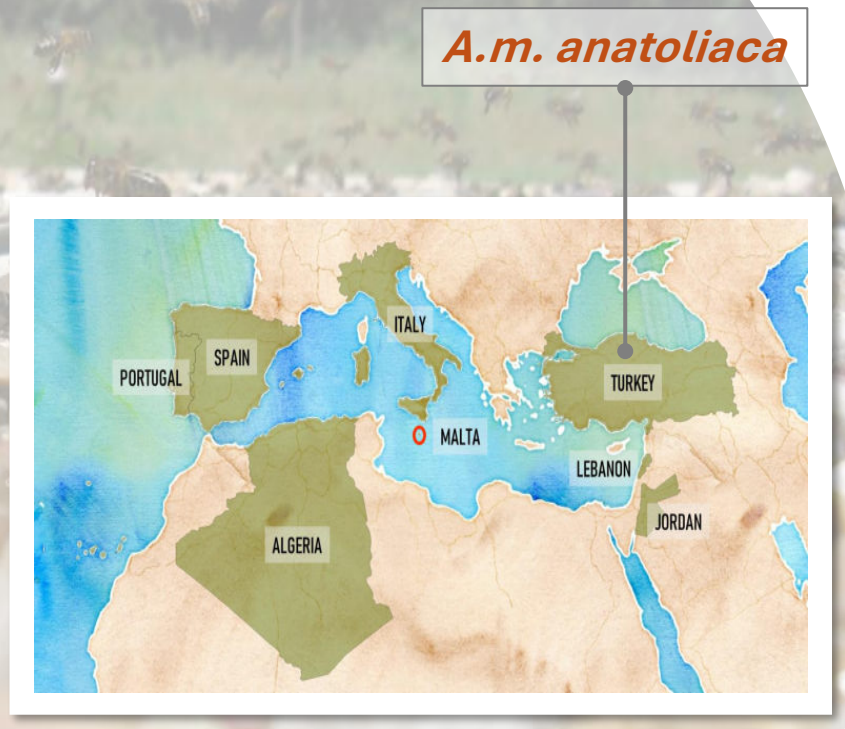


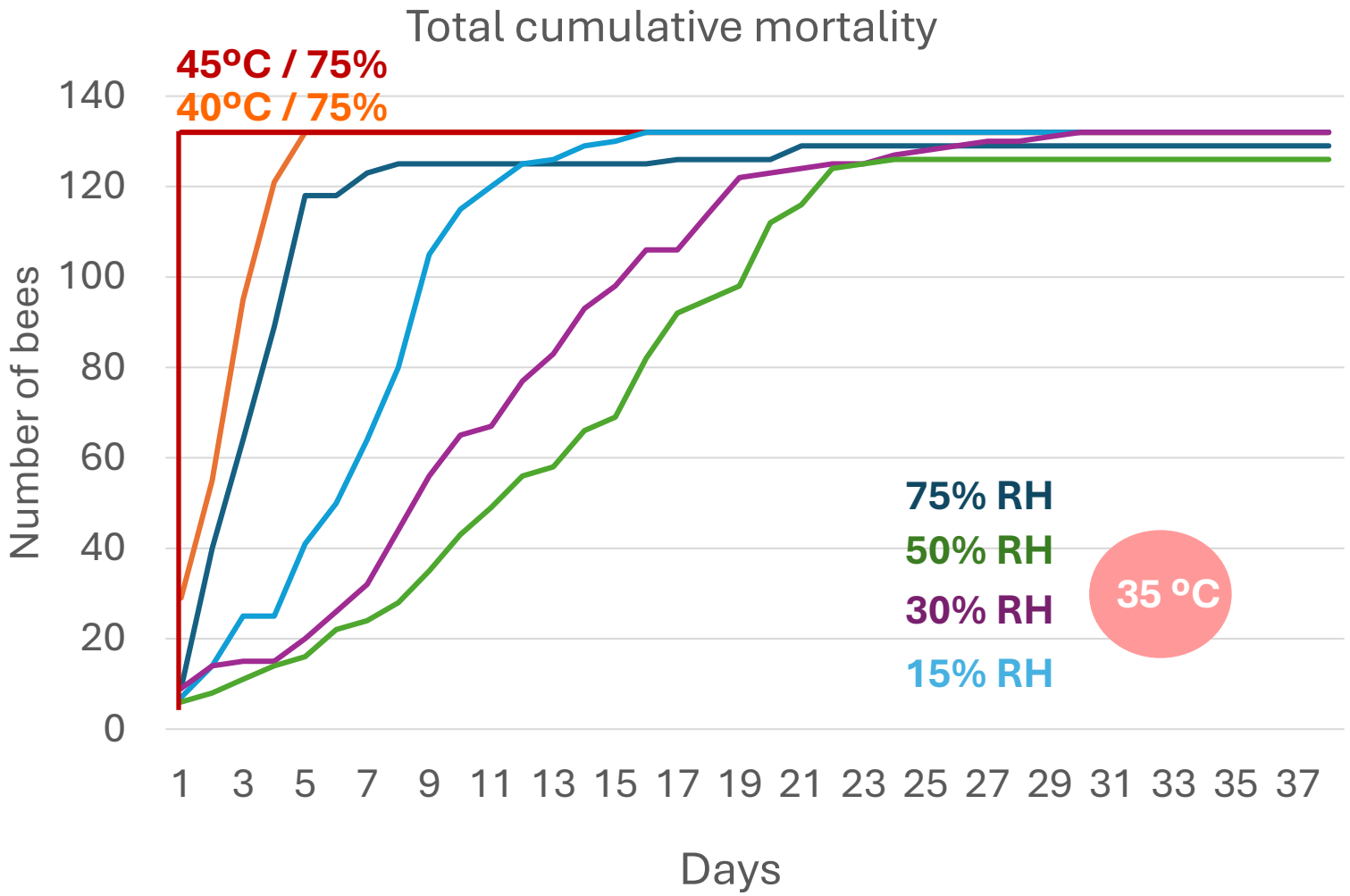
RESULTS

A.m. ligustica

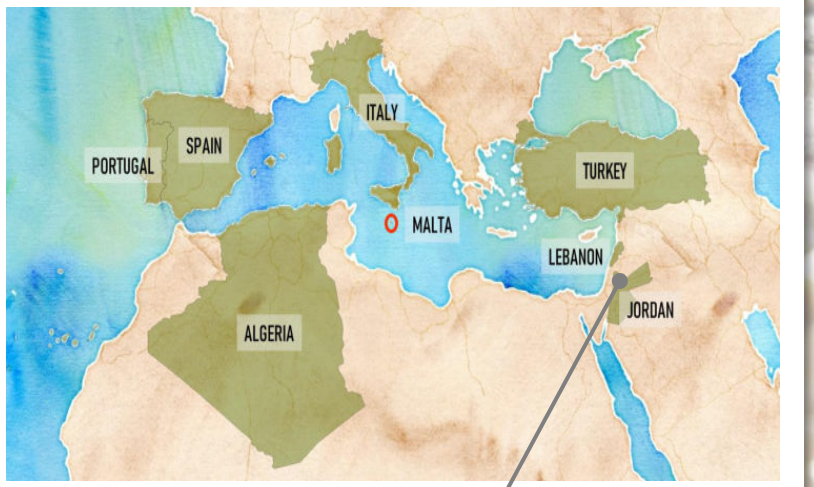


RESULTS

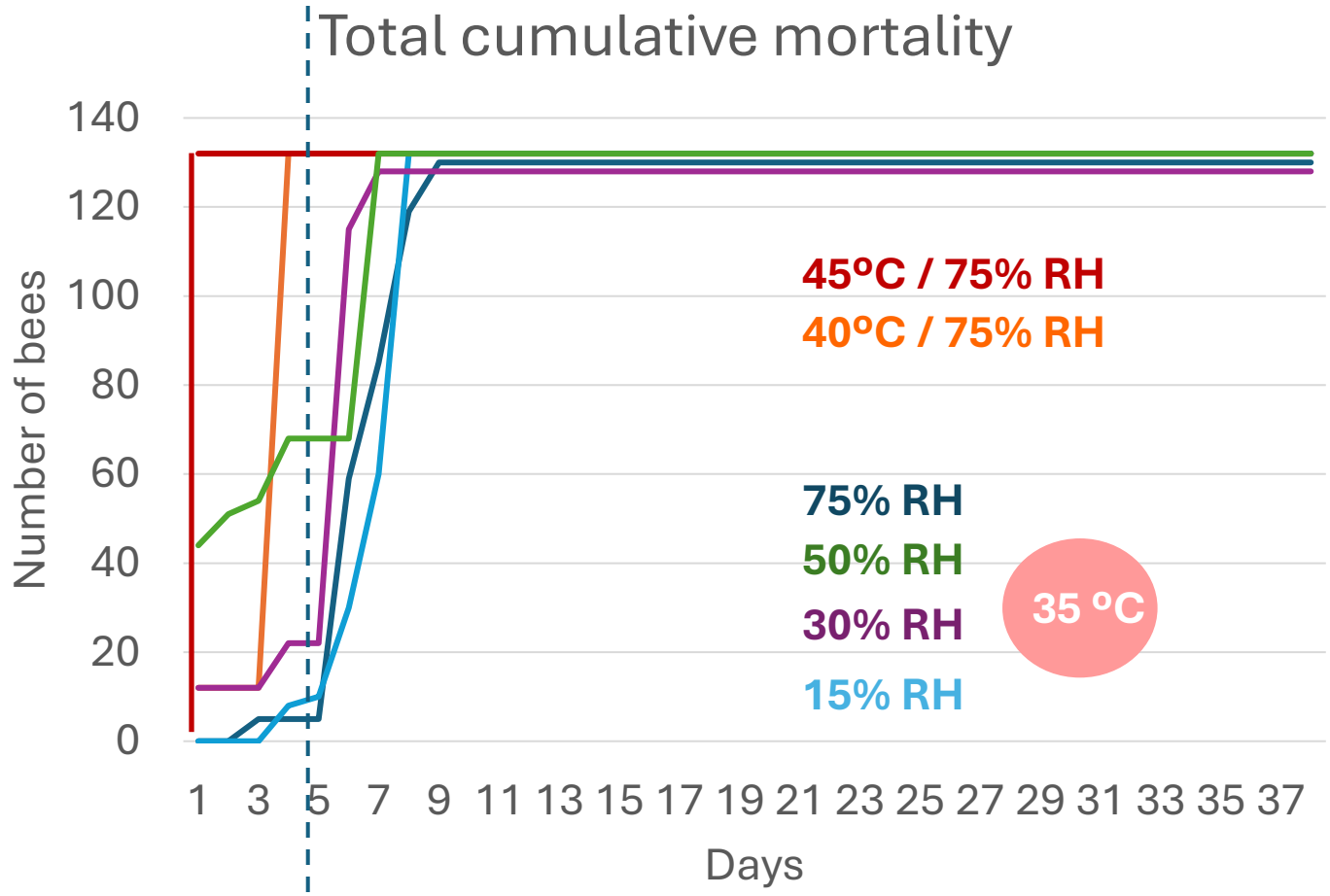

A.m. anatoliaca
PORTUGAL
SPAIN
ITALY
MALTA
TURKEY
LEBANON
JORDAN
ALGERIA


Total cumulative mortality
45ºC / 75%
40ºC / 75%
Number of bees
140
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37
Days
75% RH
50% RH
30% RH
15% RH
35 ºC

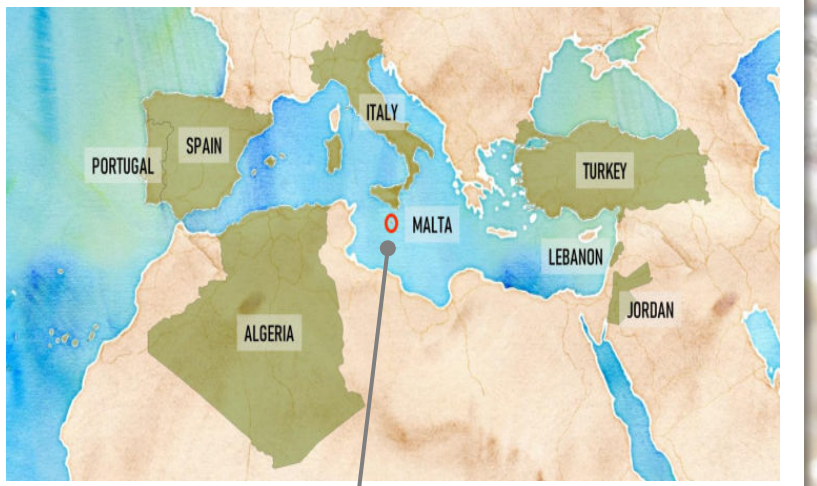
RESULTS



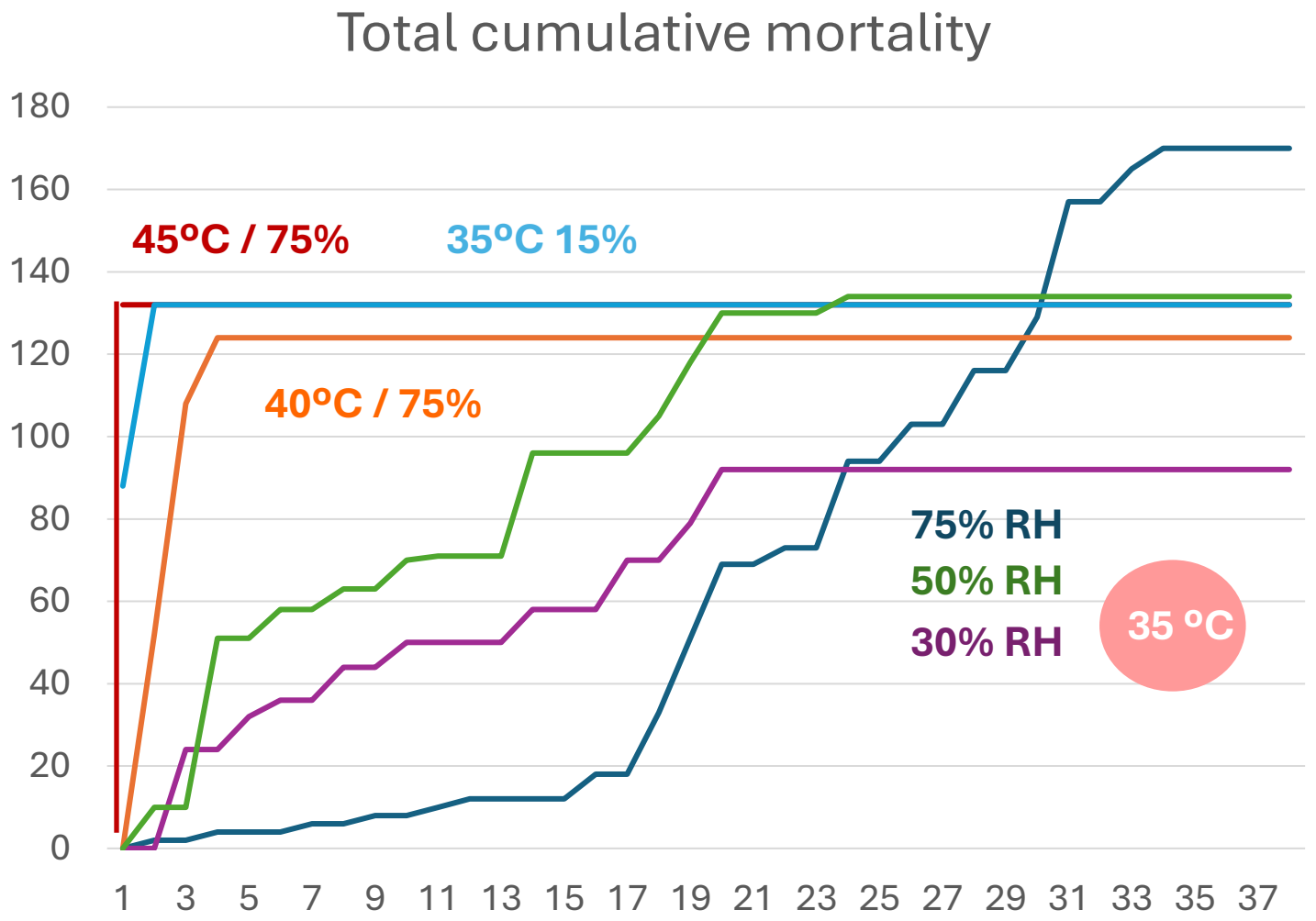
A.m. syriaca



RESULTS



A.m. ruttneri

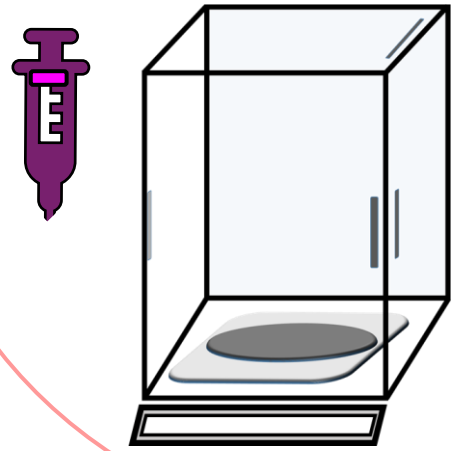


MATERIAL & METHODS

Death day

0 1 2 …

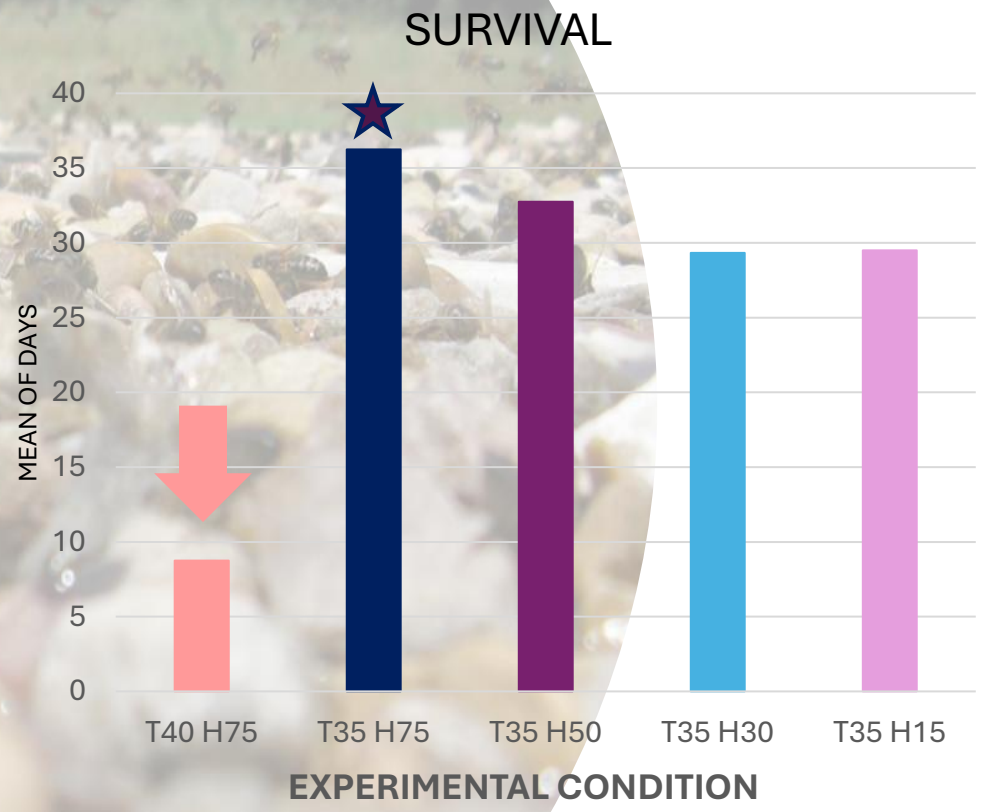
Dead
Moribund
Affected
Apathy
Vomiting

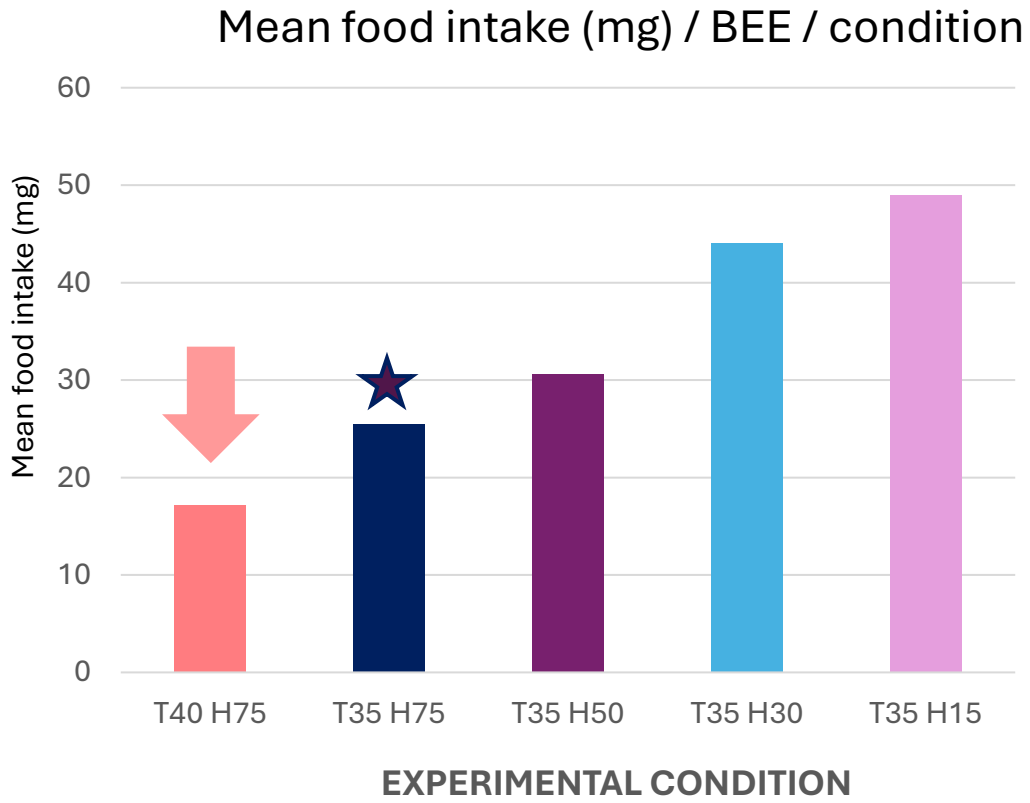


Food intake control

RESULTS

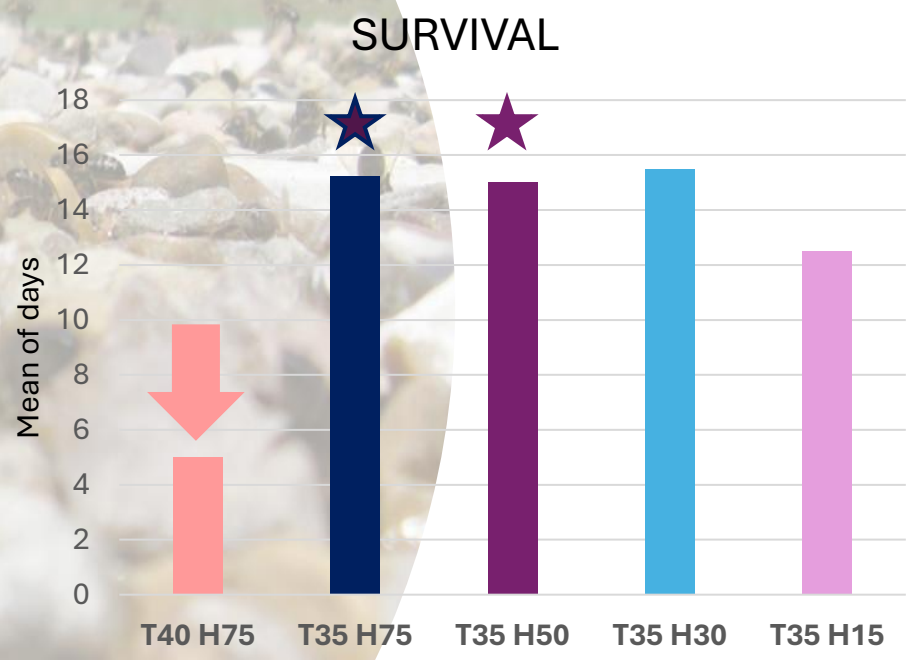
A. m. iberiensis

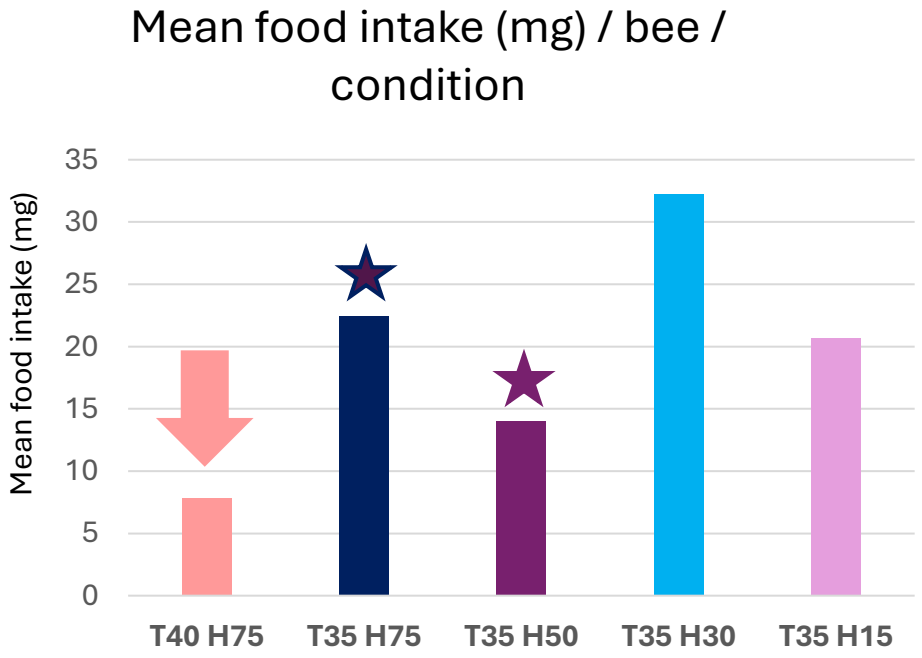




RESULTS

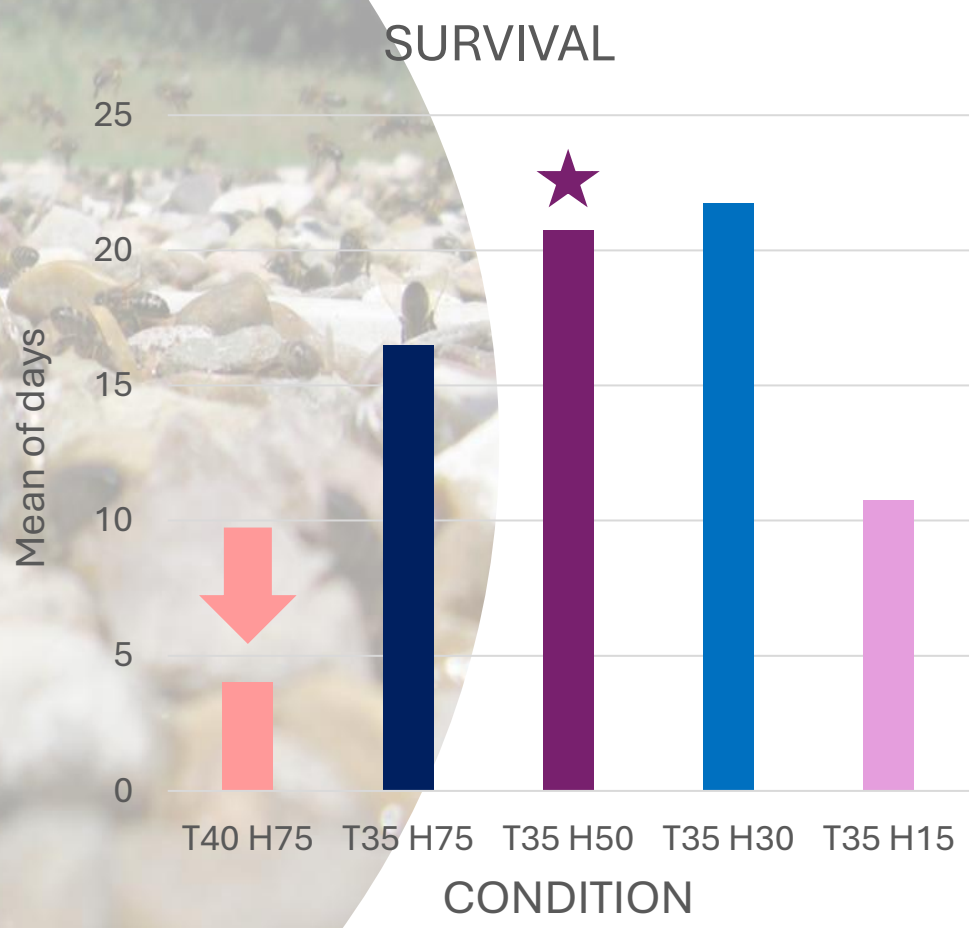
A. m. ligustica

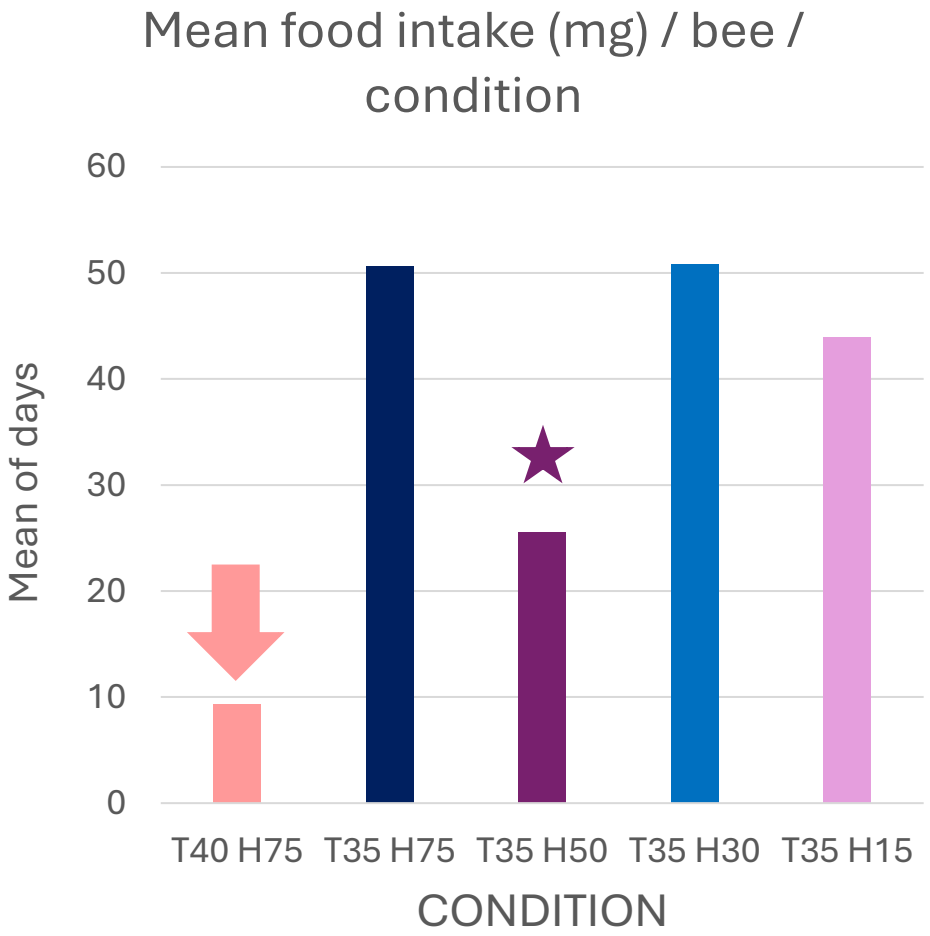




RESULTS

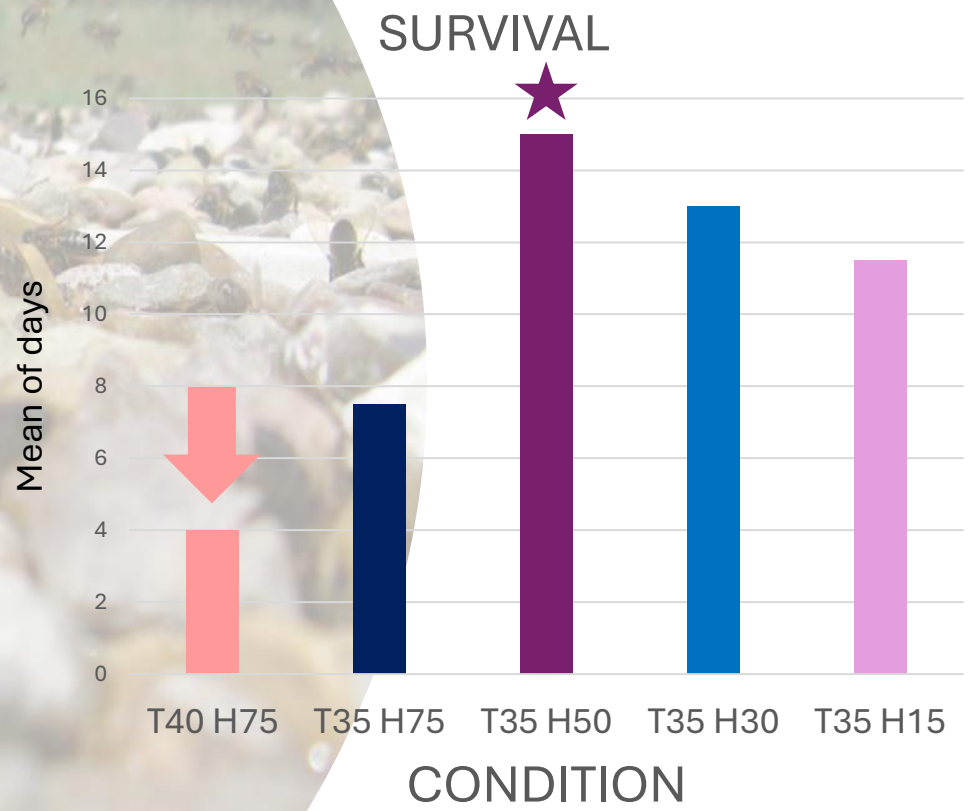
A. m. anatoliaca

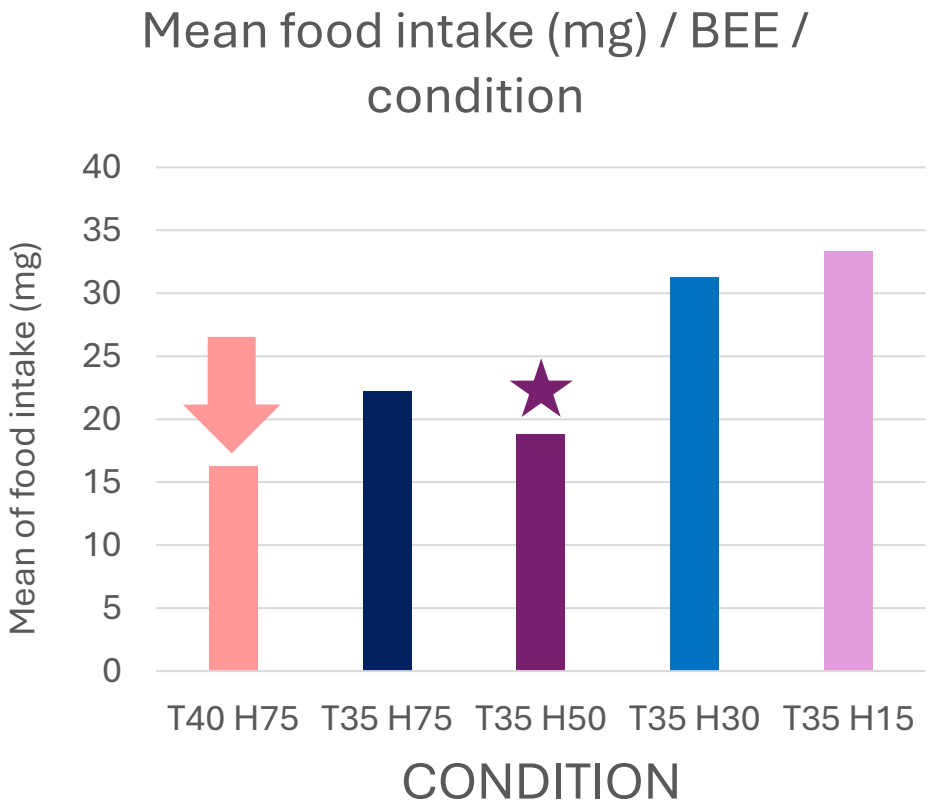




RESULTS

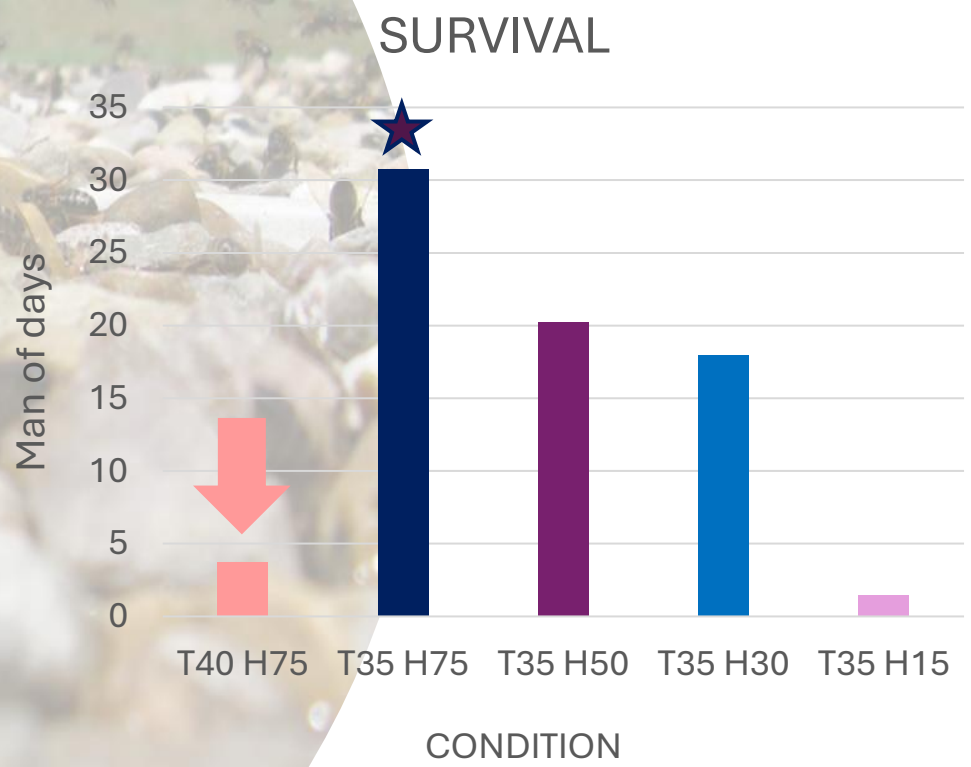
A. m. syriaca

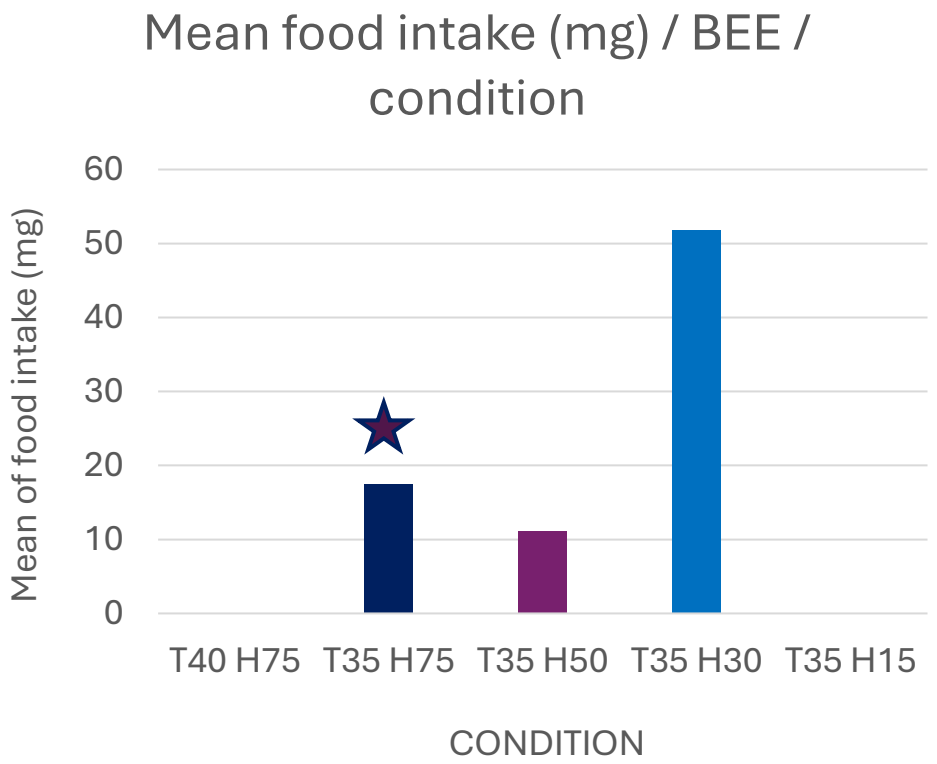




RESULTS

A. m. ruttneri

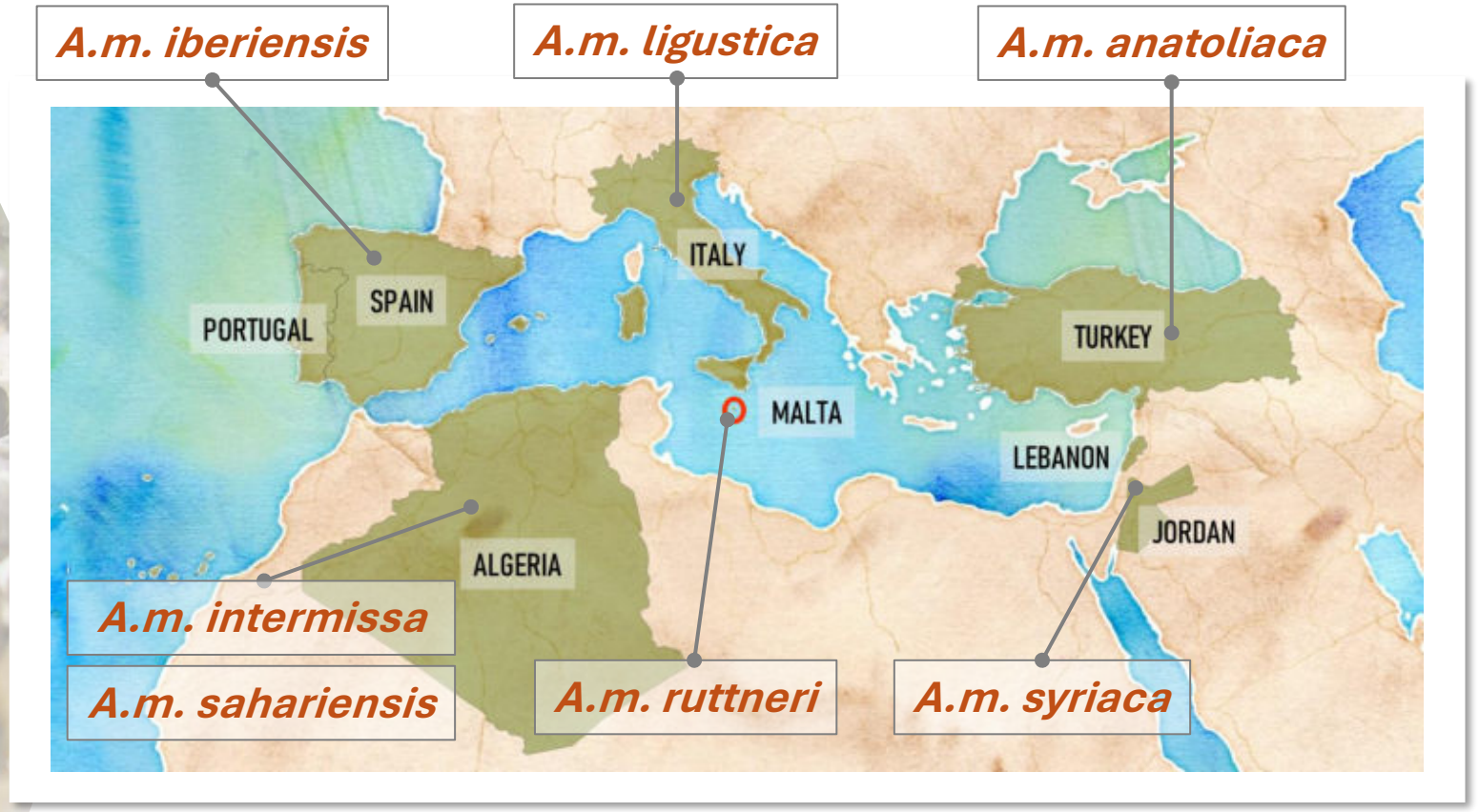




CONCLUSIONS

- *A. mellifera* subspecies showed different survival patterns under the experimental conditions
- Heat decreased survival rate in all subspecies
- No subspecies tolerated 45ºC
- The effect of humidity varied between subspecies, which may indicate adaptation to their environments
- Tendency towards lower food intake levels under conditions that show higher survival rates

RESULTS



In process….

MEDI BEES

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY
23-27 SEPTEMBER

This project is part of the PRIMA programme supported by the European Union